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Energy Conservation Program: Energy Conservation Standards for Single Package Vertical Air Conditioners and Single Package Vertical Heat Pumps; Final Rule

DEPARTMENT OF ENERGY

10 CFR Part 431

[Docket Number EERE–2012–BT–STD–0041]

RIN 1904–AC85

Energy Conservation Program: Energy Conservation Standards for Single Package Vertical Air Conditioners and Single Package Vertical Heat Pumps

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

ACTION: Final rule.

SUMMARY: The Energy Policy and Conservation Act of 1975 (EPCA), as amended, prescribes energy conservation standards for various consumer products and certain commercial and industrial equipment, including single package vertical air conditioner (SPVAC) and single package vertical heat pump (SPVHP) equipment (collectively referred to as single package vertical units or SPVUs). EPCA also requires the U.S. Department of Energy (DOE) to determine whether more-stringent standards for SPVACs and SPVHPs would be technologically feasible and economically justified, and would save a significant amount of energy. In this final rule, DOE is adopting standards equivalent to the American National Standards Institute (ANSI)/American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)/Illuminating Engineering Society (IES) Standard 90.1–2013 levels for four SPVU equipment classes, and adopting amended energy conservation standards for two other equipment classes of single package vertical units more stringent than the SPVU standards in ASHRAE Standard 90.1–2013. DOE has determined that the amended energy conservation standards for this equipment are technologically feasible and economically justified, and would result in the significant conservation of energy.

DATES: The effective date of this rule is November 23, 2015. Compliance with the amended standards established for SPVACs and SPVHPs <65,000 Btu/h cooling capacity is required on September 23, 2019; for SPVACs and SPVHPs ≥65,000 and <135,000 Btu/h cooling capacity, compliance is required on October 9, 2015; and for SPVACs and SPVHPs ≥135,000 and <240,000 Btu/h cooling capacity, compliance is required on October 9, 2016.

ADDRESSES: The docket, which includes **Federal Register** notices, public meeting attendee lists and transcripts, comments, and other supporting documents/materials, is available for review at 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-2012-BT-STD-0029*. This Web page contains a link to the docket for this document on the *www.regulations.gov* site. The *www.regulations.gov* Web page contains simple instructions on how to access all documents, including public comments, in the docket.

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

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SUPPLEMENTARY INFORMATION:

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I. Synopsis of the Final Rule

Title III, Part C [1] of the Energy Policy and Conservation Act of 1975 (EPCA or the Act), Public Law 94–163 (42 U.S.C. 6311 *et seq.*), added by Public Law 95–619, Title IV, section 441(a), established the Energy Conservation Program for Certain Industrial Equipment, which sets forth a variety of provisions designed to improve energy efficiency.[2] This equipment includes single package vertical air conditioners (SPVACs) and single package vertical heat pumps (SPVHPs), the subjects of this final rule (collectively referred to as single package vertical units or SPVUs). Pursuant to EPCA, not later than 3 years after the date of enactment of the Energy Independence and Security Act of 2007 (EISA 2007), DOE must review ASHRAE Standard 90.1, ''*Energy Standard for Buildings Except Low-Rise Residential Buildings,*'' with respect to single package vertical air conditioners and single package vertical heat pumps in accordance with the procedures established in 42 U.S.C. 6313(a)(6). (42 U.S.C. 6313(a)(10)(B))

In addition, EPCA requires that DOE conduct a rulemaking to consider amended energy conservation standards for SPVACs and SPVHPs each time ASHRAE Standard 90.1 is updated with respect to such equipment. (42 U.S.C. 6313(a)(6)(A))

At the time DOE commenced this rulemaking, energy conservation standards for SPVUs had been set by EISA 2007. The levels promulgated in EISA 2007 correspond to the levels contained in ASHRAE 90.1–2004. Because ASHRAE did not revise its SPVU standard levels until 2013, the Department did not explicitly consider adoption of the then-current ASHRAE Standard 90.1–2010 levels as part of its analytical baseline (as is typically the case under 42 U.S.C. 6313(a)(6)). Energy conservation standards for SPVUs at the time already corresponded to the ASHRAE Standard 90.1–2010 levels. However, on October 9, 2013, ASHRAE adopted ASHRAE Standard 90.1–2013, and this revision did contain amended standard levels for SPVUs, thereby triggering DOE's statutory obligation to promulgate an amended uniform national standard at those levels, unless DOE determines that clear and convincing evidence supports the adoption of more-stringent energy conservation standards than the ASHRAE levels. The test for adoption of more-stringent standards is whether such standards would result in significant additional conservation of energy and would be technologically feasible and economically justified. (42 U.S.C. 6313(a)(6)(A)(ii) (II)) As a step toward meeting DOE's statutory obligations under both 42 U.S.C. 6313(a)(6) and (a)(10)(B), DOE published a notice of proposed rulemaking (NOPR) on December 30, 2014. 79 FR 78614. In the NOPR, DOE proposed amended standards for two equipment classes of SPVUs that are more stringent than those set forth in ASHRAE Standard 90.1–2013, and adoption of the ASHRAE Standard 90.1–2013 levels for all other SPVU equipment classes. 79 FR 78614 at 78667.

In this final rule, in accordance with these and other statutory provisions discussed in this document, DOE is adopting amended energy conservation standards for SPVUs. For four of the six SPVU equipment classes, DOE is adopting the levels specified in ASHRAE Standard 90.1–2013. For the remaining two equipment classes, DOE has concluded that there is clear and convincing evidence to support more-stringent standards than the levels in ASHRAE Standard 90.1–2013. Accordingly, DOE is amending energy conservation standards for all classes of SPVUs from their existing levels consistent with ASHRAE Standard 90.1–2010. The amended standards are expressed in terms of (1) energy efficiency ratio (EER), which is the ratio of the produced cooling effect of an air conditioner or heat pump to its total work input (in Btu/watt-hour); and (2) coefficient of performance (COP), which is the ratio of produced heating effect to total work input (this metric is unitless and applicable only to heat pump units). The amended standards are shown in Table I.1. These standards apply to all products listed in Table I.1 and manufactured in, or imported into, the United States on and after the compliance date listed in the table.

The standards listed in Table I.1 that are more stringent than those contained in ASHRAE Standard 90.1–2013 apply to such equipment manufactured in, or imported into, the United States, excluding equipment that is manufactured for export, on and after a date 4 years after publication of this final rule. The standards listed in Table I.1 that are set at the levels contained in ASHRAE Standard 90.1–2013 apply to such equipment manufactured in, or imported into, the United States, excluding equipment that is manufactured for export, on and after the date 2 or 3 years after the effective date of the requirements in ASHRAE Standard 90.1–2013, depending on equipment size (*i.e.,* October 9, 2015 or October 9, 2016).

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

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

TABLE I.1—AMENDED ENERGY CONSERVATION STANDARDS FOR SPVUS

Equipment class	Cooling capacity Btu/h	Efficiency level	Standard level	Compliance date
Single Package Vertical Air Conditioner	<65,000 Btu/h	EER = 11.0	More Stringent than ASHRAE.	September 23, 2019.
Single Package Vertical Air Conditioner	≥65,000 Btu/h and <135,000 Btu/h.	EER = 10.0	ASHRAE	October 9, 2015.
Single Package Vertical Air Conditioner	≥135,000 Btu/h and <240,000 Btu/h.	EER = 10.0	ASHRAE	October 9, 2016.
Single Package Vertical Heat Pump	<65,000 Btu/h	EER = 11.0 COP = 3.3	More Stringent than ASHRAE.	September 23, 2019.
Single Package Vertical Heat Pump	≥65,000 Btu/h and <135,000 Btu/h.	EER = 10.0 COP = 3.0	ASHRAE	October 9, 2015.
Single Package Vertical Heat Pump	≥135,000 Btu/h and <240,000 Btu/h.	EER = 10.0 COP = 3,0	ASHRAE	October 9, 2016.

A. Benefits and Costs to Consumers

Table I.2 presents DOE's evaluation of the economic impacts of the adopted standards on consumers of single package vertical units, as measured by the average life-cycle cost (LCC) savings and the median payback period (PBP).[3] In order to adopt levels above the levels specified in ASHRAE Standard 90.1, DOE must determine that any more-stringent standards would result in significant additional conservation of energy (relative to the efficiency levels specified in ASHRAE Standard 90.1) and that they would be technologically feasible and economically justified. (42 U.S.C. 6313(a)(6)(A)(ii)(II)) In compliance with this statutory requirement, DOE based its determination to adopt more-stringent standards for two classes of SPVUs on an analysis comparing these proposed standards with ASHRAE 90.1–2013 (Table I.2). Thus, economic impacts of this determination are calculated as compared to the ASHRAE 90.1–2013 level because DOE is required by statute to, at a minimum, adopt that standard.[4]

The Office of Management and Budget's (OMB's) Circular A–4 [5] provides guidance on establishing the baseline for regulatory impact analyses as follows:

In some cases, substantial portions of a rule may simply restate statutory requirements that would be self-implementing, even in the absence of the regulatory action. In these cases, you should use a pre-statute baseline. If you are able to separate out those areas where the agency has discretion, you may also use a post-statute baseline to evaluate the discretionary elements of the action.

Accordingly, in this section, DOE presents consumer, manufacturer, and economic costs and benefits for the amended SPVU standards as compared to the current Federal (EPCA) minimum that are currently in effect (pre-statute baseline). In addition, as required by statute, when proposing a standard more stringent than ASHRAE 90.1, and recommended by OMB Circular A–4, DOE also provides these same analyses relative to the post-statute (ASHRAE 90.1–2013) baseline. As noted above, it is these latter analyses that DOE has used as the basis for its determination to adopt more-stringent standards for two classes of SPVUs. DOE has used the same analytic methodologies in both baselines. Key analyses (using both baselines) are summarized in Table I.2: Impacts of Amended Energy Conservation Standards on Consumers of SPVUs; Table I.3: Summary of National Economic Benefits and Costs of Amended SPVU Energy Conservation Standards; and Table I.4 and Table I.5: Annualized Benefits and Costs of Amended Energy Conservation Standards for SPVUs. Additional analyses are presented in section V.C of this preamble, and in the final rule technical support document (TSD). Note that not all analyses were conducted using both baselines; rather, DOE used the baseline(s) most appropriate to the purpose of the analysis (showing economic impacts relative to the pre-statute status quo and/or determining whether to adopt standards more stringent than ASHRAE 90.1–2013). In all cases, the baseline(s) used are indicated in the analyses.

The average LCC savings are positive for the equipment classes for which standards higher than the levels in ASHRAE 90.1–2013 are being adopted, and the PBP is less than the average lifetime of single package vertical units, which is estimated to be 15 years (see section IV.F.2.g). DOE did not evaluate economic impacts to the consumers of SPVACs ≥65,000 Btu/h and <135,000 Btu/h for the ASHRAE baseline, as the ASHRAE level is equal to max-tech. However, the economic impacts for this equipment class using the EPCA baseline can be found in Table I.2 and in appendix 8B of the final rule TSD. DOE also presents results for the parallel class of SPVHPs ≥65,000 Btu/h and <135,000 Btu/h using the EPCA baseline.[6] DOE did not evaluate economic impacts for the SPVAC and SPVHP ≥135,000 Btu/h and <240,000 Btu/h equipment classes because there are no models on the market, and, therefore, no consumers.[7]

[3] The average LCC savings are measured relative to the efficiency distribution in the ASHRAE base case, which depicts the market in the compliance year should DOE adopt the standards set forth in ASHRAE 90.1–2013, as minimally required (see section IV.F). The median PBP, which is designed to compare specific SPVU efficiency levels, is measured relative to the baseline model (see section IV.C.2).

[4] *See* 42 U.S.C. 6313(a)(6)(A)(ii)(I): In general—Except as provided in subclause (II), not later than 18 months after the date of publication of the amendment to the ASHRAE Standard 90.1 for a product described in clause (i), the Secretary shall establish an amended uniform national standard for the product at the minimum level specified in the amended ASHRAE Standard 90.1.

[5] U.S. Office of Management and Budget ''Circular A–4: Regulatory Analysis'' (Sept. 17, 2003) contains guidelines regarding development of a baseline, including that ''This baseline should be the best assessment of the way the world would look absent the proposed action.'' (Available at: *http://www.whitehouse.gov/omb/circulars_a004_a-4/*)

[6] However, there are no models available on the market for this class, and therefore these results were not carried into the national impact analysis or other downstream analyses.

[7] Equipment classes for these cooling capacities exist in ASHRAE Standard 90.1 and were established in DOE regulation through EISA 2007. Despite the lack of models and consumers, for these equipment classes DOE is proposing to adopt as federal standards the efficiency levels in ASHRAE 90.1–2013 as required under 42 U.S.C. 6313(a)(6)(A)(ii)(I).

TABLE I.2—TABLE IMPACTS OF AMENDED ENERGY CONSERVATION STANDARDS ON CONSUMERS OF SINGLE PACKAGE VERTICAL UNITS USING ASHRAE AND EPCA BASELINES

Equipment Class	Cooling capacity Btu/h	Average LCC savings *2014$*		Median payback period *years*	
		ASHRAE baseline	EPCA baseline	ASHRAE baseline	EPCA baseline
Single Package Vertical Air Conditioner	<65,000 Btu/h	$174	$280	9.6	10.6
Single Package Vertical Air Conditioner	≥65,000 Btu/h and <135,000 Btu/h.	Adopt ASHRAE	833	Adopt ASHRAE	7.3
Single Package Vertical Air Conditioner	≥135,000 Btu/h and <240,000 Btu/h.	Adopt ASHRAE	N/A	Adopt ASHRAE	N/A
Single Package Vertical Heat Pump	<65,000 Btu/h	435	392	5.8	9.9
Single Package Vertical Heat Pump	≥65,000 Btu/h and <135,000 Btu/h.	Adopt ASHRAE	287	Adopt ASHRAE	11.3
Single Package Vertical Heat Pump	≥135,000 Btu/h and <240,000 Btu/h.	Adopt ASHRAE	N/A	Adopt ASHRAE	N/A

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

B. Impact on Manufacturers

The industry net present value (INPV) is the sum of the discounted cash flows to the industry from the base year through the end of the analysis period (2014 to 2048). Using a real discount rate of 10.4 percent,[8] DOE estimates that the INPV for manufacturers of SPVUs is $41.2 million in 2014$ using ASHRAE 90.1–2013 as a baseline. The INPV of SPVUs from the EPCA baseline can be found in chapter 12 of the final rule TSD. Under the amended standards adopted in this final rule, DOE expects that manufacturers may lose between 17.9 and 10.3 percent of their INPV, which is approximately $7.4 to $4.3 million, respectively. Total conversion costs for the industry are expected to reach $9.2 million.

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

C. National Benefits and Costs[9]

DOE's analyses indicate that the amended energy conservation standards adopted here for SPVUs would save a significant amount of energy. Relative to the case in which DOE adopts the efficiency levels in ASHRAE 90.1–2013 (the ASHRAE base case), the lifetime energy savings for SPVUs purchased in the 30-year period that begins in the anticipated year of compliance with the amended standards (2019–2048), amount to 0.15 quadrillion British thermal units (quads).[10] This represents a savings of 4 percent relative to the energy use of these products in the ASHRAE base case. Energy savings using EPCA as a baseline can be found in chapter 10 of the final rule TSD.

The cumulative net present value (NPV) of total consumer costs and savings of the standards for SPVUs ranges from $0.11 billion (at a 7-percent discount rate) to $0.38 billion (at a 3-percent discount rate) using ASHRAE as a baseline. NPV results using EPCA as a baseline can be found in chapter 10 of the final rule TSD. This NPV expresses the estimated total value of future operating-cost savings minus the estimated increased product costs for SPVUs purchased in 2019–2048 under amended standards.

In addition, amended standards for SPVUs would have significant environmental benefits. DOE estimates that the standards would result in cumulative greenhouse gas (GHG) emission reductions using the ASHRAE baseline (over the same period as for energy savings) of 8.9 million metric tons (Mt)[11] of carbon dioxide (CO_2), 4.9 thousand tons of sulfur dioxide (SO_2), 16 tons of nitrogen oxides (NO_X), 38 thousand tons of methane (CH_4), 0.10 thousand tons of nitrous oxide (N_2O), and 0.02 tons of mercury (Hg).[12] The cumulative reduction in CO_2 emissions through 2030 amounts to 2 Mt, which is equivalent to the emissions resulting from the annual electricity use of more than 220,000 homes. Emissions results using the EPCA baseline can be found in chapter 13 of the final rule TSD, and cumulative reduction in CO_2 emissions through 2030 amounts to 3 Mt relative to the EPCA baseline.

The value of the CO_2 reductions is calculated using a range of values per metric ton of CO_2 (otherwise known as the Social Cost of Carbon, or SCC) developed by a recent Federal interagency process.[13] The derivation of the SCC values is discussed in section IV.K. Using discount rates appropriate for each set of SCC values, DOE estimates that the net present monetary value of the CO_2 emissions reduction using the ASHRAE baseline (not including CO_2 equivalent emissions of other gases with global warming potential) is between $0.06 billion and $0.85 billion, with a value of $0.28 billion using the central SCC case represented by $40.0/t in 2015. DOE

[8] DOE estimated draft financial metrics, including the industry discount rate, based on data in Securities and Exchange Commission (SEC) filings and on industry-reviewed values published in prior heating, ventilation, and air-conditioning (HVAC) final rules. DOE presented the draft financial metrics to manufacturers in manufacturer impact analysis (MIA) interviews. DOE adjusted those values based on feedback from manufacturers. The complete set of financial metrics and more detail about the methodology can be found in section 12.4.3 of final rule TSD chapter 12.

[9] All monetary values in this section are expressed in 2014 dollars and, where appropriate, are discounted to 2015 unless explicitly stated otherwise. Energy savings in this section refer to the full-fuel-cycle savings (see section IV.G for discussion). National benefits apply only to DOE's amended standard levels that are more stringent than the ASHRAE levels, and impacts are presented as compared to the ASHRAE 90.1–2013 level as baseline. For equipment classes where DOE is proposing the ASHRAE levels, national benefits do not accrue.

[10] A quad is equal to 10^{15} British thermal units (Btu). The quantity refers to full-fuel-cycle (FFC) energy savings. FFC energy savings includes the energy consumed in extracting, processing, and transporting primary fuels (*i.e.,* coal, natural gas, petroleum fuels), and, thus, presents a more complete picture of the impacts of energy efficiency standards. For more information on the FFC metric, see section IV.G.1.a.

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

[12] DOE calculated emissions reductions relative to the ASHRAE base-case, which reflects key assumptions in the *Annual Energy Outlook 2015 (AEO2015)* Reference case, which generally represents current legislation and environmental regulations for which implementing regulations were available as of October 31, 2014.

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

also estimates that the net present monetary value of the NO_X emissions reduction is $0.02 billion at a 7-percent discount rate, and $0.06 billion at a 3-percent discount rate.[14] Results using the EPCA baseline can be found in chapter 14 of the final rule TSD.

Table I.3 summarizes the national economic benefits and costs expected to result from the adopted standards for SPVUs using both the ASHRAE and EPCA baselines.

TABLE I.3—SUMMARY OF NATIONAL ECONOMIC BENEFITS AND COSTS OF AMENDED ENERGY CONSERVATION STANDARDS FOR SPVUS USING ASHRAE AND EPCA BASELINES *

Category	Present value *billion 2014$*		Discount rate (%)
	ASHRAE baseline	EPCA baseline	
Benefits			
Consumer Operating Cost Savings	0.37	0.80	7
	0.88	1.86	3
CO_2 Reduction Value ($12.2/t case) **	0.06	0.13	5
CO_2 Reduction Value ($40.0/t case) **	0.28	0.59	3
CO_2 Reduction Value ($62.3/t case) **	0.44	0.93	2.5
CO_2 Reduction Value ($117/t case) **	0.85	1.79	3
NO_X Reduction Monetized Value †	0.02	0.05	7
	0.06	0.12	3
Total Benefits††	0.67	1.43	7
	1.21	2.56	3
Costs			
Consumer Incremental Installed Costs	0.26	0.58	7
	0.50	1.04	3
Net Benefits			
Including CO_2 and NO_X Reduction Monetized Value ††	0.41	0.86	7
	0.71	1.52	3

* This table presents the costs and benefits associated with SPVUs shipped in 2019–2048. These results include benefits to consumers that accrue after 2048 from the products purchased in 2019–2048. The costs account for the incremental variable and fixed costs incurred by manufacturers due to the amended standards, some of which may be incurred in preparation for the rule.

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

† The $/ton values used for NO_X are described in section IV.K.

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

The benefits and costs of the adopted standards, for SPVUs sold in 2019–2048, can also be expressed in terms of annualized values. The monetary values for the total annualized net benefits are the sum of (1) the national economic value of the benefits in reduced operating costs, minus (2) the increases in product purchase prices and installation costs, plus (3) the value of the benefits of CO_2 and NO_X emission reductions, all annualized.[15]

Although DOE believes that the value of operating cost savings and CO_2 emission reductions are both important, two issues are relevant. First, the national operating cost savings are domestic U.S. consumer monetary savings that occur as a result of market transactions, whereas the value of CO_2 reductions is based on a global value. Second, the assessments of operating cost savings and CO_2 savings are performed with different methods that use different time frames for analysis. The national operating cost savings is measured for the lifetime of SPVUs shipped in 2019–2048. Because CO_2 emissions have a very long residence time in the atmosphere,[16] the SCC values in future years reflect future CO_2-emissions impacts that continue beyond 2100.

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

[15] To convert the time-series of costs and benefits into annualized values, DOE calculated a present value in 2015, the year used for discounting the NPV of total consumer costs and savings. For the benefits, DOE calculated a present value associated with each year's shipments in the year in which the shipments occur (*e.g.,* 2020 or 2030), and then discounted the present value from each year to 2015. The calculation uses discount rates of 3 and 7 percent for all costs and benefits except for the value of CO_2 reductions, for which DOE used case-specific discount rates, as shown in Table I.3. Using the present value, DOE then calculated the fixed annual payment over a 30-year period, starting in the compliance year, which yields the same present value.

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

Estimates of annualized benefits and costs of the adopted standards are shown in Table I.4. The results under the primary estimate using the ASHRAE baseline are as follows. Using a 7-percent discount rate for benefits and costs other than CO_2 reduction, (for which DOE used a 3-percent discount rate along with the SCC series that has a value of $40.0/t in 2015),[17] the estimated cost of the standards in this rule is $20 million per year in increased equipment costs, while the estimated annual benefits are $28 million in reduced equipment operating costs, $13 million in CO_2 reductions, and $1.6 million in reduced NO_X emissions. In this case, the net benefit amounts to $24 million per year. Using a 3-percent discount rate for all benefits and costs and the SCC series has a value of $40.0/t in 2015, the estimated cost of the standards is $24 million per year in increased equipment costs, while the estimated annual benefits are $43 million in reduced operating costs, $13 million in CO_2 reductions, and $2.7 million in reduced NO_X emissions. In this case, the net benefit amounts to $35 million per year. Results using the EPCA baseline are shown in Table I.5.

TABLE I.4—ANNUALIZED BENEFITS AND COSTS OF AMENDED STANDARDS FOR SPVUs (ASHRAE BASELINE) *

	Discount rate	Primary estimate	Low net benefits estimate	High net benefits estimate
		Million 2014$/year		
Benefits				
Consumer Operating Cost Savings	7%	28	26	28.
	3%	43	39	44.
CO_2 Reduction Value ($12.2/t case) **	5%	3.7	3.6	3.7.
CO_2 Reduction Value ($40.0/t case) **	3%	13	13	14.
CO_2 Reduction Value ($62.3/t case) **	2.5%	20	20	20.
CO_2 Reduction Value ($117/t case) **	3%	41	41	41.
NO_X Reduction Value †	7%	1.6	1.6	1.6.
	3%	2.7	2.7	2.7.
Total Benefits ††	7% plus CO_2 range	33 to 71	31 to 68	34 to 71.
	7%	43	41	43.
	3% plus CO_2 range	49 to 86	45 to 83	50 to 87.
	3%	59	55	60.
Costs				
Consumer Incremental Product Costs	7%	20	25	19.
	3%	24	32	24.
Net Benefits				
Total ††	7% plus CO_2 range	14 to 51	6 to 44	14 to 52.
	7%	24	16	24.
	3% plus CO_2 range	25 to 62	14 to 51	26 to 63.
	3%	35	23	36.

* This table presents the annualized costs and benefits associated with SPVUs shipped in 2019–2048. These results include benefits to consumers that accrue after 2048 from the SPVUs purchased from 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 *AEO2015* Reference case, Low Economic Growth case, and High Economic Growth case, respectively. In addition, incremental product costs reflect a constant rate in the Primary Estimate, an increasing rate in the Low Benefits Estimate, and a decline in the High Benefits Estimate. The methods used to derive projected price trends are explained in section IV.F.2.a.

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

† The $/ton values used for NO_X are described in section IV.K.

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

TABLE I.5—ANNUALIZED BENEFITS AND COSTS OF AMENDED STANDARDS FOR SPVUs (EPCA BASELINE) *

	Discount rate	Primary estimate	Low net benefits estimate	High net benefits estimate
		Million 2014$/year		
Benefits				
Consumer Operating Cost Savings	7%	60	55	60.
	3%	90	82	92.
CO_2 Reduction Value ($12.2/t case) **	5%	7.8	7.7	7.8.
CO_2 Reduction Value ($40.0/t case) **	3%	28	28	29.

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

TABLE I.5—ANNUALIZED BENEFITS AND COSTS OF AMENDED STANDARDS FOR SPVUs (EPCA BASELINE) *—Continued

	Discount rate	Primary estimate	Low net benefits estimate	High net benefits estimate
		Million 2014$/year		
CO_2 Reduction Value ($62.3/t case) **	2.5%	42	42	43.
CO_2 Reduction Value ($117/t case) **	3%	87	86	87.
NO_X Reduction Value †	7%	3.5	3.5	3.5.
	3%	5.8	5.8	5.8.
Total Benefits ††	7% plus CO_2 range	71 to 150	66 to 144	72 to 151.
	7%	92	87	92.
	3% plus CO_2 range	104 to 183	96 to 174	106 to 185.
	3%	124	117	126.
Costs				
Consumer Incremental Product Costs	7%	43	53	43.
	3%	50	65	50.
Net Benefits				
Total ††	7% plus CO_2 range	28 to 107	13 to 92	29 to 108.
	7%	49	34	50.
	3% plus CO_2 range	53 to 132	31 to 110	56 to 135.
	3%	74	52	76.

* This table presents the annualized costs and benefits associated with SPVUs shipped in 2019–2048. These results include benefits to consumers which accrue after 2048 from the SPVUs purchased from 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 *AEO2015* Reference case, Low Economic Growth case, and High Economic Growth case, respectively. In addition, incremental product costs reflect a constant rate in the Primary Estimate, an increasing rate in the Low Benefits Estimate, and a decline in the High Benefits Estimate. The methods used to derive projected price trends are explained in section IV.F.2.a.

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

† The $/ton values used for NO_X are described in section IV.K.

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

DOE's analysis of the national impacts of the adopted standards is described in sections IV.G, IV.J, and IV.K of this final rule.

D. Conclusion

Based on the analyses culminating in this final rule, DOE found the benefits to the nation of the standards (energy savings, consumer LCC savings, positive NPV of consumer benefit, and emission reductions) outweigh the burdens (loss of INPV and LCC increases for some users of this equipment). DOE has concluded that, based upon clear and convincing evidence, the amended standards adopted in this final rule represent a significant improvement in energy efficiency that is technologically feasible and economically justified, and would result in significant conservation of energy.

II. Introduction

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

A. Authority

Title III, Part C[18] of the Energy Policy and Conservation Act of 1975 (EPCA or the Act), Public Law 94–163 (42 U.S.C. 6311 *et. seq.*), added by Public Law 95–619, Title IV, section 441(a), established the Energy Conservation Program for Certain Industrial Equipment, which includes the SPVAC and SPVHP equipment that is the subject of this final rule.[19] 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)

EPCA contains mandatory energy conservation standards for commercial heating, air-conditioning, and water-heating equipment. Specifically, the statute sets standards for small, large, and very large commercial package air-conditioning and heating equipment, SPVACs and SPVHPs, warm-air furnaces, packaged boilers, storage water heaters, instantaneous water heaters, and unfired hot water storage tanks. (42 U.S.C. 6313(a)) EPCA established Federal energy conservation standards that generally correspond to the levels in ASHRAE Standard 90.1, as in effect on October 24, 1992 (*i.e.,* ASHRAE/Illuminating Engineering Society of North America (IESNA) Standard 90.1–1989), for each type of covered equipment listed in 42 U.S.C. 6313(a). EISA 2007, Public Law 110–240, amended EPCA by adding definitions and setting minimum energy conservation standards for SPVACs and SPVHPs. (42 U.S.C. 6313(a)(10)(A)) The efficiency standards for SPVACs and SPVHPs established by EISA 2007 correspond to the levels contained in ASHRAE Standard 90.1–2004, which originated as addendum ''d'' to ASHRAE Standard 90.1–2001.

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

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

EPCA requires that DOE conduct a rulemaking to consider amended energy conservation standards for a variety of enumerated types of commercial heating, ventilating, and air-conditioning equipment (of which SPVACs and SPVHPs are a subset) each time ASHRAE Standard 90.1 is updated with respect to such equipment. (42 U.S.C. 6313(a)(6)(A)) Such review is to be conducted in accordance with the procedures established for ASHRAE equipment under 42 U.S.C. 6313(a)(6). According to 42 U.S.C. 6313(a)(6)(A), for each type of equipment, EPCA directs that if ASHRAE Standard 90.1 is amended, DOE must publish in the **Federal Register** an analysis of the energy savings potential of amended energy efficiency standards within 180 days of the amendment of ASHRAE Standard 90.1. (42 U.S.C. 6313(a)(6)(A)(i)) EPCA further directs that DOE must adopt amended standards at the new efficiency level specified in ASHRAE Standard 90.1, unless clear and convincing evidence supports a determination that adoption of a more-stringent level would produce significant additional energy savings and be technologically feasible and economically justified. (42 U.S.C. 6313(a)(6)(A)(ii)(II)) In addition, DOE notes that pursuant to the EISA 2007 amendments to EPCA, the agency must periodically review its already-established energy conservation standards for ASHRAE equipment. (42 U.S.C. 6313(a)(6)(C)) In December 2012, this provision was further amended by the American Energy Manufacturing Technical Corrections Act (AEMTCA) to clarify that DOE's periodic review of ASHRAE equipment must occur ''[e]very six years.'' (42 U.S.C. 6313(a)(6)(C)(i))

AEMTCA also modified EPCA to specify that any amendment to the design requirements with respect to the ASHRAE equipment would trigger DOE review of the potential energy savings under U.S.C. 6313(a)(6)(A)(i). Additionally, AEMTCA amended EPCA to require that if DOE proposes an amended standard for ASHRAE equipment at levels more stringent than those in ASHRAE Standard 90.1, DOE, in deciding whether a standard is economically justified, must determine, after receiving comments on the proposed standard, whether the benefits of the standard exceed its burdens by considering, to the maximum extent practicable, the following seven factors:

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

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

(III) The total projected amount of energy savings likely to result directly from the standard;

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

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

(VI) The need for national energy conservation; and

(VII) Other factors the Secretary considers relevant.

(42 U.S.C. 6313(a)(6)(B)(ii))

EISA 2007 amended EPCA to provide an independent basis for a one-time review regarding SPVUs that is not tied to the conditions for initiating review specified by 42 U.S.C. 6313(a)(6)(A) or 42 U.S.C. 6313(a)(6)(C) described previously. Specifically, pursuant to 42 U.S.C. 6313(a)(10)(B), DOE must commence review of the most recently published version of ASHRAE Standard 90.1 with respect to SPVU standards in accordance with the procedures established under 42 U.S.C. 6313(a)(6) no later than 3 years after the enactment of EISA 2007. DOE notes that this provision was not tied to the trigger of ASHRAE publication of an updated version of Standard 90.1 or to a 6-year period from the issuance of the last final rule, which occurred on March 7, 2009 (74 FR 12058). DOE was simply obligated to commence its review by a specified date.

Because ASHRAE did not update its efficiency levels for SPVACs and SPVHPs in ASHRAE Standard 90.1–2010, DOE began the current rulemaking by analyzing amended standards consistent with the 6-year look-back procedures defined under 42 U.S.C. 6313(a)(6)(C). The statutory provision at 42 U.S.C. 6313(a)(6)(B)(ii), recently amended by AEMTCA, states that in deciding whether a standard is economically justified, DOE must determine, after receiving comments on the proposed standard, whether the benefits of the standard exceed its burdens by considering, to the maximum extent practicable, the seven factors stated above.

However, before DOE could finalize its rulemaking initiated by the one-time SPVU review requirement in EISA, ASHRAE acted on October 9, 2013 to adopt ASHRAE Standard 90.1–2013. This revision of ASHRAE Standard 90.1 contained amended standard levels for SPVUs, thereby triggering DOE's statutory obligation under 42 U.S.C. 6313(a)(6)(A) to promulgate an amended uniform national standard at those levels unless DOE determined that there is clear and convincing evidence supporting the adoption of more-stringent energy conservation standards than the ASHRAE levels. Consequently, DOE prepared an analysis of the energy savings potential of amended standards at the ASHRAE Standard 90.1–2013 levels (as required by 42 U.S.C. 6313(a)(6)(A)(i)), and issued a NOPR. 79 FR 78614 (Dec. 30, 2014). For this final rule, DOE updated the analyses that accompanied the NOPR in response to stakeholder comments.

DOE is adopting amended standards for two equipment classes of SPVUs that are more stringent than those set forth in ASHRAE Standard 90.1–2013, and is adopting the ASHRAE Standard 90.1–2013 levels for all other SPVU equipment classes. DOE has concluded that there is clear and convincing evidence that the amended standards more stringent than those set forth in ASHRAE Standard 90.1–2013 for two SPVU equipment classes will result in significant additional conservation of energy and be technologically feasible and economically justified, as mandated by 42 U.S.C. 6313(a)(6).

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 a covered product. (42 U.S.C. 6313(a)(6)(B)(iii)(I)) 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 product type (or class) of performance characteristics (including reliability), features, sizes, capacities, and volumes that are substantially the same as those generally available in the United States. (42 U.S.C. 6313(a)(6)(B)(iii)(II))

Further, EPCA, as codified, establishes a rebuttable presumption that a standard is economically justified if the Secretary finds that the additional cost to the consumer of purchasing a product complying with an energy conservation standard level will be less than three times the value of the energy savings during the first year that the consumer will receive as a result of the standard, as calculated under the applicable test procedure. (42 U.S.C. 6295(o)(2)(B)(iii) and 6316(e)(1))

Additionally, when a type or class of covered equipment, such as ASHRAE equipment, has two or more subcategories, DOE often specifies more than one standard level. DOE generally will adopt a different standard level than that which applies generally to such type or class of products for any group of covered products that have the same function or intended use if DOE determines that products within such group: (A) Consume a different kind of energy from that consumed by other covered products within such type (or class); or (B) have a capacity or other performance-related feature which other products within such type (or class) do not have and which justifies a higher or lower standard. (42 U.S.C. 6295(q)(1) and 6316(e)(1)) In determining whether a performance-related feature justifies a different standard for a group of products, DOE generally considers such factors as the utility to the consumer of the feature and other factors DOE deems appropriate. In a rule prescribing such a standard, DOE includes an explanation of the basis on which such higher or lower level was established. (42 U.S.C. 6295(q)(2) and 6316(e)(1))

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

B. Background

1. Current Standards

As noted above, EISA 2007 amended EPCA to establish separate equipment classes and minimum energy conservation standards for SPVACs and SPVHPs. (42 U.S.C. 6313(a)(10)(A)) DOE published a final rule technical amendment in the **Federal Register** on March 23, 2009, which codified into DOE's regulations the new SPVAC and SPVHP equipment classes and energy conservation standards for this equipment as prescribed by EISA 2007. 74 FR 12058. These standards apply to all SPVUs manufactured on or after January 1, 2010. The current standards are set forth in Table II.1.

TABLE II.1—CURRENT FEDERAL ENERGY CONSERVATION STANDARDS FOR SINGLE PACKAGE VERTICAL AIR CONDITIONERS AND HEAT PUMPS

Equipment type	Cooling capacity *Btu/h*	Efficiency level
Single Package Vertical Air Conditioner	<65,000 Btu/h	EER = 9.0
Single Package Vertical Air Conditioner	≥65,000 Btu/h and <135,000 Btu/h	EER = 8.9
Single Package Vertical Air Conditioner	≥135,000 Btu/h and <240,000 Btu/h *	EER = 8.6
Single Package Vertical Heat Pump	<65,000 Btu/h	EER = 9.0 COP = 3.0
Single Package Vertical Heat Pump	≥65,000 Btu/h and <135,000 Btu/h *	EER = 8.9 COP = 3.0
Single Package Vertical Heat Pump	≥135,000 Btu/h and <240,000 Btu/h *	EER = 8.6 COP = 2.9

* There are no models currently on the market with available efficiency data at these cooling capacities.

2. History of Standards Rulemaking for SPVACs and SPVHPs

Single package vertical units were established as a separate equipment class in ASHRAE Standard 90.1 by addendum ''d'' to ASHRAE Standard 90.1–2001. DOE subsequently evaluated the possibility of creating separate equipment classes for SPVUs, but determined that the Energy Policy Act of 2005 had revised the language in 42 U.S.C. 6313(a)(6)(A)(i) to limit DOE's authority to adopt ASHRAE amendments for small, large, and very large commercial package air-conditioning and heating equipment until after January 1, 2010, and thus, DOE could not adopt equipment classes and standards for SPVUs at that time. As explained in a March 2007 energy conservation standards final rule for various ASHRAE products, DOE determined that SPVUs fall under the definition of ''commercial package air conditioning and heating equipment'' (42 U.S.C. 6311(8)(A)), and that any SPVUs with cooling capacities less than 760,000 Btu/h would fit within the commercial package air conditioning and heating equipment categories listed in EPCA and be subjected to their respective energy efficiency standards. 72 FR 10038, 10046–10047 (March 7, 2007).

Subsequently, EISA 2007 amended EPCA to: (1) Create separate equipment classes for SPVACs and SPVHPs; (2) set minimum energy conservation standards for these equipment classes; (3) eliminate the restriction on amendments for small, large, and very large commercial package air-conditioning and heating equipment until after January 1, 2010; and (4) instruct DOE to review the most recently published ASHRAE Standard 90.1 with respect to SPVUs no later than 3 years after the enactment of EISA 2007. As noted previously, DOE published a final rule technical amendment in the **Federal Register** that codified into DOE regulations the standards for SPVUs that were established by EISA 2007. 74 FR 12058 (March 23, 2009).

On October 29, 2010, ASHRAE officially released ASHRAE Standard 90.1–2010 to the public. As an initial step in reviewing SPVUs under EPCA, DOE published a notice of data availability (NODA) on May 5, 2011, which contained potential energy savings estimates for certain industrial and commercial equipment, including SPVUs. 76 FR 25622. Although ASHRAE Standard 90.1–2010 did not update the efficiency levels for SPVUs, DOE was obligated to review the potential energy savings for these equipment classes under 42 U.S.C. 6313(a)(10)(B), as noted above. On January 17, 2012, DOE published a NOPR (January 2012 NOPR), which proposed revised energy conservation standards for certain types of commercial equipment (not including SPVUs), in response to standard levels contained in ASHRAE Standard 90.1–2010 that were more-stringent than Federal minimum standards at the time. In addition, the January 2012 NOPR proposed test procedure amendments for certain types of commercial equipment, including SPVUs, in order to incorporate the most current industry test procedures specified in ASHRAE Standard 90.1–2010. In the January 2012 NOPR, DOE proposed to incorporate by reference the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 390–2003, ''Performance

Rating of Single Package Vertical Air-Conditioners and Heat Pumps,'' into the DOE test procedure for SPVUs and proposed an optional equipment break-in period of no more than 16 hours. 77 FR 2356. On May 16, 2012, DOE published a final rule (May 2012 Rule), which incorporated by reference AHRI Standard 390–2003 into the DOE test procedure for SPVUs and increased the maximum duration of the optional break-in period to 20 hours. 77 FR 28928. The May 2012 Rule (as with the January 2012 NOPR) did not contain amended standards for SPVUs, because ASHRAE Standard 90.1–2010 did not set standard levels for SPVUs that were more stringent than the federally mandated standard levels at the time. As directed by EISA 2007, DOE was considering more-stringent standards for SPVUs on a separate timeline from the other equipment analyzed under the May 2012 Rule.

However, as noted before, during the analyses regarding whether standards more stringent than those promulgated by EISA 2007 would be justified, ASHRAE acted on October 9, 2013 to adopt ASHRAE Standard 90.1–2013. This revision to ASHRAE Standard 90.1 did contain amended standard levels for SPVUs, thereby triggering DOE's statutory obligation to promulgate an amended uniform national standard at those levels, unless DOE determines that there is clear and convincing evidence supporting the adoption of more-stringent energy conservation standards than the ASHRAE levels.

Once triggered by ASHRAE action, DOE became subject to certain new statutory requirements and deadlines. For example, the statute required DOE to publish in the **Federal Register** for comment an analysis of the energy savings potential of amended energy conservation standards at the ASHRAE Standard 90.1–2013 levels, not later than 180 days after amendment of the ASHRAE standard. DOE published this energy savings analysis as a NODA in the **Federal Register** on April 11, 2014 (April 2014 NODA). 79 FR 20114.

Once triggered by ASHRAE action, the applicable legal deadline for completion of this standards rulemaking also shifted. When DOE first commenced this rulemaking pursuant to 42 U.S.C. 6313(a)(10)(B), that provision directed DOE to follow the procedures established under 42 U.S.C. 6313(a)(6). Because DOE had not been triggered by ASHRAE action at the time (as would necessitate use of the procedures under 42 U.S.C. 6313(a)(6)(A)), DOE proceeded as a 6-year-lookback amendment of the standard under 42 U.S.C. 6313(a)(6)(C), which called for a NOPR followed by a final rule not more than 2 years later. DOE was close to issuing a NOPR at the time it was triggered by ASHRAE action on Standard 90.1–2013. Once triggered, DOE was then required to either adopt the levels in ASHRAE Standard 90.1–2013 not later than 18 months after the publication of the amended ASHRAE standard (*i.e.,* by April 9, 2015), or to adopt more-stringent standards not later than 30 months after publication of the amended ASHRAE standard (*i.e.,* by April 9, 2016). Subsequently, DOE published a NOPR in December 2014 with proposed standards for SPVU equipment. 79 FR 78614. DOE received a number of comments from interested parties; the parties are summarized in Table II.2. DOE considered these comments in the preparation of the final rule. Relevant comments, and DOE's responses, are provided in the appropriate sections of this document.

TABLE II.2—INTERESTED PARTIES PROVIDING COMMENTS

Name	Abbreviation	Type *
Air-Conditioning, Heating and Refrigeration Institute	AHRI	IR
Appliance Standards Awareness Project	ASAP	EA
Appliance Standards Awareness Project, Alliance to Save Energy, Natural Resources Defense Council.	ASAP *et al*	EA
Bard Manufacturing Company	Bard	M
Edison Electric Institute	EEI	U
Howe, Anderson, and Smith, P.C. (on behalf of First Company)	First Company	M
Friedrich Air Conditioning Company, LTD	Friedrich	M
General Electric	GE	M
Lennox International	Lennox	M
National Coil Company		M
Northwest Energy Efficiency Alliance	NEEA	EA
Pacific Gas and Electric Company, Southern California Gas Company, Southern California Edison, San Diego Gas and Electric.	CA IOUs	U
Southern Company Services	SCS	U
U.S. Chamber of Commerce and 10 trade associations	Associations	TA

* IR: Industry Representative; M: Manufacturer; EA: Efficiency/Environmental Advocate; TA: Trade Association; U: Utility.

III. General Discussion

A. Compliance Dates

Based on the statutory lead time for compliance in 42 U.S.C. 6313(a)(6)(D), for the SPVU equipment classes for which DOE is adopting the ASHRAE Standard 90.1–2013 levels, the compliance date is either 2 or 3 years after the effective date of the applicable ASHRAE standard, depending on equipment size (*i.e.,* by October 9, 2015 or October 9, 2016).[20] The compliance date for the SPVU equipment classes for which DOE is adopting more-stringent standards than the ASHRAE Standard 90.1–2013 levels is 4 years after the publication of this final rule in the **Federal Register**. Therefore, SPVU equipment classes subject to the standards more stringent than ASHRAE Standard 90.1–2013 level, which are manufactured on or after September 23, 2019 will be required to meet the more-stringent Federal standards.

B. Equipment Classes and Scope of Coverage

When evaluating and establishing energy conservation standards, DOE divides covered equipment into

[20] Under 42 U.S.C. 6313(a)(6)(D)(i), the applicable compliance date when DOE adopts the ASHRAE standard levels for small commercial package air conditioning and heating equipment (including SPVACs and SPVHPs under 135,000 Btu/h) is 2 years after the effective date of the minimum energy efficiency requirements in the amended ASHRAE Standard 90.1. Under 42 U.S.C. 6313(a)(6)(D)(ii), the applicable compliance date when DOE adopts the ASHRAE standard levels for large and very large commercial package air conditioning and heating equipment (including SPVACs and SPVHPs ≥135,000 Btu/h and <240,000 Btu/h) is 3 years after the effective date of the minimum energy efficiency requirement in the amended ASHRAE Standard 90.1.

equipment classes by the type of energy used or by capacity or other performance-related features that justify a different standard. In making a determination whether a performance-related feature justifies a different standard, DOE must consider such factors as the utility to the consumer of the feature and other factors DOE determines are appropriate. (42 U.S.C. 6295(q))

EPCA, as amended, defines ''single package vertical air conditioner'' and ''single package vertical heat pump'' in 42 U.S.C. 6311(23) and (24). In particular, these units can be single- or three-phase; must have major components arranged vertically; must be an encased combination of components; and must be intended for exterior mounting on, adjacent interior to, or through an outside wall. DOE codified these definitions into its regulations at 10 CFR 431.92.

EPCA, as amended, set energy conservation standards for eight SPVU equipment classes based on cooling capacity, whether the equipment is an air conditioner or a heat pump, and in certain cases, phase, as shown in Table III.1. (42 U.S.C. 6313(a)(10)(A)) The energy conservation standards for SPVACs and SPVHPs are identical across phase, and as such, DOE does not always show the phase breakdown. (*See,* for example, 10 CFR part 431, Table 1 to § 431.97.)

TABLE III.1—EQUIPMENT CLASSES FOR SINGLE PACKAGE VERTICAL UNITS

Equipment type	Cooling capacity *Btu/h*	Phase
Single Package Vertical Air Conditioners	<65,000	Single-Phase.
		3-Phase.
	≥65,000 and <135,000	All.
	≥135,000 and <240,000	All.
Single Package Vertical Heat Pumps	<65,000	Single-Phase.
		3-Phase.
	≥65,000 and <135,000	All.
	≥135,000 and <240,000	All.

1. Consideration of a Space-Constrained SPVU Equipment Class

In the April 2014 NODA, DOE noted that ASHRAE Standard 90.1–2013 created a new equipment class for SPVACs and SPVHPs used in space-constrained and replacement-only applications, with a definition for ''non-weatherized space constrained single-package vertical unit'' and efficiency standards for the associated equipment class. In the NODA, DOE tentatively concluded that there was no need to establish a separate space-constrained class for SPVUs, given that certain models listed by manufacturers as SPVUs, most of which would meet the ASHRAE space-constrained definition, were being misclassified and should have been classified as central air conditioners (in most cases, space-constrained central air conditioners). 79 FR 20114, 20123 (April 11, 2014). DOE reaffirmed this position in the December 2014 NOPR. In response to the NOPR, DOE received several comments from stakeholders related to the classification of products that these commenters are referring to as space constrained SPVUs, the statutory definition of SPVU, how these products are applied in the field or specified for purchase, and whether the products warranted a separate equipment class within SPVU. (AHRI, No. 19 at p. 2; Lennox, No. 16 at pp. 11–12, 14,15, 17; First Company, No. 12 at pp. 1–3; GE, No. 21 at p. 2; Friedrich, No. 15 at p. 1; NEEA, No. 23 at p. 2; CA IOUs, No. 22 at p. 2) DOE will consider these comments and take appropriate action in a separate rulemaking.

2. Relationship to Dual Duct Air Conditioners

DOE notes that in the September 30, 2014 NOPR for commercial package air conditioning and heating equipment, it discussed a type of air-conditioning equipment 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, referring to these units as ''dual-duct air-cooled air conditioners.'' 79 FR 58948, 58964. A subsequent working group established to negotiate standards for commercial package equipment recommended that dual duct air conditioners and heat pumps become a separate equipment class within the category of commercial packaged air-conditioning and heating equipment with their own standards and recommended the following definition:

''Dual duct air conditioner or heat pump means air-cooled commercial package air conditioning and heating equipment that

- is either a horizontal single package or split-system unit; or a vertical unit that consists of two components that may be shipped or installed either connected or split;
- is intended for indoor installation with ducting of outdoor air from the building exterior to and from the unit, where the unit and/or all of its components are non-weatherized and are not marked (or listed) as being in compliance with UL 1995 or equivalent requirements for outdoor use;
- (a) if it is a horizontal unit, the complete unit has a maximum height of 35 inches or the unit has components that do not exceed a maximum height of 35 inches;
- (b) if it is a vertical unit, the complete (split, connected, or assembled) unit has component that do not exceed maximum depth of 35 inches; and
- (c) has a rated cooling capacity greater than and equal to 65,000 Btu/h and up to 300,000 Btu/h.'' (EERE–2013–BT–STD–0007–0093, pp. 4–5).

DOE notes that the proposed definition does not encompass vertical single package units, and as such there is not any overlap with the definition of SPVU. DOE has not identified any equipment on the market that is arranged vertically in a single package configuration and meets all the criteria of the dual duct definition, with the sole exception of not consisting of two components. If such equipment existed, DOE would consider it to be an SPVU rather than a dual duct air conditioner or heat pump.

C. Test Procedure

DOE's current energy conservation standards for SPVUs are expressed in terms of EER for cooling efficiency and COP for heating efficiency (*see* 10 CFR 431.96(b)).

DOE's test procedures for SPVACs and SPVHPs are codified at Title 10 of the Code of Federal Regulations (CFR), section 431.96. The current test procedures were amended in a final rule dated May 16, 2012. 77 FR 28928, 28987–91. The test procedures are incorporated by reference at 10 CFR 431.95(b)(6) and include the ANSI and AHRI Standard 390–2003 ''Performance Rating of Single Package Vertical Air-Conditioners and Heat Pumps'' (AHRI 390–2003).

D. Technological Feasibility

1. General

In each energy conservation standards rulemaking, DOE conducts a screening analysis based on information gathered on all current technology options and prototype designs that could improve the efficiency of the products or equipment that are the subject of the rulemaking. As the first step in such an analysis, DOE develops a list of technology options for consideration in consultation with manufacturers, design engineers, and other interested parties. DOE then determines which of those means for improving efficiency are technologically feasible. DOE considers technologies incorporated in commercially available 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 document discusses the results of the screening analysis for SPVACs and SPVHPs, particularly the designs DOE considered, those it screened out, and those that are the basis for the standards considered in this rulemaking. For further details on the screening analysis for this rulemaking, see chapter 4 of the final rule TSD.

2. Maximum Technologically Feasible Levels

When DOE adopts (or does not adopt) an amended energy conservation standard for a type or class of covered equipment, it must determine the maximum improvement in energy efficiency or maximum reduction in energy use that is technologically feasible for such equipment. (42 U.S.C. 6295(p)(1) and 6313(a)) Accordingly, in the engineering analysis, DOE determined the maximum technologically feasible (''max-tech'') improvements in energy efficiency for SPVACs and SPVHPs using the design parameters that passed the screening analysis. The max-tech levels that DOE determined for this rulemaking are described in section IV.C.4 of this final rule and in chapter 5 of the final rule TSD.

E. Energy Savings

1. Determination of Savings

For each trial standard level (TSL), DOE projected energy savings from application of the TSL to SPVUs purchased in the 30-year period that begins in the year of compliance with any amended standards (2015–2044 for the ASHRAE level, and 2019–2048 for higher efficiency levels).[21] The savings are measured over the entire lifetime of products purchased in the 30-year analysis period. DOE quantified the energy savings attributable to each TSL as the difference in energy consumption between each standards case and the ASHRAE base case, or the case in which DOE must adopt the standard levels in ASHRAE 90.1–2013.

DOE used its national impact analysis (NIA) spreadsheet models to estimate energy savings from potential amended standards for SPVUs. The NIA spreadsheet model (described in section IV.G of this final rule) calculates savings in site energy, which is the energy directly consumed by products at the locations where they are used. Based on the site energy, DOE calculates national energy savings (NES) in terms of primary energy savings at the site or at power plants, and also in terms of full-fuel-cycle (FFC) energy savings. The FFC metric includes the energy consumed in extracting, processing, and transporting primary fuels (*i.e.,* coal, natural gas, petroleum fuels), and thus presents a more complete picture of the impacts of energy conservation standards.[22] DOE's approach is based on the calculation of an FFC multiplier for each of the energy types used by covered products or equipment. For more information on FFC energy savings, see section IV.G.1 of this final rule. For natural gas, the primary energy savings are considered to be equal to the site energy savings.

2. Significance of Savings

Among the criteria that govern DOE's adoption of more-stringent standards for SPVUs than the amended levels in ASHRAE Standard 90.1, clear and convincing evidence must support a determination that the standards would result in ''significant'' energy savings. (42 U.S.C. 6313(a)(6)(A)(ii)(II)) Although the term ''significant'' is not defined in the Act, the U.S. Court of Appeals, for the District of Columbia Circuit in *Natural Resources Defense Council* v. *Herrington,* 768 F.2d 1355, 1373 (D.C. Cir. 1985), indicated that Congress intended ''significant'' energy savings in the context of EPCA to be savings that were not ''genuinely trivial.'' DOE's estimates of the energy savings for each of the TSLs considered for the final rule for SPVUs <65,000 Btu/h (presented in section V.B.3.a) provide evidence that the additional energy savings each would achieve by exceeding the corresponding efficiency levels in ASHRAE Standard 90.1–2013 are nontrivial. Therefore, DOE considers these savings to be ''significant'' as required by 42 U.S.C. 6313(a)(6)(A)(ii)(II).

F. Economic Justification

1. Specific Criteria

EPCA provides seven factors to be evaluated in determining whether a more stringent standard for SPVACs and SPVHPs is economically justified. (42 U.S.C. 6313(a)(6)(B)(ii))

In response to the NOPR, AHRI stated that DOE is not performing the full cost-benefit analysis that EPCA section 6313(a)(6)(B)(ii) requires. It stated that DOE performed cost-benefit considerations at various points of its analysis, yet never fully reconciled those analyses or the assumptions and scope of coverage underlying them. It added that DOE's cost-benefit analyses with respect to the nation, manufacturers, and employment utilize very different geographic scopes, ignore the immediately apparent effects on employment, and rely on unsupported analyses for effects on the general economy. AHRI urged DOE to reconcile these various approaches and their assumptions, and also to make available any models or inputs/outputs DOE relied on. AHRI stated that DOE should remedy this shortcoming by performing an integrated, full cost-benefit analysis considering all factors, including the effects on all directly related domestic industries. (AHRI, No. 19 at p. 23)

As noted above, EPCA section 6313(a)(6)(B)(ii) lays out the factors the Secretary should consider, to the maximum extent practicable, in determining whether the benefits of a proposed standard exceed the burdens. EPCA does not mention or require the

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

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

type of integrated cost-benefit analysis that AHRI envisions. It does not state or imply that all of the benefits and burdens need be quantified in monetary terms. Indeed, it is clear from reading the list of factors that no integrated analysis could encompass all of the factors in a single framework.

AHRI appears to be concerned that DOE's national cost-benefit analysis does not encompass the impacts on manufacturers of the proposed standards. The NIA considers, from a national perspective, all of the costs and benefits projected for consumers of SPVUs meeting the amended standards. The costs account for the incremental variable and fixed costs incurred by manufacturers due to the standards, some of which may be incurred in preparation for the final rule. DOE assumes that these costs will be reflected in higher prices for the covered products. DOE does consider the potential effects of standards on employment, both within the SPVU manufacturing industry and in the larger economy. Apart from estimating employment impacts, DOE does not attempt to estimate effects on the general economy. DOE has made available the models used for the NIA and the manufacturer and consumer impact analyses, and the inputs are described in the final rule TSD.

The following sections discuss how DOE has addressed each of the seven factors in this rulemaking.

a. Economic Impact on Manufacturers and Consumers

In determining the impacts of an 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 INPV, which values the industry on the basis of expected future cash flows; cash flows by year; changes in revenue and income; and other measures of impact, as appropriate. Second, DOE analyzes and reports the impacts on different types of manufacturers, including impacts on small manufacturers. Third, DOE considers the impact of standards on domestic manufacturer employment and manufacturing capacity, as well as the potential for standards to result in plant closures and loss of capital investment. Finally, DOE takes into account cumulative impacts of various DOE regulations and other regulatory requirements on manufacturers.

For individual consumers, measures of economic impact include the changes in LCC and 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 NPV of the economic impacts applicable to a particular rulemaking. DOE also evaluates the LCC impacts of potential standards on identifiable subgroups of consumers that may be affected disproportionately by a national standard.

b. Savings in Operating Costs Compared To Increase in Price

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

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

c. Energy Savings

Although significant conservation of energy is a separate statutory requirement for imposing 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.G, DOE uses the NIA spreadsheet to project NES.

AHRI stated that DOE is violating section 6313(a)(6)(A)(ii)(II) and section 6313(a)(6)(B)(ii)(I)–(VII) of EPCA by purporting to give energy savings disproportionate weight. AHRI noted that EPCA requires that DOE consider seven different factors in determining whether the benefits of a proposed standard exceed its burdens, and stated that there is no indication in the statute or otherwise that Congress intended this analysis to be anything other than a roughly equal weighting of factors where no particular factor is ''king'' over all the others. (AHRI, No. 19 at p. 21)

Section 6313(a)(6)(A)(ii)(II) concerns DOE's authority to adopt a national standard more stringent than the amended ASHRAE/IES Standard 90.1 if such standard would result in significant additional conservation of energy and is technologically feasible and economically justified. Section V.C of this document sets forth in detail the reasons why DOE has concluded that the adopted standards for SPVUs would indeed result in significant additional conservation of energy and are technologically feasible and economically justified.

Section 6313(a)(6)(B)(ii)(I)–(VII) lists the factors that DOE must consider in determining whether a standard is economically justified for the purposes of subparagraph (A)(ii)(II). There is no language in the statute that indicates how the factors should be weighted, nor is there a basis for AHRI's interpretation of Congressional intent. Furthermore, given that some of the factors are amenable to quantification while others are more qualitative, it is not clear how the roughly equal weighting envisioned by AHRI would be accomplished. DOE does agree that no single factor should be given excessive consideration, and it does not give disproportionate weight to the projected quantity of energy savings.

d. Lessening of Utility or Performance of Equipment

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

e. Impact of Any Lessening of Competition

EPCA directs DOE to consider the impact of any lessening of competition that is likely to result from energy conservation standards. It also directs the Attorney General of the United States (Attorney General) to determine the impact, if any, of any lessening of competition likely to result from a 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. 6313(a)(6)(B)(ii)(V)) DOE transmitted a copy of its proposed rule to the Attorney General with a request that the Department of Justice (DOJ) provide its determination on this issue.

In a letter dated March 2, 2015, DOJ expressed concern over the proposed energy conservation standards for SPVUs less than 65,000 Btu/h. In particular, DOJ noted that, based on its consideration of the rulemaking documents and observations at the public meeting, manufacturers seemed concerned that the costs of compliance might be prohibitive, and that higher costs may necessitate higher prices to consumers who may opt to switch to other potentially less efficient products or solutions. It also noted industry concerns that proposed standards will require them to increase the size and footprint of SPVUs, which may not be feasible or acceptable to consumers, thereby potentially limiting the range of competitive alternatives available to consumers. DOJ stated that, while it is not in a position to judge whether individual manufacturers will be able to meet the proposed standards, it had concern that the proposed changes could have an effect on competition and it urged DOE to take these into account in determining its final energy efficiency standards for SPVUs. In addition, DOJ recognized that the classification of space-constrained equipment was a potentially significant issue within the rulemaking, but could offer no assessment of the possible competitive impacts of the resolution of that issue.

In response to DOJ concerns, DOE notes that the technologies required to reach the adopted level are not proprietary, are understood by the industry, and are generally available to all manufacturers. In its engineering analysis, DOE concluded that the typical design path would require changes the size of the heat exchanger but would not affect the outer dimensions of the product. Moreover, DOE based its engineering analysis solely on equipment models and configurations which are currently on the market and thus which are, presumably, acceptable to consumers. For these reasons, DOE does not believe that the standard levels included in this final rule will result in adverse impacts on competition within the SPVU marketplace. Additionally, with respect to DOJ's comment on the classification of space-constrained equipment, DOE is currently addressing that topic in a separate rulemaking.

AHRI commented that failing to secure the views of the Attorney General in advance of the proposed rule prevented public comment on the conclusions. (AHRI, No. 19 at p. 23) AHRI seems to be suggesting that DOE should request DOJ's determination prior to publication of the NOPR so that such determination could be included in the NOPR. EPCA requires the Attorney General to make a determination of the impact, of any, of any lessening of competition likely to result from such standard and shall transmit such determination, not later than 60 days after the publication of a proposed rule prescribing or amending an energy conservation standard, in writing to the Secretary, together with an analysis of the nature and extent of such impact. Any such determination and analysis shall be published by the Secretary in the **Federal Register**. 42 U.S.C. 6295(o)(2)(B)(ii). The Attorney General makes a determination of the likely competitive impacts of the proposed standard, which can occur only after the proposed standard is issued by DOE. Additionally, AHRI had the opportunity to comment on all aspects of the NOPR, including the impact of any lessening of competition.

AHRI asked DOE to explain how it weighed section 6313(a)(6)(B)(ii)(IV) (impacts on utility and product performance) or (V) (the impact of a lessening of competition) in the process of deciding which TSL to select. In the context of market competition, AHRI stated that DOE failed to consider whether the negative impacts on small business can be averted if ASHRAE 90.1–2013 or TSL 1 levels are selected. (AHRI, No. 19 at p. 23)

As discussed in sections V.B.4 and V.B.5, DOE concluded: (1) That the efficiency levels adopted in this document are technologically feasible and would not reduce the utility or performance of SPVACs and SPVHPs, and (2) the amended levels would be unlikely to have a significant adverse impact on competition. In selecting a standard level, DOE is required to weigh the sum of all benefits against all costs. The impact on small manufacturers is one consideration in the balancing of costs and benefits. Given the size and composition of the industry, any publication of conversion costs or impacts by subgroup could disclose proprietary content or enable decomposition of aggregate numbers. In the following table, DOE shows the average conversion cost per manufacturer and those conversion costs as a percentage of revenue for the industry.

	Units	Trial Standard Level			
		1	2	3	4
Average Conversion Costs per Manufacturer	2014$M	.9	1.0	2.2	4.5
Conversion Costs as a Percentage of Revenue for the Industry *	%	7.2	7.8	16.8	34.5

* Based on 2015 projected industry revenue.

f. Need for National Energy Conservation

DOE also considers the need for national energy conservation in determining whether a new or amended standard is economically justified. (42 U.S.C. 6313(a)(6)(B)(ii)(VI)) The energy savings from the adopted standards are likely to improve the security and reliability of the nation's energy system. Reductions in the demand for electricity also may result in reduced costs for maintaining the reliability of the nation's electricity system. DOE conducts a utility impact analysis to estimate how standards may affect the nation's needed power generation capacity, as discussed in section IV.L.

The adopted standards also are likely to result in environmental benefits in the form of reduced emissions of air pollutants and GHGs associated with energy production and use. DOE conducts an emissions analysis to estimate how potential standards may affect these emissions, as discussed in section IV.J; the emissions impacts are reported in section V.B.6 of this final rule. DOE also estimates the economic value of emissions reductions resulting from the considered TSLs, as discussed in section IV.K.

AHRI questioned DOE's inclusion of environmental benefits in its consideration since none of the specific factors in section 6313(a)(6)(B)(ii)(I)–(VI) refer to environmental matters. AHRI stated that DOE must clarify precisely why and how it believes that it has the statutory authority under section 6313(a)(6)(B)(ii) to consider SCC issues in any fashion and, if so, under which sub-provision (*i.e.,* which of the seven factors). (AHRI, No. 19 at pp. 24–25)

DOE maintains that environmental and public health benefits associated with more-efficient use of energy are important to take into account when considering the need for national energy and water conservation. Given the threats posed by global climate change to the economy, public health, and national security,[23] combined with the well-recognized potential of many energy conservation measures to reduce emissions of GHGs, DOE believes that evaluation of the potential benefits from slowing anthropogenic climate change must be part of the consideration of the need for national energy conservation required under 42 U.S.C. 6313(a)(6)(B)(ii)(VI).

g. Other Factors

EPCA allows the Secretary, 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)) To the extent interested parties submit any relevant information regarding economic justification that does not fit into the other categories described above, DOE could consider such information under ''other factors.''

2. Rebuttable Presumption

EPCA creates a rebuttable presumption that an energy conservation standard is economically justified if the additional cost to the consumer of a product that meets the standard is less than three times the value of the first year's energy savings resulting from the standard, as calculated under the applicable DOE test procedure. DOE's LCC and PBP analysis generates values used to calculate the effects that potential amended energy conservation standards would have on the PBP for consumers. These analyses include, but are not limited to, the 3-year PBP contemplated under the rebuttable-presumption test.

In addition, DOE routinely conducts an economic analysis that considers the full range of impacts to consumers, manufacturers, the Nation, and the environment, as required under 42 U.S.C. 6313(a)(6)(B)(ii). The results of this analysis serve as the basis for DOE's evaluation of the economic justification for a potential standard level (thereby supporting or rebutting the results of any preliminary determination of economic justification). The rebuttable presumption payback calculation is discussed in section V.B.1.c of this final rule.

G. Additional Comments

DOE received additional non-methodological comments that are not classified in the discussion sections above. Responses to these additional comments are provided below.

Referring to section VI.A of the NOPR, AHRI stated that DOE failed to identify market failures or how energy prices fail to reflect costs associated with emissions of CO_2 and other pollutants. AHRI pointed out that those who purchase and rent commercial buildings (and their tenants) are typically sophisticated consumers who have access to information on energy costs, so any market failure in this context would not be large. AHRI stated that DOE must demonstrate that market failures actually exist in the real world and that, once quantified, DOE's assessment of costs and benefits for its rules in this area align with such an important external validity check on its analysis. (AHRI, No. 19 at pp. 26–27)

Section 1(b)(1) of Executive Order (E.O.) 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. As discussed in section VI.A of this final rule, DOE identified two problems that are related to certain features of consumer decision-making (numbers 1 and 2 in section VI.A), and one problem (number 3) that concerns environmental externalities that are not reflected in energy prices.[24] Energy prices only reflect costs incurred in the production and delivery of energy products (including costs related to meeting existing emissions regulations). They do not reflect costs associated with the effects of the pollutant emissions that do occur. In the case of GHGs, the wide range of economic, public health, and environmental costs associated with climate change are discussed in the National Academies 2014 report *America's Climate Choices.*[25]

DOE acknowledges that many SPVU consumers have access to information on energy costs and have the capacity to factor this information into their purchase decision. Indeed, DOE estimates that many consumers would purchase equipment with efficiency that meets or exceeds the proposed standards in the ASHRAE base case. It is possible that the problem related to information is not highly significant in the SPVU market, but DOE believes that the problem of misaligned incentives between purchasers and users exists in the case of building tenants who pay for electricity.

Neither EPCA nor E.O. 12866 require quantification of the problems. Nor is it clear how any such quantification would bear any relationship to the costs and benefits estimated for the adopted standards. In the case of the problem that there are external benefits resulting from improved energy efficiency of equipment that are not captured by the users, DOE attempts to qualify some of the external benefits through use of SCC values.

AHRI commented that, by proposing energy conservation standards for SPVUs above the levels presented in ASHRAE 90.1–2013, DOE failed to recognize that Congress intended that DOE rely on the ''ASHRAE process'' for commercial standards-making. AHRI added that DOE should have raised concerns regarding the proposed efficiency levels through the ASHRAE process. (AHRI, No. 19 at pp. 13–15) In proposing energy conservation standards for SPVUs above the levels presented in ASHRAE 90.1–2013, DOE followed the relevant provisions of EPCA, which authorize the adoption of an energy conservation standard above the levels adopted by ASHRAE if clear and convincing evidence shows that adoption of such a more-stringent standard would result in significant

[23] See the National Academies 2014 report *America's Climate Choices.* Available at: *http://nas-sites.org/americasclimatechoices/sample-page/panel-reports/americas-climate-choices-final-report/.*

[24] Note that since the publication of the SPVU NOPR, DOE has refined the description of the problems identified pursuant to E.O. 12866. See section VI.A.

[25] Available at: *http://nas-sites.org/americasclimatechoices/sample-page/panel-reports/americas-climate-choices-final-report/.*

additional conservation of energy and be technologically feasible and economically justified. 42 U.S.C. 6313(a)(6)(A)(ii)(II)

AHRI commented that DOE did not make a meaningful attempt to show that the energy savings meet the ''clear and convincing'' requirement of proof, and that the analysis falls short as a result of omissions related to increases in physical size, decreases in shipments, and lack of evidence for the conclusions of the net employment impacts. Furthermore, AHRI noted that the analysis used by DOE in this rulemaking is functionally equivalent to the 6295(o) process that does not have this elevated requirement of proof. (AHRI, No. 19 at pp. 14–17) Following the publication of the NOPR, DOE revised its analysis to incorporate feedback received through stakeholder comments and otherwise responded to specific concerns, including those related to physical size, shipments, and employment impacts; specific revisions and comment responses are addressed in the relevant sections of the document. Following the update of its analyses and review of the results, DOE continues to believe that there is clear and convincing evidence that the standard would result in significant additional conservation of energy and is technologically feasible and economically justified. Section V.C of this document sets forth in detail the reasons why DOE has made this conclusion.

AHRI also commented that the commercial provisions of the statute do not require the maximum improvement in energy efficiency as is required by the residential provisions of the statute (42 U.S.C. 6295(o)(2)(A)). Therefore, AHRI reported that DOE should not have started at TSL 4 and walked down, but should have first considered ASHRAE and only considered higher levels based on clear and convincing evidence as noted previously. (AHRI, No. 19 at pp. 15–17) In response, as described in this final rule, DOE adopted ASHRAE levels except where clear and convincing evidence supported the adoption of a more stringent standard.

DOE also received several comments from stakeholders regarding the proposed efficiency levels. ASAP *et al.,* NEEA, and the CA IOUs supported the proposed standards for SPVUs. (ASAP *et al.,* No. 18 at p. 1; NEEA, No. 23 at p. 1; and CA IOUs, No. 22 at pp. 1–2) AHRI, Lennox, Friedrich, First Company, and National Coil Company opposed increasing efficiency levels about the ASHRAE 90.1–2013 levels. (AHRI, No. 19 at p. 2; Lennox, No. 16 at p. 2; Friedrich, No. 15 at p. 2; First Company, No. 12 at p. 3; National Coil Company, No. 14 at p. 1) Friedrich stated that adopting the ASHRAE 90.1–2013 standards would allow for a realistic product design cycle. (Friedrich, No. 15 at p. 2) Lennox and AHRI stated that DOE has not provided clear and convincing evidence of the benefits of levels above ASHRAE including TSL 2. (Lennox, No. 16 at pp. 7–8; AHRI, No. 19 at p. 2) Lennox also cited instances when DOE rejected TSLs with higher energy savings in favor of ASHRAE, and noted that TSL 2 does not result in significant energy savings if DOE were to consider reduced future shipments and repairs. (Lennox, No. 16 at pp. 7–8) Similarly, National Coil Company noted that the economic benefits would actually be smaller than those in the NOPR because shipments projections are flawed and the PBPs will discourage consumers from purchasing the higher efficiency product. (National Coil Company, No. 14 at p. 2)

DOE appreciates stakeholder comments on the proposed efficiency levels. With respect to Friedrich's comment regarding design cycle, DOE believes that the compliance period associated with TSL 2 provides adequate time for development and implementation of any necessary changes to equipment offerings. Additionally, DOE's engineering analysis is based on equipment already on the market, so DOE does not believe that design cycle concerns should be a significant issue. In response to Lennox and AHRI, in section V.C of this final rule, DOE presents results related to energy savings, economic justification, and technological feasibility, which together meet the clear and convincing evidence requirement. While Lennox is correct in stating that in the past DOE has rejected TSLs with energy savings greater than those expected from adopting ASHRAE standard levels, in each of those cases, DOE had determined that there is not clear and convincing evidence to support the higher levels based on specific concerns identified in those rulemakings. DOE has revised its shipments analysis in response to comments, including those from Lennox and National Coil Company. After making these revisions, which include consideration of increased repairs and reduced shipments in the standards case, DOE still finds that there is clear and convincing evidence that TSL 2 provides significant energy savings that are economically justified.

Lennox stated that if DOE does not adopt the ASHRAE 90.1–2013 efficiency levels, it should engage stakeholders in a negotiated rulemaking to address multiple concerns. (Lennox, No. 16 at p. 2) AHRI stated that as an alternative to adopting the levels in ASHRAE 90.1–2013, DOE could issue a supplemental notice of proposed rulemaking (SNOPR) and allow stakeholders opportunity to comment on a revised analysis and proposal. (AHRI, No. 19 at p. 2) AHRI also noted that DOE may not adopt a final rule with energy conservation standards that it determined in the NOPR are not economically justified (*i.e.,* above TSL 2) without issuing an SNOPR. (AHRI, No. 19 at p. 22)

In response, DOE notes that there is no legal requirement for DOE to engage in a negotiated rulemaking. Furthermore, all stakeholders have had the opportunity to comment on DOE's proposals, which specifically included proposed standards for certain classes of SPVUs at levels more stringent than ASHRAE 90.1–2013. In this final rule, DOE is not adopting energy conservation standards above TSL 2.

IV. Methodology and Discussion of Related Comments

This section addresses the analyses DOE has performed for this rulemaking with regard to SPVACs and SPVHPs. Separate subsections address each component of the analysis.

DOE used several analytical tools to estimate the impact of the standards considered in this document. The first tool is a spreadsheet that calculates the LCC and PBP of potential amended or new energy conservation standards. The NIA uses a second spreadsheet set that provides shipments forecasts and calculates NES and NPV resulting from potential energy conservation standards. DOE uses the third spreadsheet tool, the Government Regulatory Impact Model (GRIM), to assess manufacturer impacts of potential standards. These three spreadsheet tools are available on the DOE docket Web page for this rulemaking: *http://www.regulations.gov/#!docketDetail;D=EERE-2012-BT-STD-0041*. Additionally, DOE used output from the latest version of the Energy Information Administration's (EIA's) *Annual Energy Outlook* (*AEO)* for the emissions and utility impact analyses.

AHRI stated that in the NOPR, DOE used *AEO2013* rather than *AEO2014* even though DOE acknowledged that *AEO2014* would reduce environmental benefits resulting from reductions of certain emissions. AHRI further stated that updating to *AEO2014* in the final rule is not consistent with the theory or practice of notice and comment rulemaking. According to AHRI, if DOE determines not to adopt ASHRAE 90.1–2013 levels, DOE must issue an SNOPR based on *AEO2014* data. AHRI stated that if DOE issues a final rule, it will be too late to file comments and AHRI's only option will be litigation as the rule will have a fatal procedural error. (AHRI, No. 19 at pp. 18–19)

For the final rule, DOE updated to *AEO2015,* the most recent version available, wherever possible. Updating to the most recent AEO versions, however, had *de minimus* impact on the analysis and no impact on the conclusions DOE reached. The NOPR provided stakeholders with the opportunity to comment on the methodology in the rulemaking.

A. Market and Technology Assessment

To start the rulemaking analysis for SPVACs and SPVHPs, DOE researched information that provided an overall picture of the market for this equipment, including the purpose of the equipment, the industry structure, manufacturers, market characteristics, and technologies used in the equipment. This activity included both quantitative and qualitative assessments based primarily on publicly available information.

The market and technology assessment presented in the December 2014 NOPR discussed definitions, equipment classes, manufacturers, quantities, types of equipment sold and offered for sale, and technology options that could improve the energy efficiency of the equipment under examination. See chapter 3 of the final rule TSD for further discussion of the market and technology assessment.

In written submissions after publication of the NOPR, and discussion during the February 6, 2015 NOPR public meeting, several stakeholders provided comment on DOE's NOPR market and technology assessment. Bard commented that there were several domestic SPVU manufacturers that were not listed among the seven manufacturers considered by DOE in the NOPR. (Bard, NOPR Public Meeting Transcript, No. 11 at p. 52) DOE subsequently identified two additional domestic manufacturers of SPVUs that were not considered in the NOPR. AHRI commented that floor-mounted SPVUs used in offices and retail spaces were not included in the analysis. (AHRI, No. 19 at p. 27) DOE is not aware of any manufacturers of products that meet the statutory definition of an SPVU and are designed to be floor-mounted inside an office or retail space.

Lennox commented that, according to the AHRI database, no units exist on the market that meet the 12.3 EER max-tech level analyzed in the NOPR. (Lennox, No. 16 at p. 17) AHRI also commented that there are no units currently on the market that meet the 12.3 EER max-tech efficiency level. (AHRI, No. 19 at p. 34) For the final rule analysis, DOE reexamined up-to-date SPVU product listings in both the AHRI database and manufacturers' Web sites, and found the max-tech level to be 12.0 EER. This resulted in DOE's selection of a different max-tech level, but did not significantly alter the outcome of the analyses, because the standard level selected was not at the max-tech level of performance.

The December 2014 NOPR listed all of the potential technology options that DOE considered for improving energy efficiency of SPVACs and SPVHPs. 79 FR at 78631. These technology options are listed in Table IV.1.

TABLE IV.1—POTENTIAL TECHNOLOGY OPTIONS FOR IMPROVING ENERGY EFFICIENCY OF SPVACS AND SPVHPS

Technology options	
Heat Exchanger Improvements	Increased frontal coil area.
	Increased depth of coil.
	Increased fin density.
	Improved fin design.
	Improved tube design.
	Hydrophilic film coating on fins.
	Microchannel heat exchangers.
	Dual condensing heat exchangers.
Indoor Blower and Outdoor Fan Improvements	Improved fan motor efficiency.
	Improved fan blades.
Compressor Improvements	Improved compressor efficiency.
	Multi-speed Compressors.
Other Improvements	Thermostatic expansion valves.
	Electronic expansion valves.

DOE received multiple comments regarding implementation of the technology options listed in Table IV.1 as a means of improving the energy efficiency of SPVUs. These comments are addressed in the relevant sections of the screening analysis and engineering analysis in sections IV.B and IV.C, respectively. DOE did not receive any comments regarding technology options that are not listed in Table IV.1.

B. Screening Analysis

After DOE identified the technologies that might improve the energy efficiency of SPVACs and SPVHPs, DOE conducted a screening analysis. The purpose of the screening analysis is to evaluate the technologies that improve equipment efficiency to determine which technologies to consider further and which to screen out. DOE uses four screening criteria to determine which design options are suitable for further consideration in a standards rulemaking. Namely, design options will be removed from consideration if they are not technologically feasible; are not practicable to manufacture, install, or service; have adverse impacts on product utility or product availability; or have adverse impacts on health or safety. (10 CFR part 430, subpart C, appendix A at 4(a)(4) and 5(b)) Details of the screening analysis are in chapter 4 of the final rule TSD.

Technologies that pass through the screening analysis are referred to as ''design options'' in the engineering analysis. These four screening criteria do not include the proprietary status of design options. DOE will only consider efficiency levels achieved through the use of proprietary designs in the engineering analysis if they are not part of a unique path to achieve that efficiency level.

Through a review of each technology, DOE found that the technologies identified met all four screening criteria to be examined further in the analysis in the December 2014 NOPR. 79 FR at 78631.

Technologies Not Considered in the Engineering Analysis

Typically, energy-saving technologies that pass the screening analysis are evaluated in the engineering analysis.

However, some technologies are not included in the analysis for other reasons, including: (1) Data are not available to evaluate the energy efficiency characteristics of the technology; (2) available data suggest that the efficiency benefits of the technology are negligible; or (3) the test procedure and EER or COP metric would not measure the energy impact of these technologies. Accordingly, in the December 2014 NOPR, DOE eliminated the following technologies from consideration in the engineering analysis based upon these additional considerations: increased fin density, improved fin design, improved tube design, hydrophilic film coating on fins, thermostatic or electronic expansion valves, thermostatic cyclic controls, microchannel heat exchangers (MCHXs), and multi-speed compressors. 79 FR at 78631–32.

DOE received multiple comments on its exclusion of MCHXs from the engineering analysis. ASAP *et al.* commented that higher efficiency levels may have been found to be more cost effective if MCHXs had been incorporated in the analysis. Although DOE did not find any models on the market that use MCHX technology, ASAP *et al.* expressed the position that DOE could have modeled MCHX technology in order to determine its cost effectiveness. Additionally, ASAP *et al.* stated that MCHX technology offers reliability benefits to users of SPVUs. (ASAP *et al.,* No. 18 at p. 2) NEEA commented that MCHXs are currently found in some rooftop units manufactured by at least one manufacturer of SPVUs. NEEA stated that DOE would have found MCHXs to be a cost effective design option if modeling software had been used to simulate their use in SPVUs in the engineering analysis. (NEEA, No. 23 at pp. 1–2). The CA IOUs commented that MCHX is a mature technology that has been proven in various automotive and HVAC applications. Further, the CA IOUs stated that the non-existence of this technology in SPVUs may be because the current efficiency standards are sufficiently low to not encourage its use, and it may be cost effective if utilized. (CA IOUs, No. 22 at p. 2) DOE is aware that the technological feasibility of MCHX technology has been proven in certain HVAC applications, including some commercial packaged air conditioners (CUACs). However, DOE is not aware of any manufacturers of SPVUs who either currently or in the past have incorporated MCHX technology into SPVU products. As such, DOE is not aware of any research or data that document the effect that MCHX technology has on the energy efficiency of SPVUs. Therefore, DOE did not consider MCHX technology in its engineering analysis.

After screening out or otherwise removing from consideration the aforementioned technologies, the technologies that DOE identified for consideration in the engineering analysis are included in Table IV.2.

TABLE IV.2—DESIGN OPTIONS RETAINED FOR ENGINEERING ANALYSIS

Increased frontal coil area.
Increased depth of coil.
Improved fan motor efficiency.
Improved fan blade efficiency.
Improved compressor efficiency.
Dual condensing heat exchangers.

These remaining technology options from Table IV.2 are briefly described below.

Increased Frontal Coil Area

Manufacturers of SPVACs and SPVHPs will often improve the effectiveness of a unit's heat exchangers by using a coil with a larger frontal area, which increases the total heat transfer surface area. Enlarging the frontal area of a condenser coil allows heat to be rejected from the refrigerant at a lower condensing temperature. Similarly, such changes to the evaporator coil allow air to be cooled at a higher refrigerant temperature. These changes (either individually, or in tandem) can reduce the pressure difference across the compressor, and thus reduce the required compressor power. Increases in frontal coil area are limited by two factors. Growth of the evaporator coil is limited because it must be able to dehumidify the indoor air at a higher evaporating temperature. Also, existing cabinet dimensions often cannot accommodate increases in frontal coil area without the incursion of additional costs to enlarge the cabinet.

Increased Depth of Coil

Manufacturers of SPVACs and SPVHPs may choose to increase heat exchanger efficiency by adding tube rows to the evaporator and/or condenser coils. Adding tube rows increases total heat transfer surface area, which decreases the required compressor power (similar to the effect of increased frontal coil area). Adding tube rows to a coil increases its depth. Due to cabinet size constraints, there are limits on how much the depth of the coil can be increased without requiring cabinet expansion. Also, increased coil depth may impose a greater static pressure drop for the fan motor to overcome such that adequate air flow can be maintained. Any added fan power requirements must be considered when assessing the net efficiency benefit of increasing coil depth.

Improved Fan Motor Efficiency

SPVU manufacturers use either permanent split capacitor (PSC) motors or brushless permanent magnet (BPM) motors to power the fans and blowers of the SPVU. BPM motors have higher efficiencies than PSC motors, but are also more expensive and require additional control hardware. In addition, BPM motors weigh more than PSC motors, and may necessitate some system redesign to accommodate their increased weight.

DOE found that PSC motors are the dominant motor design in lower efficiency units and BPM motors are commonly found in higher efficiency equipment. Based on market data, DOE found that, in general, at the 10 EER efficiency level manufacturers transition from using a PSC motor to using a BPM motor to power the indoor blower.

Improved Fan Blade Efficiency

Air system efficiency can be improved through more advanced fan and blower design and by reducing the restrictions to air flow. The air delivery system of an SPVU typically consists of two motors driving three fans: Two indoor blowers (which move air across the evaporator coil) and an outdoor fan (which moves air across the condenser coil). The evaporator blowers are typically centrifugal blowers, while the condenser fan is typically a propeller-type fan. Improvements to the fan blade designs could increase the overall efficiency by decreasing the power demands for the fan motor. Most SPVUs use forward-curved blowers, but some manufacturers have been experimenting with backward-curved blowers for their quieter performance and higher efficiencies. However, the space limitations within SPVUs make reduction of flow resistance difficult. Backward-curved fan blades were found in SPVUs at the max-tech efficiency level. DOE has not found any data quantifying the efficiency improvement of a backward-curved blower in SPVU models.

Improved Compressor Efficiency

The compressors used in SPVUs are almost exclusively scroll compressors, which use two interleaving scrolls to pump refrigerant throughout the sealed system. The compressor consumes the majority of the electrical input to an

SPVU (indoor and outdoor blower fans and controls account for the remainder). As such, utilizing a higher efficiency compressor yields a significant improvement to the EER/COP of an SPVU.

Based on physical teardowns, baseline efficiency SPVUs use single-speed compressors with lower peak-load EERs, whereas more-efficient SPVUs incorporate two-speed compressors with higher EERs in their designs.

Dual Condenser Heat Exchangers

In air-conditioning equipment, the effectiveness of a condenser at discharging heat into the outdoor air stream is directly related to the amount of surface area of the condenser heat exchanger coils.

In order to continue improving the efficiency of the condenser section of a unit when increasing the size of the condenser coil is uneconomical, SPVU manufacturers may utilize two separate condensing heat exchangers, rather than just one. Doing so allows the manufacturer to achieve the desired increase in total condenser coil surface area without the cost constraints of manufacturing a single, large condenser coil as an alternative.

Based on all available information, DOE did not change the screening analysis between the December 2014 NOPR and this final rule. Additional detail on the screening analysis is contained in chapter 4 of the final rule TSD.

C. Engineering Analysis

The engineering analysis establishes the relationship between an increase in energy efficiency of the equipment and the increase in manufacturer selling price (MSP) associated with that efficiency increase. This relationship serves as the basis for cost-benefit calculations for individual consumers, 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 higher efficiency levels for each equipment class.

1. Methodology

DOE has identified three basic methods for developing cost-efficiency curves: (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.

DOE conducted the engineering analysis presented in the December 2014 NOPR using a combination of the efficiency level and cost-assessment approaches for analysis of the EER and COP efficiency levels. More specifically, DOE identified the efficiency levels for the analysis based on the range of rated efficiencies of SPVAC and SPVHP equipment found in the AHRI database and manufacturer literature. DOE selected SPVAC and SPVHP equipment that was representative of the market at different efficiency levels, then purchased and reverse-engineered the selected equipment. DOE used the cost-assessment approach to determine the manufacturer production costs (MPCs) for SPVAC and SPVHP equipment across a range of efficiencies from the baseline to max-tech efficiency levels. The methodology used to perform the reverse-engineering analysis and derive the cost-efficiency relationship is described in chapter 5 of the final rule TSD.

2. Efficiency Levels for Analysis

The engineering analysis first identifies representative baseline equipment, which is the starting point for analyzing potential technologies that provide energy efficiency improvements. ''Baseline equipment'' refers to a model or models having features and technologies typically found in the least-efficient equipment currently available on the market. As described in the December 2014 NOPR, DOE identified 36,000 Btu/h (3-ton) as the representative cooling capacity for SPVACs and SPVHPs with a cooling capacity less than 65,000 Btu/h, and DOE identified 72,000 (6-ton) as the representative cooling capacity for SPVACs and SPVHPs with a cooling capacity greater than or equal to 65,000 Btu/h and less than 135,000 Btu/h. 79 FR at 78632. DOE identified some SPVHP models with a cooling capacity greater than or equal to 65,000 Btu/h and less than 135,000 Btu/h; however, it could not identify any models in this category with efficiency data available, so these units were not included in the engineering analysis. DOE did not find any models of SPVHP greater than or equal to 135,000 Btu/h on the market. DOE found some SPVAC models with cooling capacities greater than or equal to 135,000 Btu/h and less than 240,000 Btu/h; however, DOE did not consider these models in the engineering analysis due to a lack of available efficiency data.

Next, using the information DOE gathered during the market and technology assessment, DOE selected higher efficiency levels for analysis for the representative cooling capacities based on the most common equipment efficiencies on the market and efficiency levels that are typically achieved via substantial design changes, as well as the highest efficiency level on the market for each equipment class (*i.e.,* the max-tech level). Next, DOE identified typical technologies and features incorporated into equipment at these higher efficiency levels. To determine the appropriate COP heating mode efficiency levels for SPVHPs, DOE performed an analysis of how COP relates to EER. DOE reviewed the models in the database it compiled, and for each equipment class, DOE calculated the median COP for each EER efficiency level for analysis.

Table IV.3 and Table IV.4 list the efficiency levels analyzed for SPVUs. Due to changes in equipment efficiency certification ratings since the analysis conducted for the December 2014 NOPR, the max-tech efficiency level (EL) decreased from 12.3 EER to 12.0 EER. In addition, the median COP value at both EL 3 and EL 4 decreased from 3.9 COP to 3.7 COP. Because DOE could not find any SPVUs with cooling capacities ≥135,000 Btu/h and <240,000 that had efficiency data available, DOE did not analyze any efficiency levels for SPVACs or SPVHPs with cooling capacities ≥135,000 Btu/h and <240,000 Btu/h.

TABLE IV.3—EFFICIENCY LEVELS FOR ANALYSIS FOR SPVUS <65,000 BTU/H

Efficiency level	SPVACs, 36,000 Btu/h	SPVHPs, 36,000 Btu/h
EPCA Baseline *	9.0 EER	9.0 EER 3.0 COP
ASHRAE Baseline **	10.0 EER	10.0 EER 3.0 COP
EL1	10.5 EER	10.5 EER 3.2 COP
EL2	11.0 EER	11.0 EER 3.3 COP
EL3	11.75 EER	11.75 EER 3.7 COP
EL4 (max-tech)	12.0 EER	12.0 EER 3.7 COP

* Refers to the currently applicable Federal minimum efficiency level. See *http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/35.*

** Refers to the current minimum efficiency permitted by the latest version of the ASHRAE standard, ASHRAE 90.1–2013.

TABLE IV.4—EFFICIENCY LEVELS FOR ANALYSIS FOR SPVUS ≥65,000 BTU/H AND <135,000 BTU/H

Efficiency level	SPVACs, 72,000 Btu/h	SPVHPs, 72,000 Btu/h
EPCA Baseline	8.9 EER	8.9 EER 3.0 COP
ASHRAE Baseline (max-tech)	10.0 EER	10.0 EER 3.0 COP

DOE received multiple comments regarding the method that was used to correlate the EER and COP efficiency metrics for formulation of the efficiency levels analyzed in the December 2014 NOPR. AHRI opined that it is not appropriate to correlate increases in EER with COP, since manufacturers may choose to increase either cooling or heating performance levels without increasing the other. (AHRI, No. 19 at p. 30) Lennox also asserted that EER and COP are not necessarily related because product designs may be optimized for cooling or heating performance. (Lennox, No. 16 at p. 17)

DOE acknowledges that product designs may be optimized for either cooling or heating performance, and understands that EER and COP cannot be directly correlated in practice. In its analyses, DOE found that the EER efficiency distributions for SPVACs and SPVHPs are similar, and that the design options used to achieve each EER efficiency level are generally the same for SPVACs and SPVHPs. Due to the similar relationships of cooling mode efficiency ratings versus implementation of design options for both SPVACs and SPVHPs, DOE has determined that SPVHP equipment is usually optimized to achieve a certain cooling mode performance level, with heating mode performance as a secondary concern. This determination has also been confirmed by feedback from manufacturer interviews. As such, DOE believes that because design option implementation in SPVHPs is more closely aligned with changes in cooling mode efficiency ratings than changes in heating mode efficiency ratings, the efficiency levels analyzed for SPVHPs should be centered on cooling mode efficiency data. Therefore, with the understanding that changes in COP do not have a definitive relationship to changes in EER, DOE believes that selecting the median COP value for SPVHPs on the market at each EER efficiency level is the most market-representative way of analyzing trends between SPVHP design option implementation and heating mode efficiency ratings.

3. Teardown Analysis

After selecting a representative capacity for each equipment class, DOE selected equipment near both the representative capacity and the selected efficiency levels for each of the equipment classes that was directly analyzed via physical teardowns. DOE gathered information from these teardowns to create detailed bills of materials (BOMs) that included all components and processes used to manufacture the equipment. The teardown analysis allowed DOE to identify the technologies that manufacturers typically incorporate into their equipment, along with the efficiency levels associated with each technology or combination of technologies. The end result of each teardown is a structured BOM. The BOMs from the teardown analysis were used as inputs to calculate the MPC for each unit that was torn down. The MPCs resulting from the teardowns were used to develop an industry average MPC for each efficiency level analyzed in each equipment class. During the development of the engineering analysis, DOE held interviews with manufacturers to gain insight into the SPVU industry and to request feedback on the engineering analysis and assumptions that DOE used. DOE used the information it gathered from those interviews, along with the information obtained through the teardown analysis, to refine the assumptions and data in the cost model. For additional detail on the teardown process, see chapter 5 of the final rule TSD.

4. Incremental Efficiency Levels and Design Options

During the teardown process, DOE quantified the typical design options manufacturers use to reach specific efficiency levels, as well as the efficiency levels at which manufacturers tend to make major technological design changes. DOE determined that to improve efficiency from the current EPCA baseline efficiency level of 9 EER to 10 EER, manufacturers will usually increase the heat exchanger face area, which necessitates an increase in cabinet size. In addition, DOE determined from market data and teardown results that manufacturers will typically switch from using a PSC indoor blower motor to using a BPM motor to reach 10 EER. To increase efficiency from 10 EER to 10.5 EER, teardown data showed that manufacturers will typically increase the depth of one of the heat exchanger coils (either the evaporator or condenser) by adding another tube row. To increase from 10.5 EER to 11 EER, DOE found that manufacturers will add another tube row to the other heat exchanger coil that was not enlarged in the process of increasing efficiency from 10 EER to 10.5 EER. In the units torn down, both of these design changes were found to not necessitate an increase in cabinet size. To further increase efficiency from 11 EER to 11.75 EER, DOE determined that manufacturers will typically increase the face areas of both the evaporator and condenser heat exchanger coils, which necessitates an increase in cabinet size. In addition, DOE found that manufacturers will often utilize a higher efficiency compressor to reach 11.75 EER. To reach the 12.0 EER (max-tech) efficiency level, DOE found that manufacturers may switch from using a PSC outdoor fan motor to using a more-efficient BPM motor, as well as incorporate a high-efficiency fan blade for the outdoor fan. In addition, product data verified that manufacturers may also choose to increase the condensing heat exchanger face area by using two condensing heat exchangers rather than just one, which necessitates an increase in cabinet size.

DOE received multiple comments on the usage of BPM indoor blower motors as a design option to increase efficiency to 10 EER. AHRI stated that not all manufacturers will find it necessary to switch from a PSC to a BPM motor in order to reach the 10 EER efficiency level, but that BPM motors will likely be required to reach 11 EER. (AHRI, No. 19 at p. 34) Similarly, Lennox stated that while some manufacturers may choose to switch to a BPM motor as a means of achieving the 10 EER level, others may continue to use a PSC motor and instead modify heat transfer efficiency in order to reach 10 EER. (Lennox, No. 16 at p. 17) Friedrich stated that it would need to use a BPM motor to reach 10 EER. (Friedrich, No. 15 at p. 2) Additionally, National Coil Company stated that it currently uses BPM motors, in tandem with other means of improving energy efficiency, to achieve the 10 EER efficiency level in its products. (National Coil Company, No. 14 at p. 2) DOE understands that the usage of a BPM motor to reach the 10 EER efficiency level may not be required across all product lines by all manufacturers. However, DOE cannot determine specifically what share of SPVU product lines would not use a BPM motor to reach 10 EER, due to a lack of definitive data from stakeholders. In addition, market data indicates that a majority of SPVUs with efficiencies greater than or equal to 10 EER use BPM indoor blower motors. As a result, in the engineering analysis DOE has maintained the use of a BPM indoor blower motor as a required design option to reach the 10 EER efficiency level.

DOE also received multiple comments regarding the addition of heat exchanger coil rows as a design option to increase efficiency. Friedrich commented that it would need to increase the footprint of its units in order to add two additional heat exchanger coil rows. (Friedrich, NOPR Public Meeting Transcript, No. 11 at p. 111) AHRI commented that using the addition of two heat exchanger coil rows to increase efficiency from 10 to 11 EER may not be possible for all manufacturers, and that this design change will require some manufacturers to increase cabinet size for certain units, such as floor-mounted SPVUs. Additionally, AHRI stated that an increase in coil depth will negatively affect airside pressure drop, which may further complicate the design of the SPVU by requiring a larger fan motor. (AHRI, No. 19 at pp. 30–31) Bard commented that there are many different manufacturers and versions of SPVU products on the market, and it may not be possible to use the addition of tube rows to increase efficiency in all SPVU models without overcoming certain design hurdles. According to Bard, specific issues may include the need to jump cabinet sizes to a larger cabinet, as well as redesigning the entire backup electric heat system for particular models. (Bard, NOPR Public Meeting Transcript, No. 11 at pp. 92–93). Bard also commented that, in particular, the industry will have trouble reaching 11 EER in the higher capacity 5-ton units without increasing cabinet size. (Bard, No. 13 at p. 3) In addition, National Coil Company stated that simply adding rows of coil to their heat exchangers would not be sufficient to meet an 11 EER standard, and a complete redesign of their product lines would be needed. (National Coil Company, No. 14 at p. 2) DOE is aware that there are numerous SPVU product lines with unique characteristics, and that the applicability of design options will vary by manufacturer. In the engineering analysis, DOE estimated the aggregate industry cost of design changes to meet the efficiency levels analyzed by tearing down units that are representative of most models at each efficiency level. The teardown process provided definitive data that were used as a basis for determining the cost-efficiency relationship for market-representative SPVUs. DOE did not receive any additional, specific data from stakeholders that describe changes to particular units resulting from the addition of heat exchanger tube rows, that are not already accounted for in the engineering analysis. As a result, DOE was not able to modify the engineering analysis to model additional design changes; DOE did not receive any definitive engineering information to use as a platform for such adjustments.

Several stakeholders commented on the potential use of modeling to determine the energy efficiency impacts of design options. ASAP commented that when there is a technology proven in the market, but not incorporated in the specific product covered by the rulemaking, that DOE will typically use modeling to look at the impact of that technology. Specifically, ASAP asked whether DOE considered modeling the energy efficiency impact of MCHX technology. (ASAP, NOPR Public Meeting Transcript, No. 11 at p. 76) AHRI also noted that DOE has modeled the effect of technology options for other recent air-conditioning product rulemakings but not for this one. Further, AHRI noted that since the market for SPVUs is relatively small, it would likely take less time to develop a proper model for SPVUs. (AHRI, NOPR Public Meeting Transcript, No. 11 at pp. 77–81) NEEA expressed support of AHRI's suggestion that DOE model technology options for SPVUs, such as higher efficiency compressors and MCHXs. (NEEA, NOPR Public Meeting Transcript, No. 11 at pp. 91–92)

DOE acknowledges that in the rulemaking for CUACs (docket EERE–2014–BT–STD–0015), modeling was used to determine the effects on energy use of different technology options. In the analyses for that rulemaking, the integrated energy efficiency ratio (IEER) metric is used as the basis for differentiating the efficiency levels considered, which is different from the metric of EER, which is currently used to certify CUAC equipment. IEER is an efficiency metric that accounts for part load operations while EER is the full load efficiency measure. The AHRI Directory of Certified Product Performance provides IEER ratings as well as EER at the full load condition, but it does not provide detailed EERs at different part load conditions. DOE understands that part load operating characteristics of CUAC equipment are critical for accurate assessment of equipment energy use in the field. DOE conducted laboratory testing for CUAC equipment in order to understand the part load operations at different ambient conditions. However, DOE was limited by the number of units the Department could purchase, as well as laboratory testing capability. Therefore, DOE conducted equipment modeling using simulation programs to better understand the part load operations of CUAC equipment in order to more accurately characterize the energy use in the field. In the analyses for SPVUs, each efficiency level is distinguished by the full load EER rating. DOE elected not to use the same type of detailed equipment modeling for part load operations that was conducted for CUAC because the design options that can potentially impact part load efficiency do not impact EER, and were therefore not considered in the engineering analysis. However, equipment performance curves were used to model energy use.

For CUAC, modeling was also used in the engineering analysis to characterize the design changes needed to reach incrementally higher efficiency levels, because the large breadth of CUAC product offerings could not be accurately examined solely via a teardown analysis. For SPVUs, due to the relatively small number of product offerings, DOE determined that teardowns combined with analysis of product literature and published efficiency ratings were sufficient to accurately examine the design changes used in market-representative products to improve efficiency. As a result, modeling was not needed to determine the efficiency impacts of technology options currently used in SPVUs. Lastly, DOE did not model the efficiency impacts of MCHX technology on SPVUs. As explained in detail in section IV.B, DOE did not consider MCHX in the engineering analysis due to a lack of documentation regarding any improvements offered by MCHX to the overall energy efficiency of an SPVU.

For more information on the design options DOE considered at each efficiency level, see chapter 5 of the final rule TSD.

5. Cost Model

DOE developed a manufacturing cost model to estimate the MPC of SPVUs. The cost model is a spreadsheet model that converts the materials and components in the BOMs into dollar values based on the price of materials, average labor rates associated with fabrication and assembling, and the cost of overhead and depreciation, as determined based on manufacturer interviews and DOE expertise. To convert the information in the BOMs into dollar values, DOE collected information on labor rates, tooling costs, raw material prices, and other factors. For purchased parts, the cost model estimates the purchase price based on volume-variable price quotations and detailed discussions with manufacturers and component suppliers. For fabricated parts, the prices of raw metal materials (*e.g.,* tube, sheet metal) are estimates on the basis of 5-year averages (2010 to 2014). The cost of transforming the intermediate materials into finished parts is estimated based on current industry pricing. Additional details on the cost model are contained in chapter 5 of the final rule TSD.

6. Manufacturer Production Costs

Once the cost estimates for all the components in each teardown unit were finalized, DOE totaled the cost of materials, labor, depreciation, and overhead used to manufacture each type of equipment in order to calculate the MPC. The total cost of the equipment was broken down into two main costs: (1) The full MPC; and (2) the non-production cost, which includes selling, general, and administration (SG&A) costs; the cost of research and development; and interest from borrowing for operations or capital expenditures. DOE estimated the MPC at each efficiency level considered for each equipment class, from the baseline through the max-tech level. The incremental increases in MPC over the EPCA baseline efficiency level for each subsequently higher efficiency level in each equipment class are shown in Table IV.5. After incorporating all of the assumptions into the cost model, DOE calculated the percentages attributable to each element of total production costs (*i.e.,* materials, labor, depreciation, and overhead). These percentages are used to validate the assumptions by comparing them to manufacturers' actual financial data published in annual reports, along with feedback obtained from manufacturers during interviews. DOE uses these production cost percentages in the MIA.

TABLE IV.5—INCREMENTAL MPC INCREASES (2014$)

Equipment type	EPCA baseline	ASHRAE baseline	EL1	EL2	EL3	EL4
SPVACs <65,000 Btu/h	....	$271	$349	$427	$578	$917
SPVACs ≥65,000 Btu/h and <135,000 Btu/h	....	385	....	....	....	....
SPVHPs <65,000 Btu/h	....	316	407	498	673	1,069
SPVHPs ≥65,000 Btu/h and <135,000 Btu/h	....	449	....	....	....	....

7. Cost-Efficiency Relationship

The result of the engineering analysis is a cost-efficiency relationship, which depicts how changes in the energy efficiency of SPVUs drive changes in MSP. DOE created a separate cost-efficiency relationship at the representative cooling capacity for each of the four equipment classes analyzed. DOE reported the MPCs for the units analyzed in the teardown analysis in aggregated form to maintain confidentiality of sensitive component data. DOE obtained input from manufacturers during the manufacturer interview process on the MPC estimates and assumptions to confirm their accuracy. For SPVACs with a cooling capacity <65,000 Btu/h, DOE performed physical teardowns supplemented with virtual teardowns to develop cost-efficiency relationships for each manufacturer analyzed in the teardown analysis, and then created a market-share-weighted relationship based on approximate market share data obtained during manufacturer interviews. For SPVACs with a cooling capacity ≥65,000 Btu/h and <135,000 Btu/h, DOE performed virtual teardowns of a 6-ton SPVAC and determined the average percentage increase in cost from a 3-ton SPVAC to a 6-ton SPVAC. Then, DOE scaled the 3-ton cost-efficiency curve by that average percentage increase in cost. Likewise for SPVHPs with a cooling capacity <65,000 Btu/h, DOE performed a physical teardown and compared the average percentage increase in cost of a 3-ton SPVHP compared to a 3-ton SPVAC. DOE applied this average percentage increase in cost to the cost-efficiency curve for both SPVACs with a cooling capacity <65,000 Btu/h and SPVACs with a cooling capacity ≥65,000

Btu/h and <135,000 Btu/h to obtain the respective cost-efficiency curves for both SPVHP equipment classes.

In order to develop the final cost-efficiency relationships for SPVUs, DOE examined the cost differential to move from one efficiency level to the next for each manufacturer analyzed in the teardown analysis. DOE used the results of the teardowns on a market-share weighted average basis to determine the industry average cost increase to move from one efficiency level to the next. Additional details on how DOE developed the cost-efficiency relationships and related results, as well as a presentation of the final results, are available in chapter 5 of the final rule TSD.

8. Manufacturer Markup

To account for manufacturers' non-production costs and profit margin, DOE applies a non-production cost multiplier (the manufacturer markup) to the full MPC. The resulting MSP is the price at which the manufacturer can recover all production and non-production costs and earn a profit. To meet new or amended energy conservation standards, manufacturers often introduce design changes to their equipment lines that result in increased MPCs. Depending on competitive pressures, some or all of the increased production costs may be passed from manufacturers to retailers and eventually to customers in the form of higher purchase prices. As production costs increase, manufacturers typically incur additional overhead. The MSP should be high enough to recover the full cost of the equipment (*i.e.,* full production and non-production costs) and yield a profit. The manufacturer markup has an important bearing on profitability. A high markup under a standards scenario suggests manufacturers can readily pass along the increased variable costs and some of the capital and product conversion costs (the one-time expenditure) to customers. A low markup suggests that manufacturers will not be able to recover as much of the necessary investment in plant and equipment.

DOE normally develops the manufacturer markup through an examination of corporate annual reports and Securities and Exchange Commission (SEC) 10–K reports; however, in the case of SPVU manufacturers, DOE did not feel this process would be representative of the majority of the industry, because most SPVU manufacturers are privately held companies. Therefore, DOE based the manufacturer markup for the SPVU industry on the markup used for the package terminal air conditioner and package terminal heat pump (PTAC/PTHP) final rule published in the **Federal Register** on October 7, 2008 (73 FR 58772), and sought manufacturer feedback on this markup number during the interview process. DOE used the PTAC manufacturer markup because it is a comparable industry to the SPVU industry in terms of the size of the market (*i.e.,* the number of annual shipments) and the types of equipment on the market (*i.e.,* both are commercial air conditioners of similar capacities). DOE estimated the average manufacturer markup for the SPVU industry to 1.28. See chapter 5 of the final rule TSD for additional details.

9. Shipping Costs

Manufacturers of HVAC equipment typically pay for shipping to the first step in the distribution chain. Freight is not a manufacturing cost, but because it is a substantial cost incurred by the manufacturer, DOE is accounting for shipping costs of SPVUs separately from other non-production costs that comprise the manufacturer markup. To calculate the MSP for SPVUs, DOE first multiplied the MPC at each efficiency level (determined from the cost model) by the manufacturer markup, and then added the shipping costs for equipment at that given efficiency level. Chapter 5 of the final rule TSD contains details about DOE's shipping cost assumptions and DOE's shipping cost estimates.

10. Manufacturer Interviews

As noted in the preceding section, throughout the rulemaking process, DOE has sought and continues to seek feedback and insight from interested parties that would improve the information used in its analysis. DOE interviewed manufacturers as part of the NOPR MIA. During the interviews, DOE sought feedback on all aspects of its analyses for SPVUs. For the engineering analysis, DOE discussed the analytical assumptions and estimates, cost model, and cost-efficiency curves with SPVU manufacturers. DOE considered all the information manufacturers provided when refining the cost model and assumptions. However, DOE incorporated data and information specific to individual manufacturers into the analysis as averages in order to avoid disclosing sensitive information about individual manufacturers' equipment or manufacturing processes. More detail about the manufacturer interviews is contained in chapter 12 of the final rule TSD.

D. Markups To Determine Equipment Price

The markups analysis develops appropriate markups in the distribution chain to convert the estimates of MSP to consumer prices. (''Consumer'' 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 consumer price.

DOE understands that the price of SPVU equipment depends on the distribution channel the customer uses to purchase the equipment. Typical distribution channels for most commercial HVAC equipment include shipments that may pass through manufacturers' national accounts, or through entities including wholesalers, mechanical contractors, and/or general contractors. However, DOE understands that there are multiple branched distribution channels for SPVU equipment for both new construction and replacement equipment. For SPVU equipment, the new equipment distribution channel is one in which SPVU equipment is sold directly or indirectly to manufacturers of wood and non-wood modular buildings, and the rest of the supply chain is essentially the chain of manufacturing, wholesaling, and contractor support for wood and non-wood modular buildings. The distribution channel for replacement equipment goes directly, or through air conditioning wholesalers/distributors, to mechanical contractors who install replacements on behalf of customers, or to wholesalers/distributors of modular buildings, who own leased fleets of modular buildings and who are assumed to perform their own SPVU replacements in their leased fleets.

DOE developed supply chain markups in the form of multipliers that represent increases above equipment purchase costs for air-conditioning equipment wholesalers/distributors, modular building manufacturers and wholesalers/distributors, and mechanical contractors and general contractors working on behalf of customers. DOE applied these markups (or multipliers) to each distribution channel entity's costs that were developed from the engineering analysis. DOE then included sales taxes and installation costs (where appropriate) to arrive at the final installed equipment prices for baseline and higher-efficiency equipment. DOE identified two separate distribution channels for SPVU equipment to describe how the equipment passes from the equipment manufacturer to the customer, as presented in Table IV.6.

TABLE IV.6—DISTRIBUTION CHANNELS FOR SPVU EQUIPMENT

Channel 1 New SPVU equipment	*Channel 2* Replacement SPVU equipment
Air-Conditioning Wholesale Distributor or Manufacturer's Representative.	Air-Conditioning Wholesale Distributor or Manufacturer's Representative.
Modular Building Manufacturer	Mechanical Contractor or Modular Building Distributor.
Modular Building Distributor or General Contractor	
Customer	Customer.

DOE developed baseline and incremental markups based on available financial data. More specifically, DOE based the air-conditioning wholesaler/distributor markups on data from the Heating, Air Conditioning, and Refrigeration Distributors International (HARDI) 2013 Profit Report.[26] DOE also used financial data from the 2007 U.S. Census Bureau [27] for the wood [28] and non-wood [29] modular building manufacturing industries; concrete product manufacturing sector; [30] the wood [31] and non-wood [32] modular building wholesale industries; brick, stone, and related construction material merchant wholesalers [33]; the plumbing, heating, and air-conditioning contractor industry [34]; and the non-residential general contractor industries [35] to estimate markups for all of these sectors.

The overall markup is the product of all the markups (baseline or incremental markups) for the different steps within a distribution channel, and sales tax. DOE calculated sales taxes based on 2014 State-by-State sales tax data reported by the Sales Tax Clearinghouse.[36] Because both distribution channel costs and sales tax vary by State, DOE allowed markups due to distribution channel costs and sales taxes within each distribution channel to vary by State. No information was available to develop State-by-State distributions of SPVU equipment by building type or business type, so the distributions of sales by business type are assumed to be the same in all States. The national distribution of the markups varies among business types. Chapter 6 of the final rule TSD provides additional detail on markups.

DOE requested comment regarding the selected distribution channels and the shipments through each channel as outlined in the NOPR. DOE did not specifically receive comment on the selected channels, but did receive comments regarding incremental markups. AHRI commented that incremental markups understate the cost to manufacturers and end user of the proposed standards. (AHRI, No. 19 at pp. 2, 25) Lennox commented that baseline markups get carried through to the end user in all efficiency ranges. (Lennox, NOPR Public Meeting Transcript, No. 11 at p. 129) Downstream markups do not affect manufacturer MSPs or MPCs, and the Department maintains that incremental markups are applicable and reasonable to use in the markups analysis.

E. Energy Use Analysis

The energy use analysis provides estimates of the annual unit energy consumption (UEC) of SPVAC and SPVHP equipment at the considered efficiency levels. The annual UECs are used in subsequent analyses.

Approximately 35 percent of SPVAC shipments go to educational facilities, the majority of which are for space conditioning of modular classroom buildings. Additionally, approximately 35 percent of the shipments go to providing cooling for telecommunications and electronics enclosures. The remainder of all shipments (30 percent) are used in a wide variety of commercial buildings, including offices, temporary buildings, and some miscellaneous facilities. In almost all of these commercial building applications, the buildings served are expected to be of modular construction, because SPVUs, as packaged air conditioners installed on external building walls, do not impact site preparation costs for modular buildings, which may be relocated multiple times over the building's life. The vertically oriented configuration of SPVUs allows the building mounting to be unobtrusive and minimizes impacts on modular building transportation requirements. These advantages do not apply to a significant extent in site-constructed buildings. DOE also modeled shipments of SPVHP equipment to primarily

[26] Heating, Air-conditioning & Refrigeration Distributors International (HARDI), 2013 Profit Report (2012 Data) (Available at: *http://www.hardinet.org/Profit-Report*).

[27] The U.S. Census Bureau conducts an economic census every 5 years. The 2012 Economic Census may become available early in 2015; if so, the final rule analysis will be updated with data from the 2012 Economic Census.

[28] U.S. Census Bureau. 2007. Prefabricated Wood Building Manufacturing. Sector 32: 321992. Table EC073111 Manufacturing: Industry Series: Detailed Statistics by Industry for the United States: 2007. (Available at *http://factfinder2.census.gov/faces/nav/jsf/pages/searchresults.xhtml?ref=top&refresh=t#none*)

[29] U.S. Census Bureau. 2007. Prefabricated Metal Building and Component Manufacturing. Sector 33: 332311. EC073111 Manufacturing: Industry Series: Detailed Statistics by Industry for the United States: 2007 (Available at: *http://factfinder2.census.gov/faces/nav/jsf/pages/searchresults.xhtml?ref=top&refresh=t#none*).

[30] U.S. Census Bureau. 2007. Other Concrete Product Manufacturing Sector 32: 327390. EC073111 Manufacturing: Industry Series: Detailed Statistics by Industry for the United States: 2007 (Available at: *http://factfinder2.census.gov/faces/nav/jsf/pages/searchresults.xhtml?ref=top&refresh=t#none*).

[31] U.S. Census Bureau. 2007. 423310 Lumber, plywood, millwork, and wood panel merchant wholesalers. EC0742SXSB06. Wholesale Trade: Subject Series—Misc Subjects: Gross Margin and its Components for Merchant Wholesalers for the United States: 2007. (Available at: *http://factfinder2.census.gov/faces/nav/jsf/pages/searchresults.xhtml?ref=top&refresh=t#none*).

[32] U.S. Census Bureau. 2007. 423390 Other construction material merchant wholesalers. EC0742SXSB06. Wholesale Trade: Subject Series—Misc Subjects: Gross Margin and its Components for Merchant Wholesalers for the United States: 2007. (Available at: *http://factfinder2.census.gov/faces/nav/jsf/pages/searchresults.xhtml?ref=top&refresh=t#none*).

[33] U.S. Census Bureau. 2007. Brick, stone, and related construction material merchant wholesalers: 2007. Sector 42: 423320 Other Construction Material Merchant Wholesalers. Brick, stone, and related construction material merchant wholesalers: Merchant wholesalers, except manufacturers' sales branches and offices. Detailed Statistics by Industry for the United States: 2007. (Available at: *http://factfinder2.census.gov/faces/nav/jsf/pages/searchresults.xhtml?ref=top&refresh=t#none*).

[34] U.S. Census Bureau. 2007. Sector 23: 238220. Plumbing, heating, and air-conditioning contractors. EC0723I1: Construction: Industry Series: Preliminary Detailed Statistics for Establishments: 2007. (Available at: *http://factfinder2.census.gov/faces/nav/jsf/pages/searchresults.xhtml?ref=top&refresh=t#none*).

[35] U.S. Census Bureau. 2007. Sector 23: 236220. Commercial and institutional building construction. EC0723I1: Construction: Industry Series: Preliminary Detailed Statistics for Establishments: 2007. (Available at: *http://factfinder2.census.gov/faces/nav/jsf/pages/searchresults.xhtml?ref=top&refresh=t#none*).

[36] The Sales Tax Clearing House (2014) (Last accessed Feb. 16, 2015) (Available at: *www.thestc.com/STrates.stm*).

educational facilities or office-type end uses, but notes that SPVHPs would be infrequently used for telecommunication or electronics enclosures for which the heating requirements are often minimal.

DOE analyzed energy use in three different classes of commercial buildings that utilize SPVU equipment: (1) Modular classrooms; (2) modular offices; and (3) telecommunications shelters. To estimate the energy use of SPVU equipment in these building types, DOE developed building simulation models for use with DOE's EnergyPlus software.[37] A prototypical building model was developed for each building type, described by the building footprint, general building size, and design. The building types were represented by a 1,568 ft^2 wood-frame modular classroom, a 1,568 ft^2 wood-frame modular office, and a 240 ft^2 concrete-wall telecommunication shelter. In each case, the building construction (footprint, window-wall ratio, general design) was developed to be representative of typical designs within the general class of building. Operating schedules, internal load profiles, internal electric receptacle (plug) loads, and occupancy for the modular classroom were those from classroom-space-type data found in the DOE Primary School commercial prototype building model.[38] Operating schedules, internal load profiles, internal plug loads, and occupancy for modular office buildings were those from office space in the DOE Small Office commercial prototype building model. *Id.* For the telecommunications shelters, DOE did not identify a source for typical representative internal electronic loads as a function of building size, nor did it find information on representative internal gain profiles. However, based on feedback from shelter manufacturers, DOE used a 36,000 Btu/h (10.55 kW) peak internal load to reflect internal design load in the shelter. DOE determined that on average over a given year, this load ran at a scheduled 65 percent of peak value, reflecting estimates for computer server environments.[39] Each of these three building models was used to establish the energy usage of SPVAC and SPVHP equipment in the same building class.

Envelope performance (*e.g.,* wall, window, and roof insulation, and window performance) and lighting power inputs were based on requirements in ASHRAE Standard 90.1–2004.[40] DOE believes that the requirements in ASHRAE Standard 90.1–2004 are sufficiently representative of a mixture of both older and more recent construction[41] and that resulting SPVU equipment loads will be representative of typical SPVU equipment loads in the building stock. Ventilation levels were based on ASHRAE Standard 62.1–2004.[42]

DOE simulated each building prototype in each of 237 U.S. climate locations, taking into account variation in building envelope performance for each climate as required by ASHRAE 90.1–2004. For simulations used to represent the less than 65,000 Btu/h SPVU equipment, no outside air economizers were assumed for the modular office and modular classroom buildings.[43] However, for simulations used to represent greater than or equal to 65,000 Btu/h but less than 135,000 Btu/h equipment, economizer usage was presumed to be climate-dependent in these building types, based on ASHRAE Standard 90.1–2004 requirements for unitary equipment in that capacity range. For the telecommunications shelters, economizers were assumed to operate in 45 percent of buildings, based on multiple comments received in the NOPR stage of this rulemaking.

DOE's understanding is that the 54,000 Btu/h limit introduced in ASHRAE Standard 90.1–2010 is for comfort cooling applications and that ASHRAE Standard 90.1 has separate economizer requirements for computer rooms (generally defined as a space where the primary function is to house equipment for processing of electronic data and which has a design electronics power density exceeding 20 W/ft^2—as would be typical of a telecommunication shelter).[44] These computer room economizer requirements begin to require economizers only for fan cooling units greater than or equal to 65,000 Btu/h and at that threshold only for certain climate zones. The comfort cooling requirements in ASHRAE Standard 90.1, to the extent they are adopted by local jurisdictions, would appear not to apply to telecommunications shelters. And, if such requirements were to apply, they would do so only for a fraction of the products in the less than 65,000 Btu/h SPVU market. For these reasons, DOE maintained its NOPR analysis assumption regarding economizers for this final rule by implementing economizer use in 45 percent of the SPVAC units used in telecommunication shelters. Users of the SPVU LCC spreadsheet can change the percentage of equipment using economizers to see the impact of different weights. In addition, for telecommunication shelters, redundant identical air conditioners with alternating usage were assumed when establishing average annual energy consumption per unit.

Simulations were done for the buildings using SPVAC equipment and electric resistance heating, and then a separate set of simulations was done for buildings with SPVHP equipment. For each equipment type and building type combination, DOE simulated each efficiency level identified in the engineering analysis for each equipment class. Fan power at these efficiency levels was based on manufacturer's literature and reported fan power consumption data as developed in the engineering analysis. BPM supply air blower motors were assumed at an EER of 10.0 and higher for all classes of equipment based on results from the engineering analysis. The supply air blower motors are assumed to run at constant speed and constant power while operating.

DOE used typical meteorological weather data (TMY3) for each location in the simulations.[45] DOE sized equipment for each building simulation using a design day sizing method incorporating the design data found in the EnergyPlus design-day weather data

[37] EnergyPlus Energy Simulation Software and documentation are available at: *http://apps1.eere.energy.gov/buildings/energyplus/.*

[38] The commercial prototype building models are available on DOE's Web site as Energy Plus input files at: *http://www.energycodes.gov/development/commercial/90.1_models.* Documentation of the initial model development is provided in: Deru, M., *et al., U.S. Department of Energy Commercial Reference Building Models of the National Building Stock,* NREL/TP–5500–46861 (2011).

[39] EnergyConsult Pty Ltd., *Equipment Energy Efficiency Committee Regulatory Impact Statement Consultation Draft: Minimum Energy Performance Standards and Alternative Strategies for Close Control Air Conditioners,* Report No 2008/11 (2008) (Available at: *www.energyrating.gov.au*).

[40] ASHRAE, *Energy Standard for Buildings Except Low-Rise Residential Buildings,* ANSI/ASHRAE/IESNA Standard 90.1–2004 (2005).

[41] ASHRAE 90.1–2004 is still one of the prevailing building codes for the design of new commercial buildings. In addition, a large percentage of existing buildings were built in accordance with earlier versions of ASHRAE Standard 90.1.

[42] ASHRAE, *Ventilation for Acceptable Indoor Air Quality,* ANSI/ASHRAE/IESNA Standard 62.1–2004 (2004).

[43] An ''outside air economizer'' is a combination of ventilation and exhaust air dampers and controls that increase the amount of outside air brought in to a building when the outside air conditions (*i.e.,* temperature and humidity) are low, such that increasing the amount of ventilation air reduces the equipment cooling loads.

[44] DOE notes that these requirements introduced in ASHRAE Standard 90.1.2010 continued unchanged in ASHRAE Standard 90.1–2013.

[45] Wilcox S. and W. Marion, *User's Manual for TMY3 Data Sets,* National Renewable Energy Laboratory, Report No. NREL/TP–581–43156 (2008).

files for each climate.[46] DOE also incorporated an additional cooling sizing factor of 1.1 for the equipment used in the modular office and modular classroom simulations, reflective of the typical sizing adjustment needed to account for discrete available equipment capacities in SPVAC and SPVHP equipment.

EER and heating COP were converted to corresponding simulation inputs for each efficiency level simulated. These inputs, along with the calculated fan power at each efficiency level, were used in the building simulations. Further details of the building model and the simulation inputs for the SPVAC and SPVHP equipment can be found in chapter 7 of the final rule TSD.

From the annual simulation results for SPVAC equipment, DOE extracted the condenser energy use for cooling, the supply air blower energy use for both heating and cooling hours, the electric resistance heating energy, and the equipment capacity for each building type, climate, and efficiency level. From these, DOE developed corresponding normalized annual cooling energy per cooling ton and annual blower energy per ton for the efficiency levels simulated. DOE also developed the electrical heating energy per ton for the building. These per-ton cooling and blower energy values were added together and then multiplied by the average cooling capacity estimated for the equipment class simulated to arrive at an initial energy consumption estimate for SPVACs. DOE calculated a heating ''take back'' effect for higher efficiency levels as a deviation from the baseline heating energy use for each equipment capacity. The final SPVAC energy consumption estimates were then based on the calculated cooling and supply blower energy uses plus this heating take back, which allowed the resulting energy savings estimates to correctly account for the heating energy increase during the year. In addition, it was estimated that 5 percent of the market for the SPVACs less than 65,000 Btu/h class utilize gas furnace heating. The heating take back for these systems was estimated based on the heating load of the systems with electric resistance heat and assuming an average 81-percent furnace annual fuel utilization efficiency.

The analytical method for SPVHPs was carried out in a similar fashion; however, for heat pumps, DOE included the heating energy (compressor heating and electric resistance backup) directly from the simulation results and, thus, did not separately calculate a heating take back effect. From these data, DOE developed per-ton energy consumption values for cooling, supply blower, and heating electric loads. These per-ton energy figures were summed and multiplied by the nominal capacity for the equipment class simulated to arrive at the annual per-ton energy consumption for SPVHPs for each combination of building type, climate, and efficiency level.

For each combination of equipment class, building type, climate, and efficiency level, DOE developed UEC values for each State using weighting factors to establish the contribution of each climate in each State. Once State-level UEC estimates were established, they were provided as input to the LCC analysis. National average UEC estimates for each equipment class and efficiency level were also established based on population-based weighting across States and shipment weights to the different building types. With regard to the latter, while DOE established shipment weights for SPVAC equipment related to the three building types (educational, office, and telecommunications), DOE determined that SPVHP equipment was not used to a significant extent in telecommunication facilities and, thus, only allocated shipments of SPVHP equipment to two building types: educational and office.

For details of this energy use analysis, see chapter 7 of the final rule TSD.

Table IV.7 shows the annual UEC estimates for SPVACs and SPVHPs corresponding to the efficiency levels analyzed.

TABLE IV.7—NATIONAL UEC ESTIMATES FOR SPVAC AND SPVHP EQUIPMENT

Efficiency level	Equipment class				
	SPVACs, <65 kBtu/h		SPVHPs, <65 kBtu/h	SPVACs, ≥65 and <135 kBtu/h	SPVHPs, ≥65 and <135 kBtu/h
	kWh/yr	Gas kBtu/yr *	kWh/yr	kWh/yr	kWh/yr
EPCA Baseline	6,880	—	20,921	13,743	41,721
ASHRAE Baseline **	6,175	54	20,383	12,251	40,589
EL1	5,923	54	19,921	NA	NA
EL2	5,694	54	19,629	NA	NA
EL3	5,387	54	18,924	NA	NA
EL4 **	5,300	54	18,858	NA	NA

* Calculated average gas heating ''take back'' based on 5 percent of market with gas heat.
** ASHRAE baseline represents max-tech levels established for SPVACs and SPVHPs greater than or equal to 65,000 Btu/h, but less than 135,000 Btu/h. EL 4 represents max-tech levels established for SPVACs and SPVHPs less than 65,000 Btu/h.

DOE received multiple comments during the NOPR public meeting and public comment period regarding the use of economizers in telecommunication shelters. AHRI commented that energy savings currently realized through the use of economizers could be greater than that determined by DOE in the NOPR due to the more pervasive use of economizers. AHRI suggested that 40 to 80 percent of units used in telecommunication shelters use this operating feature. (AHRI, No. 19 at pp. 31, 35) Bard commented that 40 to 45 percent of the units in the telecommunication shelter market use economizers. (Bard, No. 13 at p. 2) Consistent with these suggestions, DOE's final rule maintains the assumptions made for the NOPR analysis, which is that 45 percent of all telecommunication shelters use economizers.

[46] EnergyPlus TMY3-based weather data files and design day data files are available at: *http://apps1.eere.energy.gov/buildings/energyplus/weatherdata_about.cfm.*

F. Life-Cycle Cost and Payback Period Analysis

DOE conducted the LCC and PBP analysis to estimate the economic impacts of potential standards on individual consumers of SPVU equipment. DOE first analyzed these impacts for SPVU equipment by calculating the change in consumers' LCCs likely to result from higher efficiency levels compared with the EPCA and ASHRAE baseline efficiency levels for the SPVU classes discussed in the engineering analysis. The LCC calculation considers total installed cost (equipment cost, sales taxes, distribution chain markups, and installation cost), operating expenses (energy, repair, and maintenance costs), equipment lifetime, and discount rate. DOE calculated the LCC for all customers as if each would purchase an SPVU unit in the year the standard takes effect. DOE presumes that the purchase year for all SPVU equipment for purposes of the LCC calculation is 2015, the compliance date for the energy conservation standard equivalent to the levels in ASHRAE 90.1–2013 (for the EPCA baseline), or 2019, the compliance date for the energy conservation standard more stringent than the corresponding levels in ASHRAE 90.1–2013 (for the ASHRAE baseline). To compute LCCs, DOE discounted future operating costs to the time of purchase and summed them over the lifetime of the equipment.

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

DOE conducted the LCC and PBP analysis using a commercially available spreadsheet tool and a purpose-built spreadsheet model, available on DOE's Web site.[47] This spreadsheet model developed by DOE accounts for variability in energy use and prices, installation costs, repair and maintenance costs, and energy costs. It uses weighting factors to account for distributions of shipments to different building types and States to generate national LCC savings by efficiency level. The results of DOE's LCC and PBP analysis are summarized in section V.B.1 and described in detail in chapter 8 of the final rule TSD.

1. Approach

Recognizing that each business that uses SPVU equipment is unique, DOE analyzed variability and uncertainty by performing the LCC and PBP calculations assuming a correspondence between five types of businesses (education, telecommunications, construction and mining firms occupying temporary offices, a variety of service and retail firms occupying conventional office space, and health care firms) for customers located in three types of commercial buildings (telecommunications, education, and office). DOE developed financial data appropriate for the customers in each business and building type. Each type of building has typical customers who have different costs of financing because of the nature of the business. DOE derived the financing costs based on data from the Damodaran Online Web site.[48]

The LCC analysis used the estimated annual energy use for each SPVU equipment unit described in section IV.E. Because energy use of SPVU equipment is sensitive to climate, energy use varies by State. Aside from energy use, other important factors influencing the LCC and PBP analysis are energy prices, installation costs, equipment distribution markups, and sales tax. All of these factors are assumed to vary by State. At the national level, the LCC spreadsheets explicitly model both the uncertainty and the variability in the model's inputs, using probability distributions based on the shipments of SPVU equipment to different States.

As mentioned earlier, DOE generated LCC and PBP results by business type within building type and State and developed weighting factors to generate national average LCC savings and PBPs for each efficiency level. As there is a unique LCC and PBP for each calculated value at the building type and State level, the outcomes of the analysis can also be expressed as probability distributions with a range of LCC and PBP results. A distinct advantage of this type of approach is that DOE can identify the percentage of customers achieving LCC savings or attaining certain PBP values due to an increased efficiency level, in addition to the average LCC savings or average PBP for that efficiency level.

2. Life-Cycle Cost Inputs

For each efficiency level DOE analyzed, the LCC analysis required input data for the total installed cost of the equipment, its operating cost, and the discount rate. Table IV.8 summarizes the inputs and key assumptions DOE used to calculate the consumer economic impacts of all energy efficiency levels analyzed in this rulemaking. A more detailed discussion of the inputs follows.

TABLE IV.8—SUMMARY OF INPUTS AND KEY ASSUMPTIONS USED IN THE LCC AND PBP ANALYSIS

Inputs	Description
Affecting Installed Costs	
Equipment Price	Equipment price was derived by multiplying manufacturer sales price or MSP (calculated in the engineering analysis) by distribution channel markups, as needed, and sales tax from the markups analysis.
Installation Cost	Installation cost includes installation labor, installer overhead, and any miscellaneous materials and parts, derived from *RS Means CostWorks 2014*.[49]

[47] See *http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/35*.

[48] Damodaran Online (Last accessed Feb. 14, 2014) (Available at: *http://pages.stern.nyu.edu/~adamodar/New_Home_Page/home.htm*).

TABLE IV.8—SUMMARY OF INPUTS AND KEY ASSUMPTIONS USED IN THE LCC AND PBP ANALYSIS—Continued

Inputs	Description
	Affecting Operating Costs
Annual Energy Use	Annual unit energy consumption for each class of equipment at each efficiency level estimated by state and building type using simulation models and a population-based mapping of climate locations to states.
Electricity Prices, Natural Gas Prices	DOE developed average electricity prices based on EIA Form 826 data for 2014.[50] Future electricity prices are projected based on Annual Energy Outlook 2015 (*AEO2015*).[51] DOE developed natural gas prices based on EIA state-level commercial prices in EIA data navigator.[52] Future natural gas prices are projected based on *AEO2015*.
Maintenance Cost	DOE estimated annual maintenance costs based on RS Means CostWorks 2014 for small, single-zone rooftop commercial air conditioning equipment. Annual maintenance cost did not vary as a function of efficiency.
Repair Cost	DOE estimated the annualized repair cost for baseline-efficiency SPVU equipment based on cost data from RS Means CostWorks 2014 for small, single-zone rooftop commercial air conditioning equipment. DOE assumed that the materials and components portion of the repair costs would vary in direct proportion with the MSP at higher efficiency levels because it generally costs more to replace components that are more efficient.
	Affecting Present Value of Annual Operating Cost Savings
Equipment Lifetime	DOE estimated that SPVU equipment lifetimes range between 10 and 25 years, with an average lifespan of 15 years, based on estimates cited in available packaged air conditioner literature.[53 54 55]
Discount Rate	Mean real discount rates for all buildings range from 2.6 percent for education buildings to almost 10.5 percent for some office building owners.
Analysis Start Year	Start year for LCC is 2019, which is the earliest compliance date that DOE can set for new standards if it adopts any efficiency level for energy conservation standards higher than that shown in ASHRAE Standard 90.1–2013.
	Analyzed Efficiency Levels
Analyzed Efficiency Levels	DOE analyzed the ASHRAE baseline efficiency levels and up to four higher efficiency levels for SPVUs <65,000 Btu/h and only the ASHRAE baseline for SPVUs >65,000 Btu/h. See the engineering analysis for additional details on selections of efficiency levels and cost.

DOE analyzed the EPCA and ASHRAE baseline efficiency levels (reflecting the efficiency levels in ASHRAE Standard 90.1–2013) and up to four higher efficiency levels for SPVUs <65,000 Btu/h. Chapter 5 of the final rule TSD provides additional details on selections of efficiency levels and cost.

a. Equipment Prices

The price of SPVU equipment reflects the application of distribution channel markups (mechanical contractor markups) and sales tax to the MSP, which is the cost established in the engineering analysis. As described in section IV.D, DOE determined distribution channel costs and markups for air-conditioning equipment. For each equipment class, the engineering analysis provided contractor costs for the ASHRAE baseline equipment and up to four higher equipment efficiencies.

The markup is the percentage increase in price as the SPVU equipment passes through distribution channels. As explained in section IV.D, SPVU equipment is assumed to be delivered by the manufacturer through a variety of distribution channels. If the SPVU equipment is for a new installation, it is assumed to be sold as a component of a new modular building. There are several distribution pathways that involve different combinations of the costs and markups of air-conditioning equipment wholesaler/distributors, manufacturers of modular buildings, and wholesalers/distributors of modular buildings. In some cases, a general contractor is also involved for site preparation and management. Some replacement equipment is assumed to be sold directly to mechanical contractors and to wholesalers/distributors of modular buildings, but some is sold through air-conditioning equipment wholesalers/distributors to these same entities. The overall markups used in LCC analyses are weighted averages of all of the relevant distribution channel markups.

To project an MSP price trend for the final rule, DOE derived an inflation-

[49] RS Means CostWorks 2014, R.S. Means Company, Inc. (2013) (Last accessed on February 27, 2014) (Available at: *www.meanscostworks.com/*).

[50] U.S. Energy Information Administration. Electric Sales, Revenue, and Average Price 2014, Select table Sales and Revenue Data by State, Monthly Back to 1990 (Form EIA–826), (Last accessed on April 17, 2015) (Available at: *http://www.eia.gov/cneaf/electricity/page/sales_revenue.xls*).

[51] U.S. Energy Information Administration. *Annual Energy Outlook 2015* (2015) DOE/EIA–0383(2015). (Last Accessed April 18, 2015) (Available at: *http://www.eia.gov/forecasts/aeo/data.cfm*).

[52] U.S. Energy Information Administration. Average Price of Natural Gas Sold to Commercial Consumers—by State. (Last accessed on February 17, 2014) (Available at: *http://www.eia.gov/dnav/ng/ng_pri_sum_a_EPG0_PCS_DMcf_a.htm*).

[53] ASHRAE, ASHRAE Handbook: 2011 Heating, Ventilating, and Air-Conditioning Applications (2011).

[54] Abramson, Interactive Web-based Owning and Operating Cost Database, Final Report ASHRAE Research Project RP–1237 (2005).

[55] Energy Efficient Strategies Pty Ltd., Equipment Energy Efficiency Committee Regulatory Impact Statement Consultation Draft. Revision to the Energy Labelling Algorithms and Revised MEPS levels and Other Requirements for Air Conditioners, Report No 2008/09 (September 2008) (Last accessed March 22, 2012) (Available at: *http://www.energyrating.gov.au/wp-content/uploads/Energy_Rating_Documents/Library/Cooling/Air_Conditioners/200809-ris-ac.pdf*).

adjusted index of the Producer Price Index (PPI) for miscellaneous refrigeration and air-conditioning equipment over the period 1990–2010. These data show a general price index decline from 1990 to 2004, followed by a sharp increase, primarily due to rising prices of copper and steel components that go into this equipment, in turn driven by rapidly rising global demand. Since 2009, there has been no clear trend in the price index. Given the continued slow global economic activity in 2009 through 2014, DOE believes that the extent to which the future trend can be predicted based on the last two decades is very uncertain and that the observed data do not provide a firm basis for projecting future costs trends for SPVU equipment. Therefore, DOE used a constant price assumption as the default price factor index to project future SPVU prices in 2019. Thus, prices projected for the LCC and PBP analysis are equal to the 2014 values for each efficiency level in each equipment class. Appendix 8D of the final rule TSD describes the historical data and the derivation of the price projection.

b. Installation Costs

DOE derived national average installation costs for SPVU equipment from data provided in RS Means CostWorks 2014 (hereafter referred to as RS Means) specifically for packaged air-conditioning equipment. RS Means provides estimates for installation costs for SPVU units by equipment capacity, as well as cost indices that reflect the variation in installation costs for 295 cities in the United States. The RS Means data identify several cities in all 50 States and the District of Columbia. DOE incorporated location-based cost indices into the analysis to capture variation in installation costs, depending on the location of the consumer.

For more-stringent efficiency levels, DOE recognized that installation costs potentially could be higher with larger units and higher-efficiency SPVU equipment, mainly due to increased size. DOE utilized RS Means installation cost data from RS Means to derive installation cost curves by size of unit for base-efficiency models. DOE did not have data to calibrate the extent to which installation costs might change as efficiency increased. For the final rule LCC analysis, DOE assumed that installation cost would not increase as a function of increased efficiency.

c. Annual Energy Use

DOE estimated the annual electricity and natural gas consumed by each class of SPVU equipment, by efficiency level, based on the energy use analysis described in section IV.E and in chapter 7 of the final rule TSD.

d. Electricity and Natural Gas Prices

Electricity prices and natural gas prices are used to convert changes in the electric and natural gas consumption from higher-efficiency equipment into energy cost savings. Because of the variation in annual electricity and natural gas consumption savings and equipment costs across the country, it is important to consider regional differences in electricity and natural gas prices. DOE used average effective commercial electricity prices [56] and commercial natural gas prices [57] at the State level from EIA data for 2014. This approach captured a wide range of commercial electricity and natural gas prices across the United States. Furthermore, different kinds of businesses typically use electricity in different amounts at different times of the day, week, and year, and therefore, face different effective prices. To make this adjustment, DOE used EIA's 2003 Commercial Building Energy Consumption Survey (CBECS) data set [58] to identify the average prices that the five business types paid for electricity and natural gas and compared them separately with the corresponding average prices that all commercial customers paid. DOE used the ratios of prices paid by the five types of businesses to the national average commercial prices seen in the 2003 CBECS as multipliers to adjust the average commercial 2014 State price data.

DOE weighted the electricity and natural gas consumption and prices each business type paid in each State by the estimated percentages of SPVU equipment in each business type and by the population in each State to obtain weighted-average national electricity and natural gas costs for 2014. The State/building-type weights reflect the probabilities that a given unit of SPVU equipment shipped will operate with a given fuel price. The original State-by-State average commercial prices range from approximately $0.078 per kWh to approximately $0.343 per kWh for electricity and from approximately $6.81 per MBtu to $43.36 per MBtu for natural gas. See chapter 8 of the final rule TSD for further details.

The electricity and natural gas price trends provide the relative change in electricity and natural gas costs for future years. DOE used the *AEO2015* Reference case to provide the default electricity and natural gas price scenarios. DOE extrapolated the trend in values at the Census Division level from 2025 to 2040 of the projection for all five building types to establish prices beyond 2040 (see section IV.F.2.g). DOE provides a sensitivity analysis of the LCC savings and PBP results to different fuel price scenarios using both the *AEO2015* high-price and low-price projections in appendix 8C of the final rule TSD.

e. Maintenance Costs

Maintenance costs are the costs to the consumer of ensuring continued equipment operation. Maintenance costs include services such as cleaning heat-exchanger coils and changing air filters. DOE estimated annual routine maintenance costs for SPVU air conditioners as $315 per year (2014$) for capacities up to 135,000 Btu/h. For heat pumps less than 65,000 Btu/h capacity, maintenance costs reported in the RS Means CostWorks 2013 database were $350 per year; costs were $420 per year for larger capacities. Because data were not available to indicate how maintenance costs vary with equipment efficiency, DOE used preventive maintenance costs that remain constant as equipment efficiency increases.

f. Repair Costs

The repair cost is the cost to the customer of replacing or repairing components that have failed in the SPVU equipment. DOE estimated the one-time repair cost in RS Means as equivalent to those for small packaged rooftop units: $2,630 (2014$) for both air conditioners and heat pumps less than 65,000 Btu/h capacity, and $3,291 for larger units. Based on frequency and type of major repairs in the RS Means database, DOE assumed that the repair would be a one-time event at about year 10 of the equipment life that involved replacing the supply fan motor, compressor, some bearings, and refrigerant. DOE then annualized the present value of the cost over the average equipment life of 15 years to obtain an annualized equivalent repair cost. DOE determined that the materials portion of annualized repair costs

[56] Energy Information Administration, Form EIA–826 Database Monthly Electric Utility Sales and Revenue Data (EIA–826 Sales and Revenue Spreadsheets) (Available at: *http://www.eia.gov/electricity/data/eia826/*; on the right side of the screen under Aggregated, select 1990-current) (Last accessed April 17, 2015).

[57] Energy Information Administration, Natural Gas Prices (Available at: *http://www.eia.gov/dnav/ng/ng_pri_sum_a_EPG0_PCS_DMcf_a.htm)* (Last accessed February 13, 2014).

[58] Energy Information Administration, Commercial Building Energy Consumption Survey 2003, CBECS Public Use Microdata Files (Available at: *http://www.eia.gov/emeu/cbecs/cbecs2003/public_use_2003/cbecs_pudata2003.html*) (Last accessed February 12, 2014).

would increase in direct proportion with increases in equipment prices, because the replacement parts would be similar to the more-expensive original equipment that they replaced. Because the price of SPVU equipment increases with efficiency, the cost for component repair is also expected to increase as the efficiency of equipment increases. See chapter 8 of the final rule TSD for details on the development of repair cost estimates.

g. Equipment Lifetime

DOE defines ''equipment lifetime'' as the age when a unit of SPVU equipment is retired from service. DOE reviewed available literature to establish typical equipment lifetimes, which showed a wide range of lifetimes from 10 to 25 years. The data did not distinguish between classes of SPVU equipment. Consequently, DOE used a distribution of lifetimes between 10 and 25 years, with an average of 15 years based on a review of a range of packaged cooling equipment lifetime estimates found in published studies and online documents. DOE applied this distribution to all classes of SPVU equipment analyzed. Chapter 8 of the final rule TSD contains a detailed discussion of equipment lifetimes.

Friedrich commented during the public meeting that based on feedback from its customers, 8 to 9 years was a more realistic lifetime than the 15 years proposed by DOE. (Friedrich, NOPR Public Meeting Transcript, No. 11 at p. 166) For the final rule, DOE maintained its equipment lifetime assumptions for the LCC and PBP analysis, but notes that there is a distribution of lifetimes between 10 and 25 years, wherein approximately half of the equipment fails before 15 years.

h. Discount Rate

The discount rate is the rate at which future expenditures are discounted to establish their present value. DOE determined the discount rate by estimating the cost of capital for purchasers of SPVU equipment. Most purchasers use both debt and equity capital to fund investments. Therefore, for most purchasers, the discount rate is the weighted-average cost of debt and equity financing, or the weighted-average cost of capital (WACC), less the expected inflation.

To estimate the WACC of SPVU equipment purchasers, DOE used a sample of more than 340 companies grouped to be representative of operators of each of five commercial business types (health care, education, telecommunications, temporary office, and general office) drawn from a database of 7,766 U.S. companies presented on the Damodaran Online Web site.[59] This database includes most of the publicly traded companies in the United States. The WACC approach for determining discount rates accounts for the current tax status of individual firms on an overall corporate basis. DOE did not evaluate the marginal effects of increased costs, and, thus, depreciation due to more-expensive equipment, on the overall tax status.

DOE used the final sample of companies to represent purchasers of SPVU equipment. For each company in the sample, DOE derived the cost of debt, percentage of debt financing, and systematic company risk from information on the Damodaran Online Web site. Damodaran estimated the cost of debt financing from the nominal long-term Federal government bond rate and the standard deviation of the stock price. DOE then determined the weighted average values for the cost of debt, range of values, and standard deviation of WACC for each category of the sample companies. Deducting expected inflation from the cost of capital provided estimates of the real discount rate by ownership category.

For most educational buildings and a portion of the office buildings occupied by public schools, universities, and State and local government agencies, DOE estimated the cost of capital based on a 40-year geometric mean of an index of long-term tax-exempt municipal bonds (>20 years).[60] Federal office space was assumed to use the Federal bond rate, derived as the 40-year geometric average of long-term (>10 years) U.S. government securities.[61]

Based on this database, DOE calculated the weighted-average, after-tax discount rate for SPVU equipment purchases, adjusted for inflation, in each of the five business types, which were allocated to the three building types used in the analysis based on estimated market shares of modular buildings used by each business type. The allocation percentages came from a combination of manufacturer interviews and industry data published by the Modular Buildings Institute.[62 63 64 65]

Chapter 8 of the final rule TSD contains the detailed calculations related to discount rates.

3. Payback Period

DOE also determined the economic impact of potential amended energy conservation standards on consumers by calculating the PBP of more-stringent efficiency levels relative to the base-case efficiency levels. The PBP measures the amount of time it takes the commercial customer to recover the assumed higher purchase expense of more-efficient equipment through lower operating costs. Similar to the LCC, the PBP is based on the total installed cost and the operating expenses for each building type and State, weighted on the probability of shipment to each market. Because the PBP does not take into account changes in operating expense over time or the time value of money, DOE considered only the first year's operating expenses to calculate the PBP, unlike the LCC, which is calculated over the lifetime of the equipment. Chapter 8 of the final rule TSD provides additional details about the PBP calculations.

DOE received comments during the NOPR public meeting and in written form regarding the LCC analysis. AHRI commented that physical changes in cabinet size will incur higher installation costs, and that physical size changes also affect repair vs. replacement decisions. (AHRI, No. 19 at pp. 16, 17, 31, 32, 34) Bard commented that schools will repair failing equipment rather than replace it with more-expensive, efficient models; customers will not tolerate 14.7 and 10.1 year PBPs, and more efficient models require larger cabinet sizes. (Bard, No. 13 at pp. 2, 3) Lennox commented that increasing cabinet size will increase installation cost as modifications to buildings will be required. (Lennox, No. 16 at p. 18) Lennox also commented that commercial entities will not like paybacks as long as 8.4 years, and will end up repairing old equipment rather

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

[60] Federal Reserve Bank of St. Louis, *State and Local Bonds—Bond Buyer Go 20-Bond Municipal Bond Index* (Last accessed April 16, 2015) Available at: *http://research.stlouisfed.org/fred2/series/MSLB20/downloaddata?cid=32995.*

[61] Rate calculated with 1975–2014 data. Data source: U.S. Federal Reserve (Last accessed April 16, 2015) (Available at: *www.federalreserve.gov/releases/h15/data.htm*).

[62] Modular Building Institute, State of the Industry 2006 (Available at: *http://www.modular.org/HtmlPage.aspx?name=analysis*) (March 6, 2014).

[63] Modular Building Institute, Commercial Modular Construction Report 2008 (Available at: *http://www.modular.org/HtmlPage.aspx?name=analysis*) (March 6, 2014).

[64] Modular Building Institute, Commercial Modular Construction Report 2009 (Available at: *http://www.modular.org/HtmlPage.aspx?name=analysis*) (March 6, 2014).

[65] Modular Building Institute, Relocatable Buildings 2011 Annual Report (Available at: *http://www.modular.org/HtmlPage.aspx?name=analysis*) (March 6, 2014).

than buying new. (Lennox, NOPR Public Meeting Transcript, No. 11 at p. 138) DOE appreciates these comments and addressed repair vs. replacement decisions in the NIA, as discussed in section IV.G.2.b. National Coil Company commented that more efficient equipment yields larger cabinet sizes, which are more expensive to install. (National Coil Company, No. 14 at p. 3) Edison Electric Institute commented that some modular portable buildings are only used for 4 to 5 years, which is shorter than the average lifetime of this equipment, and expressed concern that education facilities have longer paybacks and higher net costs relative to the average customer. (Edison Electric Institute, NOPR Public Meeting Transcript, No. 11 at pp. 118, 144) DOE notes that most modular buildings are not destroyed after 4 to 5 years of use, but are moved to another location and continue to be used. Because they are an integral component of modular buildings, SPVUs are moved along with the building and continue giving service in the new location. Friedrich commented that the majority of its equipment goes to the hotel/motel industry, and there is a higher cost to install more-efficient, larger units. (Friedrich, NOPR Public Meeting Transcript, No. 11 at p. 132)

DOE acknowledges and appreciates the comments shared in the public meeting and via written comment. DOE agrees that to a certain extent, more-efficient equipment requires larger cabinet sizes and therefore higher installation costs. As discussed in section IV.C.4, transitioning from EER 9.0 to EER 10.0 necessitates an increase in cabinet size. The economic analyses DOE conducted for equipment with efficiencies greater than EER 10.0 equipment are compared against EER 10.0 equipment. DOE notes that the standard levels for equipment less than 65,000 Btu/h of EER 11.0 and EER 11.0/COP 3.3 for SPVACs and SPVHPs, respectively, do not necessitate larger cabinet sizes than the ASHRAE efficiency equipment. Therefore, DOE did not modify its approach for calculating installation costs for the final rule.

G. National Impact Analysis

The NIA evaluates the effects of a considered energy conservation standard from a national perspective rather than from the customer perspective represented by the LCC. This analysis assesses the NPV (future amounts discounted to the present) and the NES of total commercial consumer costs and savings that are expected to result from amended standards at specific efficiency levels.[66]

The NES refers to cumulative energy savings for the lifetime of units shipped from 2019 through 2048. DOE calculated energy savings in each year relative to a base case, defined as DOE adoption of the efficiency levels specified by ASHRAE Standard 90.1–2013. DOE also calculated energy savings from adopting efficiency levels specified by ASHRAE Standard 90.1–2013 compared to the EPCA base case (*i.e.,* the current Federal standards) for units shipped from 2015 through 2044. The NPV refers to cumulative monetary savings. DOE calculated net monetary savings in each year relative to the ASHRAE base case as the difference between total operating cost savings and increases in total installed cost. DOE accounted for operating cost savings until 2072, when the equipment installed in the 30th year after the compliance date of the amended standards should be retired. Cumulative savings are the sum of the annual NPV over the specified period.

1. Approach

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

To make the analysis more transparent to all interested parties, DOE used a spreadsheet tool, available on DOE's Web site,[67] to calculate the energy savings and the national economic costs and savings from potential amended standards. Interested parties can review DOE's analyses by changing various input quantities within the spreadsheet.

Unlike the LCC analysis, the NES spreadsheet does not use distributions for inputs or outputs, but relies on national average equipment costs and energy costs developed from the LCC spreadsheet. DOE used the NES spreadsheet to perform calculations of energy savings and NPV using the annual energy consumption and total installed cost data from the LCC analysis. For efficiency levels higher than ASHRAE, DOE projected the energy savings, energy cost savings, equipment costs, and NPV of benefits for equipment sold in each SPVU class from 2019 through 2048. For the ASHRAE level, DOE projected energy savings for equipment sold from 2015 through 2044. DOE does not calculate economic benefits for the ASHRAE level because it is statutorily required to use the ASHRAE level as the baseline. The projection provided annual and cumulative values for all four output parameters described above.

a. National Energy Savings

DOE calculated the NES associated with the difference between the per-unit energy use under a standards-case scenario and the per-unit energy use in the base case. The average energy per unit used by the SPVUs in service gradually decreases in the standards case relative to the base case because more-efficient SPVUs are expected to gradually replace less-efficient ones.

Unit energy consumption values for each equipment class are taken from the LCC spreadsheet for each efficiency level and weighted based on market efficiency distributions. To estimate the total energy savings for each efficiency level, DOE first calculated the delta unit energy consumption (*i.e.,* the difference between the energy directly consumed by a unit of equipment in operation in the base case and the standards case) for each class of SPVUs for each year of the analysis period. The analysis period begins with the earliest expected compliance date of amended energy conservation standards (*i.e.,* 2015), assuming DOE adoption of the baseline ASHRAE Standard 90.1–2013 efficiency levels. For the analysis of DOE's potential adoption of more-stringent efficiency levels, the analysis period does not begin until the compliance date of 2019, four years after DOE would likely issue a final rule requiring such standards.

Second, DOE determined the annual site energy savings by multiplying the stock of each equipment class by vintage (*i.e.,* year of shipment) by the delta unit energy consumption for each vintage (from step one). As mentioned in section IV.E, this includes an increase in gas usage for some SPVAC units sold with gas furnaces (where fan power was reduced to achieve higher efficiency levels).

Third, DOE converted the annual site electricity savings into the annual amount of energy saved at the source of electricity generation (the source or primary energy), using annual conversion factors derived from *AEO2015.* Finally, DOE summed the annual primary energy savings for the lifetime of units shipped over a 30-year period to calculate the total NES. DOE performed these calculations for each

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

[67] DOE's Web page on SPVUs can be found at: *http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/35.*

efficiency level considered for SPVUs in this rulemaking.

In 2011, in response to the recommendations of a committee on ''Point-of-Use and Full-Fuel-Cycle Measurement Approaches to Energy Efficiency Standards'' appointed by the National Academy of Sciences, DOE announced its intention to use FFC measures of energy use and GHG and other emissions in the national impact analyses and emissions analyses included in future energy conservation standards rulemakings. 76 FR 51281 (Aug. 18, 2011). After evaluating the approaches discussed in the August 18, 2011 document, DOE published a statement of amended policy in which DOE explained its determination that EIA's National Energy Modeling System (NEMS) is the most appropriate tool for its FFC analysis and its intention to use NEMS for that purpose. 77 FR 49701 (Aug. 17, 2012). NEMS is a public domain, multi-sector, partial equilibrium model of the U.S. energy sector[68] that EIA uses to prepare its *Annual Energy Outlook.* The approach used for the final rule, and the FFC multipliers that were applied, are described in appendix 10A of the final rule TSD. NES results are presented in both primary and FFC savings in section V.B.3.a.

DOE considered whether a rebound effect is applicable in its NES analysis for SPVUs. A rebound effect occurs when an increase in equipment efficiency leads to increased demand for its service. For example, when a consumer realizes that a more-efficient air conditioner will lower the electricity bill, that person may opt for increased comfort in the home by lowering the temperature, thereby returning a portion of the energy cost savings. For the SPVU market, there are two ways that a rebound effect could occur: (1) Increased use of the air-conditioning equipment within the commercial buildings in which such units are installed; and (2) additional instances of air-conditioning of spaces that were not being cooled before. In the case of SPVUs, the person owning the equipment (*i.e.,* the building owner) is usually not the person operating the equipment (*i.e.,* the renter). Because the operator usually does not own the equipment, that person will not have the operating cost information necessary to influence their operation of the equipment. Therefore, DOE believes that the first instance is unlikely to occur. Similarly, the second instance is unlikely because a small change in efficiency is insignificant among the factors that determine how much floor space will be air-conditioned.

b. Net Present Value

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

First, DOE determined the difference between the equipment costs under the standard-level case and the base case in order to obtain the net equipment cost increase resulting from the higher standard level. As noted in section IV.F.2.a, DOE used a constant price assumption as the default price forecast; the cost to manufacture a given unit of higher efficiency neither increases nor decreases over time. In addition, DOE considered two alternative price trends in order to investigate the sensitivity of the results to different assumptions regarding equipment price trends. One of these used an exponential fit on the deflated PPI for all other miscellaneous refrigeration and air-conditioning equipment, and the other is based on the ''deflator—other durables excluding medical'' that was forecasted for *AEO2015*. The derivation of these price trends is described in appendix 10B of the final rule TSD.

Second, DOE determined the difference between the base-case operating costs and the standard-level operating costs in order to obtain the net operating cost savings from each higher efficiency level. The operating cost savings are energy cost savings, which are calculated using the estimated energy savings in each year and the projected price of the appropriate form of energy. To estimate energy prices in future years, DOE multiplied the average regional energy prices by the forecast of annual national-average residential energy price changes in the Reference case from *AEO2015,* which has an end year of 2040. To estimate price trends after 2040, DOE used the average annual rate of change in prices from 2030 to 2040. As part of the NIA, DOE also analyzed scenarios that used inputs from the *AEO2015* Low Economic Growth and High Economic Growth cases. Those cases have higher and lower energy price trends compared to the Reference case. NIA results based on these cases are presented in appendix 10B of the final rule TSD.

Third, DOE determined the difference between the net operating cost savings and the net equipment cost increase in order to obtain the net savings (or expense) for each year. DOE then discounted the annual net savings (or expenses) to 2015 for SPVUs bought in or after 2019 and summed the discounted values to provide the NPV for an efficiency level.

In accordance with the OMB's guidelines on regulatory analysis,[69] DOE calculated NPV using both a 7-percent and a 3-percent real discount rate. The 7-percent rate is an estimate of the average before-tax rate of return on private capital in the U.S. economy. DOE used this discount rate to approximate the opportunity cost of capital in the private sector, because recent OMB analysis has found the average rate of return on capital to be near this rate. DOE used the 3-percent rate to capture the potential effects of standards on private consumption (*e.g.,* through higher prices for products and reduced purchases of energy). This rate represents the rate at which society discounts future consumption flows to their present value. This rate can be approximated by the real rate of return on long-term government debt (*i.e.,* yield on United States Treasury notes minus annual rate of change in the Consumer Price Index), which has averaged about 3 percent on a pre-tax basis for the past 30 years.

2. Shipments Analysis

In its shipments analysis, DOE developed shipment projections for SPVUs and, in turn, calculated equipment stock over the course of the analysis period. DOE used the shipments projection and the equipment stock to determine the NES. In order to account for the analysis periods of both the ASHRAE level and higher efficiency levels, the shipments portion of the spreadsheet model projects SPVU shipments from 2015 through 2048.

a. Shipments Model and Forecast

To develop the shipments model, DOE started with 2005 shipment estimates from the Air-Conditioning and Refrigeration Institute (ARI, now AHRI) for units less than 65,000 Btu/h as published in a previous rulemaking,[70]

[68] For more information on NEMS, refer to *The National Energy Modeling System: An Overview,* DOE/EIA–0581 (98) (Feb. 1998) (Available at: *http://www.eia.gov/oiaf/aeo/overview/*).

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

[70] U.S. Department of Energy—Office of Energy Efficiency and Renewable Energy, Technical Support Document: Energy Efficiency Program for Commercial and Industrial Equipment: Efficiency Standards for Commercial Heating, Air-Conditioning, and Water Heating Equipment Including Packaged Terminal Air-Conditioners and Packaged Terminal Heat Pumps, Small Commercial Packaged Boiler, Three-Phase Air-Conditioners and

Continued

as more recent data are not available. DOE added additional shipments for SPVACs greater than or equal to 65,000 Btu/h and less than 135,000 Btu/h, which make up 3 percent of the market, based on manufacturer interviews. As there are no models on the market for SPVHPs greater than or equal to 65,000 Btu/h and less than 135,000 Btu/h, or for any SPVUs greater than or equal to 135,000 Btu/h, DOE did not develop shipment estimates (or generate NES and NPV) for these equipment classes. See chapter 9 of the final rule TSD for more details on the initial shipment estimates by equipment class that were used as the basis for the shipments projections discussed below.

To project shipments of SPVUs for new construction (starting in 2006) for the NOPR, DOE relied primarily on sector-based estimates of saturation and projections of floor space. Based on manufacturer interview information, DOE allocated 35 percent of shipments to the education sector, 35 percent to telecom, and 30 percent to offices. DOE used the 2005 new construction shipments and 2005 new construction floor space for education (from *AEO2013*) to estimate a saturation rate.[71] DOE applied this saturation rate to *AEO2013* projections of new construction floor space to project shipments to new construction in the education sector through 2048. For offices, DOE decided to hold SPVU shipments to new office construction constant at 2005 levels. For shipments to telecom, DOE developed an index based on County Business Pattern data for establishments [72] and projected this trend forward.

To allocate the total projected shipments for office, education, and telecom into the equipment classes applicable to each sector for the NOPR, DOE used the fraction of shipments from 2005 for each equipment class in each sector. The fractions within each sector remained constant over time.

In order to model shipments for replacement SPVUs for the NOPR, DOE developed historical shipments for SPVUs back to 1981 based on an index of square footage production data from the Modular Buildings Institute.[73] Shipments prior to 1994 were extrapolated based on a trend from 1994 to 2005. In the stock model, the lifetime of SPVUs follows the distribution discussed in section IV.F.2.g, with a minimum of 10 years and a maximum of 25 years. All retired units are assumed to be replaced with new shipments.

In response to the NOPR, Lennox commented that the NOPR indicated that the SPVU market has grown since 2006, ignoring past market volatility and the recent recession. Lennox stated that its own shipments of SPVUs declined dramatically in the 2008 to 2009 timeframe and have continued at levels lower than the 2005 to 2006 timeframe when DOE began its projections. (Lennox, No. 16 at pp. 6, 20) Similarly, AHRI commented that SPVU levels decreased through 2009 and have not yet rebounded to their 2006 levels, so DOE's projections are too high for 2006–2013. (AHRI, No. 19 at pp. 28–29) Bard also stated that its unit shipments in that same period experienced a decline. (Bard Manufacturing Company, No. 13 at p. 2)

For the final rule, DOE modified its estimate of shipments prior to 2014 to account for decline in shipments related to the recession. DOE used information on historical shipments from Lennox and AHRI to develop a revised trend for shipments from 2005 to 2014 to more accurately reflect the shipments of SPVUs as defined in this final rule. The complete discussion of the method for extrapolating historical shipments can be found in chapter 9 of the final rule TSD. As a result of the above change, DOE modified its projection of shipments to new construction. Instead of using shipments in 2005 as a basis (as described above), DOE used the revised estimates for 2014.

The complete discussion of shipment allocation and projected shipments for the different equipment classes can be found in chapter 9 of the final rule TSD.

b. Effect of Amended Standards on Shipments

As equipment purchase price and repair costs increase with efficiency, higher first costs and repair costs can result in a drop in shipments. In manufacturer interviews prior to the NOPR, manufacturers expressed concern that an increase in first cost could lead customers to switch to split-system or rooftop units. However, manufacturers did not provide any information on the price point at which this switch might occur, and DOE had insufficient data for estimating the elasticity of shipments for SPVUs as a function of first costs, repair costs, or operating costs. For these and other reasons, DOE assumed that the shipments projection would not change under the considered standard levels.

In response to the NOPR, numerous stakeholders disagreed with the NOPR assumption of no change in shipments.

AHRI commented that higher efficiency equipment will be more expensive and consumers will look towards other HVAC products if the price becomes prohibitive or the PBP is too long, or equipment will be repaired instead of replaced. AHRI stated that DOE should analyze the negative impacts that occurred when small unitary air conditioning efficiencies were increased from 10 to 13 seasonal energy efficiency ratio, and noted that the recent CUAC NOPR projects a reduction in shipments after higher standards. (AHRI, No. 19 at p. 28) Lennox indicated that the shipments model should project a drop in future shipments due to increased efficiency levels. Lennox commented that many businesses that are end-users of SPVU equipment have strict budget obligations and will forgo replacements due to the higher installation and building modification costs and instead repair their current SPVU products. Lennox also noted that the CUAC NOPR projects a decline in future shipments due to increased product costs. (Lennox, No. 16 at pp. 6–7) Bard stated that an 11.0 EER standard would cause many of its customers to abandon SPVUs in favor of other more economically sensible products. In particular, Bard stated that DOE's assumption ignores the price sensitivity of the modular/relocatable building market, which is the largest SPVU market. (Bard Manufacturing Company, No. 13 at p. 3)

For the final rule, DOE modified its approach to reflect the potential market response to more-stringent standards for SPVUs. DOE implemented a repair vs. replace decision in the shipment model. First, DOE assumed a price elasticity of

Heat Pumps <65,000 Btu/h, and Single-Package Vertical Air Conditioners and Single-Package Vertical Heat Pumps <65,000 Btu/h (March 2006) (Available at: *http://www1.eere.energy.gov/buildings/appliance_standards/commercial/pdfs/ashrae_products/ashrae_products_draft_tsd_030206.pdf*). This TSD was prepared for the rulemaking that resulted in the Final Rule: Energy Efficiency Program for Certain Commercial and Industrial Equipment: Efficiency Standards for Commercial Heating, Air-Conditioning, and Water-Heating Equipment. 72 FR 10038 (March 7, 2007).

[71] Manufacturers reported that in 2012, 50 percent of shipments were for new construction. DOE originally adjusted that split for 2005 until the result from the shipments model was 50/50 in 2012. This resulting 2005 split was 84 percent new construction and 16 percent replacement. However, this led to a steep shipments increase in the model from 2005 to 2006. Instead, DOE used the 50/50 split directly in 2005, which resulted in a much steadier shipments trend. Therefore, 2005 new construction shipments are derived using 50 percent of the total 2005 historical shipments.

[72] U.S. Census Bureau, County Business Patterns for NAICS 237130 Power and Communication Line and Related Structures Construction (Available at: *http://www.census.gov/econ/cbp/index.html*) (Last accessed April 15, 2014).

[73] Available at: *http://www.modular.org/HtmlPage.aspx?name=analysis* (Last accessed May 18, 2012).

-0.5 to estimate the fraction of consumers that would be sensitive to the higher prices of equipment under new standards.[74] Their units would undergo a major repair instead of replacement upon failure, in this case assumed to be a compressor repair. In the case of the adopted standards, the model resulted in 3 percent of SPVU consumers opting to repair rather than replace in the compliance year. Next, DOE extended the lifetime of repaired equipment by half the original lifetime, or approximately 7.5 years on average. The complete discussion of the method for the repair vs. replace decision can be found in chapter 9 of the final rule TSD. For the adopted standards, the revised shipments model results in a cumulative drop in shipments of 1 percent compared to the shipments in the ASHRAE case, or 2 percent compared to the market base case.

DOE also modified the NES and NPV calculations to take into account the increased energy use and repair cost for the units that are repaired instead of replaced in each standards case. These calculations are discussed in chapter 10 of the final rule TSD.

3. Base-Case and Standards-Case Forecasted Distribution of Efficiencies

To project what the SPVU market would look like in the absence of amended standards, DOE developed a base-case distribution of efficiency levels for SPVU equipment using manufacturer-provided estimates. DOE applied the percentages of models within each efficiency range to the total unit shipments for a given equipment class to estimate the distribution of shipments for the base case. Then, from those market shares and projections of shipments by equipment class, DOE extrapolated future equipment efficiency trends both for a base-case scenario and for standards-case scenarios.

To estimate an efficiency trend in the base-case, DOE used the trend from 2012 to 2035 found in the Commercial Unitary Air Conditioner Advance Notice of Proposed Rulemaking (ANOPR), which estimated an increase of approximately 1 EER every 35 years.[75] DOE used this same trend in the standards-case scenarios, when seeking to ascertain the impact of amended standards.

For each efficiency level analyzed, DOE used a ''roll-up'' scenario to establish the market shares by efficiency level for the year that compliance would be required with amended standards (*i.e.,* 2015 if DOE adopts the efficiency levels in ASHRAE Standard 90.1–2013, or 2019 if DOE adopts more-stringent efficiency levels than those in ASHRAE Standard 90.1–2013). DOE collected information suggesting that, as the name implies, the efficiencies of equipment in the base case that did not meet the standard level under consideration would roll up to meet the amended standard level. This information also suggests that equipment efficiencies in the base case that were above the standard level under consideration would not be affected. The efficiency distributions for each equipment class are presented in chapter 10 of the final rule TSD.

H. Consumer Subgroup Analysis

In analyzing the potential impact of new or amended standards on commercial consumers, DOE evaluates the impact on identifiable groups (*i.e.,* subgroups) of consumers, such as different types of businesses that may be disproportionately affected by a national standard level. For this rulemaking, DOE identified mining and construction companies occupying temporary office space as a disproportionately affected subgroup. Because it has generally higher costs of capital and, therefore, higher discount rates than other firms using SPVUs, this consumer subgroup is less likely than average to value the benefits of increased energy savings. However, this group also faces relatively high electricity prices compared with some other consumer subgroups. These two conditions tend to offset each other, so a quantitative analysis was required to determine whether this subgroup would experience higher or lower than average LCC savings. Another type of consumer that might be disproportionately affected is public education facilities. Because of their tax-exempt status, public education agencies generally have lower capital costs than other SPVU users and, thus, might disproportionately benefit from increased SPVU energy efficiency; however, they also typically face lower electricity costs than other commercial customers, so a quantitative analysis was required to determine whether they would have lower or higher than average LCC savings.

DOE also analyzed the potential effects of amended SPVU standards on businesses with high capital costs, which are generally (but not always) small businesses. DOE analyzed the potential impacts of amended standards by conducting the analysis with different discount rates, because small businesses do not have the same access to capital as larger businesses, but they may pay similar prices for electricity. DOE obtained size premium data from Ibbotson Associates' *Stocks, Bonds, Bills, and Inflation 2013 Yearbook.*[76] For the period of 1926–2012, the geometric mean of annual returns for the smallest companies in all industries (13 percent) was 103.1 percent of the average for the total value-weighted index of companies listed on the New York Stock Exchange (NYSE), American Stock Exchange (AMEX), and National Association of Security Dealers Stock Exchange (NASDAQ) (9.6 percent), implying that on average, historical performance of small companies has been (113.0/109.6) = 1.031 or 3.1 percent points higher than the market average, in effect a ''small company size premium,'' an extra cost premium that they have to pay to do business. DOE assumed that for businesses purchasing SPVUs and purchasing or renting modular buildings containing SPVUs, the average discount rate for small companies is 3.1 percent higher than the industry average.

DOE determined the impact of consumer subgroup costs and savings using the LCC spreadsheet model. DOE conducted the LCC and PBP analysis separately for consumers represented by the mining and construction firms using temporary office buildings and for public education agencies using portable classrooms, and then compared the results with those for average commercial customers. DOE also conducted an analysis in which only firms with a discount rate 3.1 percent higher than the corresponding industry average were selected. While not all of these firms were small businesses (some had volatile stock prices or other special circumstances), they were the ones that had the highest costs of capital and were the least likely to benefit from increased SPVU standards.

Due to the higher costs of conducting business, benefits of SPVU standards for small and other high-capital-cost businesses are estimated to be slightly

[74] DOE typically uses a price elasticity of −0.34 for residential products. However, DOE has no information regarding the price elasticity for commercial equipment. DOE believes that the price elasticity may be somewhat higher for commercial equipment than for residential products, as it is more expensive, but that it would be less than perfectly elastic because of other significant considerations. As a result, DOE selected the midpoint between inelastic and elastic.

[75] *See* DOE's TSD underlying DOE's July 29, 2004 ANOPR. 69 FR 45460 (Available at: *http://www.regulations.gov/#!documentDetail;D=EERE-2006-STD-0103-0078*). SPVUs have only had EER standards since 2002, which was not long enough to establish an efficiency trend.

[76] Morningstar, Inc., *Ibbotson SBBI 2013 Classic Yearbook. Market Results for Stocks, Bonds, Bills, and Inflation* 1926–2012 (2013).

lower than for the general population of SPVU owners.

The results of DOE's LCC subgroup analysis are summarized in section V.B.1.b and described in detail in chapter 11 of the final rule TSD.

I. Manufacturer Impact Analysis

1. Overview

DOE performed an MIA to estimate the financial impact of amended energy conservation standards on manufacturers of SPVACs and SPVHPs, and to calculate 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 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 INPV. Different sets of assumptions (markup scenarios) will produce different results. The qualitative part of the MIA addresses factors such as equipment characteristics, impacts on particular subgroups of firms, and important market and equipment trends. The complete MIA is outlined in chapter 12 of the final rule TSD.

DOE conducted the MIA for this rulemaking in three phases. In Phase 1 of the MIA, DOE conducted structured, detailed interviews with a representative cross-section of manufacturers and prepared a profile of the SPVAC and SPVHP industry. During manufacturer interviews, DOE discussed engineering, manufacturing, procurement, and financial topics to identify key issues or concerns and to inform and validate assumptions used in the GRIM.

DOE used information obtained during these interviews to prepare a profile of the SPVAC and SPVHP industry, including a manufacturer cost analysis. Drawing on financial analysis performed as part of the 2008 energy conservation standard for SPVACs and SPVHPs as well as feedback obtained from manufacturers, DOE derived financial inputs for the GRIM (*e.g.,* SG&A expenses; research and development (R&D) expenses; and tax rates). DOE also used public sources of information, including company SEC 10–K filings,[77] corporate annual reports, the U.S. Census Bureau's Economic Census,[78] and Hoover's reports,[79] to develop the industry profile.

In Phase 2 of the MIA, DOE prepared an industry cash-flow analysis to quantify the potential impacts of an amended energy conservation standard on manufacturers of SPVACs and SPVHPs. 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. To quantify these impacts, DOE used the GRIM to perform a cash-flow analysis for the SPVAC and SPVHP industry using financial values derived during Phase 1.

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.

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

The Small Business Administration (SBA) defines a small business for North American Industry Classification System (NAICS) code 333415, ''Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing,'' as having 750 employees or fewer. During its research, DOE identified two domestic companies that manufacture equipment covered by this rulemaking and qualify as small businesses under the SBA definition. The SPVAC and SPVHP small manufacturer subgroup is discussed in chapter 12 of the final rule TSD and in section VI.C of this document.

2. Government Regulatory Impact Model

DOE uses the GRIM to quantify the changes in cash flow due to amended 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 for a 30-year period that begins in the compliance year for each equipment class. DOE calculated INPVs by summing the stream of annual discounted cash flows during this period. DOE used a real discount rate of 10.4 percent, which was derived from industry financials and then modified according to feedback received during manufacturer interviews.

The GRIM calculates cash flows using standard accounting principles and compares changes in INPV between 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.

DOE collected information on critical GRIM inputs from a number of sources, including publicly available data and interviews with manufacturers (described in the next section). The GRIM results are shown in section V.B.2. Additional details about the GRIM, the discount rate, and other financial parameters can be found in chapter 12 of the final rule TSD.

a. Government Regulatory Impact Model Key Inputs

Manufacturer Production Costs

Manufacturing more-efficient equipment is typically more expensive than manufacturing baseline equipment due to the use of more complex components, which are typically more costly than baseline components. The changes in the MPC 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 and further detailed in chapter 5 of the final rule TSD. In addition, DOE used information

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

[78] ''Annual Survey of Manufacturers: General Statistics: Statistics for Industry Groups and Industries.'' U.S. Census Bureau. 2014. Available at: *http://factfinder2.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t.*

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

from its teardown analysis, described in chapter 5 of the final rule 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 equipment 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. See section IV.G and chapter 10 of the final rule TSD for additional details.

For the standards-case shipment forecast, the GRIM uses the NIA standards-case shipment forecasts. The NIA assumes that product efficiencies in the base case that do not meet the energy conservation standard in the standards case ''roll up'' to meet the amended standard in the standard year. See section IV.G and chapter 9 of the final rule 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 equipment designs into compliance. DOE evaluated the level of conversion-related expenditures that would be needed to comply with each considered efficiency level in each equipment class. For the MIA, DOE classified these conversion costs into two major groups: (1) Product conversion costs; and (2) capital conversion costs. Product conversion costs are one-time investments in research, development, testing, marketing, and other non-capitalized costs necessary to make equipment designs comply with the amended energy conservation standard. 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.

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 validated manufacturer comments through estimates of capital expenditure requirements derived from the equipment teardown analysis and engineering analysis described in chapter 5 of the final rule 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 from multiple manufacturers to determine conversion costs, such as R&D expenditures, at each efficiency level. Manufacturer numbers were aggregated to better reflect the industry as a whole and to protect confidential information.

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 of this document. For additional information on the estimated product and capital conversion costs, see chapter 12 of the final rule TSD.

b. Government Regulatory Impact Model Scenarios

Markup Scenarios

MSPs include direct MPCs (*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 markup 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. As production costs increase with efficiency, this scenario implies that the absolute dollar markup will increase as well. DOE assumed the non-production cost markup—which includes SG&A expenses, R&D expenses, interest, and profit—to be 1.28 for SPVU equipment. This markup is consistent with the one DOE assumed in the base case for the GRIM. Manufacturers tend to believe it is optimistic to assume that they would be able to maintain the same gross margin percentage markup as their production costs increase. Therefore, DOE assumes that this scenario represents a high bound to industry profitability under an amended energy conservation standard.

In the preservation-of-operating-profit scenario, as the cost of production goes up under a standards case, manufacturers are generally required to reduce their markups to a level that maintains base-case operating profit. DOE implemented this scenario in the GRIM by lowering the manufacturer markups at each TSL to yield approximately the same earnings before interest and taxes in the standards case as in the base case in the year after the compliance date of the amended standards. The implicit assumption behind this markup scenario is that the industry can only maintain its operating profit in absolute dollars after the standard.

3. Discussion of Comments

During the NOPR public comment period, interested parties commented on assumptions and results described in the December 2014 NOPR and accompanying TSD. Written comments submitted to DOE and oral comments delivered during the February 2015 NOPR public meeting address several topics related to manufacturer impacts. These include cumulative regulatory burden, conversion costs, changes in customer demand, diminished product offering, and impacts on the subgroup of small business manufacturers.

a. Cumulative Regulatory Burden

Many manufacturers commented that this rule combined with other pending rulemakings would place high cumulative regulatory burden on manufacturers with multiple products subject to updated appliances standards. (AHRI, No. 19 at p. 26; Bard, No. 11 at p. 173; Friedrich, No. 11 at p. 175, No. 15 at p. 2; Lennox, No. 11 at p. 171, No. 16 at p. 2; National Coil Company, No. 11 at p. 174, No. 14 at p. 2) Specifically, the stakeholders noted obligations related to room air conditioners, residential central air conditioners and heat pumps, commercial warm air furnaces, air-cooled CUACs and heat pumps, and walk-in coolers and freezers rulemakings. DOE provides additional detail on these rules in section V.B.2.e of this final rule. First Company and Bard also added that the cumulative regulatory burden would have a more significant effect on small and mid-sized companies that are already overburdened by other regulations. (First Company, No. 12 at p. 2; Bard, No. 11 at p. 173). DOE has taken these comments under advisement. The Department lists the complete set of Federal regulations contributing to cumulative regulatory burden in section V.B.2.e. DOE takes cumulative regulatory impact into account when selecting the appliance standard in this final rule.

b. Conversion Costs

Lennox and AHRI commented that DOE underestimated the conversion costs needed to update manufacturing facilities, and that this undue financial burden on manufacturers could diminish their ability to stay competitive in the marketplace. (Lennox, No. 11 at p. 173; AHRI, No. 19 at p. 11) Lennox stated that its estimate of the industry's conversion costs are at least twice DOE's estimate, but more likely in the 300 to 500 percent range above DOE's current estimate. (Lennox, No. 16 at p. 4) In response, DOE's conversion costs are based on detailed discussions of capital and production conversion costs with a broad range of manufacturers of the covered product. DOE interviewed and collected conversion cost data from manufacturers that constitute the majority of the SPVU market. While any single manufacturer may have higher conversion cost than the average, DOE believes its conversion cost model is representative of the industry at large. DOE did revise its conversion costs upward between the NOPR and final rule, from $7.2M to $9.2M. However, this revision was primary driven by changes in the number of manufacturers and shifts in the number of product listings between the time of the NOPR analysis and the time of the final rule analysis.

c. Changes in Customer Demand

Bard stated that an 11.0 EER standard would cause many of its customers to abandon SPVUs in favor of other more economically sensible products, which would cause Bard to shrink in size. (Bard, No. 13 at p. 3) DOE estimates shipments impacts in the shipment analysis. During interviews, manufacturers stated that split system air conditioners and rooftop units would be the primary competitors. For much of the replacement market, these alternatives would continue to have a much higher installed cost than SPVUs due to the need for ductwork. Therefore, DOE believes that its shipments analysis accurately reflects potential changes in industry shipments over the analysis period.

d. Diminished Product Offering

AHRI and Bard commented that raising the standard for smaller units to 11 EER and 3.3 COP would eliminate most product lines from the market. AHRI also suggested that the cost to redesign, impact on annual shipments, and the loss of utility to customers would be extremely significant. (AHRI, No. 11 at p. 19; Bard, No. 11 at p. 176) DOE notes that its analysis takes into account the percentage of products that would be eliminated by an 11 EER and 3.3 COP standard, as described in section V.B.2.a. In response to AHRI and Bard, DOE's INPV calculations and estimates of manufacturer impacts take into account manufacturers' costs to redesign in its estimate of conversion costs, changes in annual shipments as estimated in the shipments analysis, and considerations of changes in utility in the screening and engineering analyses. Through tear-downs of existing products on the market, DOE concluded that most models could reach 11 EER and 3.3 COP with changes in heat exchanger surface area that do not require changes to the dimensions of the cabinet. DOE's analysis does reflect Bard's and AHRI's comments on the portion of units that require redesign. DOE's analysis concludes that 71 percent of SPVU models require some redesign to meet the adopted standard. The need for product redesign affect's DOE's analysis of conversion costs and MSPs. These, in turn, drive the estimates of manufacturer impacts. The portion of products that require redesign are considered in the MIA and are part of the weighing of cost and benefits in the selection of the adopted standard.

e. Impacts on the Subgroup of Small Business Manufacturers

Bard stated that they direct much of their engineering resources towards remaining competitive in the SPVU market. They added that to achieve the proposed 11 EER efficiency level, they would have to repurpose these resources, which could impact their ability to stay competitive, particularly since it is a small business.. (Bard, No. 13 at p. 3). In response to Bard, . DOE notes that regulations apply to the entire industry and all manufacturers will need to re-direct engineering resources to comply with efficiency regulations. However, DOE understands that small businesses manufacturers generally have smaller engineering teams to manage the redesign of products. DOE notes that disproportionate impacts to small business as a result of an energy conservation standard are analyzed in section VI.C

National Coil Company added that it believes it should be treated as a small business because, even though it has a parent company (Eubank) that has more than 750 total employees, Nation Coil Company operates as a separate entity and directly employs a number of employees much less that the 750 person threshold. (National Coil Company, No. 14 at p. 1) In response to National Coil Company, DOE notes that small business standards are listed by NAICS code and industry description and are available at *http://www.sba.gov/sites/default/files/files/Size_Standards_Table.pdf*. Further, the SBA requires parent company employees to be included when determining whether a business is a small manufacturer.

J. Emissions Analysis

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

The analysis of power sector emissions uses marginal emissions factors that were derived from data in *AEO2015,* as described in section IV.L. The methodology is described in chapter 13 and chapter 15 of the final rule TSD.

Combustion emissions of CH_4 and N_2O are estimated using emissions intensity factors published by the U.S. Environmental Protection Agency (EPA), GHG Emissions Factors Hub.[80] The FFC upstream emissions are estimated based on the methodology described in chapter 13 of the final rule TSD. The upstream emissions include both emissions from fuel combustion during extraction, processing, and transportation of fuel, and ''fugitive''

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

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

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

For CH_4 and N_2O, DOE calculated emissions reduction in tons and also in terms of units of carbon dioxide equivalent (CO_2eq). Gases are converted to CO_2eq by multiplying each ton of gas by the gas' global warming potential (GWP) over a 100-year time horizon. Based on the Fifth Assessment Report of the Intergovernmental Panel on Climate Change,[81] DOE used GWP values of 28 for CH_4 and 265 for N_2O.

The *AEO* incorporates the projected impacts of existing air quality regulations on emissions. *AEO2015* generally represents current legislation and environmental regulations, including recent government actions, for which implementing regulations were available as of October 31, 2014. DOE's estimation of impacts accounts for the presence of the emissions control programs discussed in the following paragraphs.

SO_2 emissions from affected electric generating units (EGUs) are subject to nationwide and regional emissions cap-and-trade programs. Title IV of the Clean Air Act sets an annual emissions cap on SO_2 for affected EGUs in the 48 contiguous States and the District of Columbia (DC). (42 U.S.C. 7651 *et seq.*) SO_2 emissions from 28 eastern States and DC were also limited under the Clean Air Interstate Rule (CAIR). 70 FR 25162 (May 12, 2005). CAIR created an allowance-based trading program that operates along with the Title IV program. In 2008, CAIR was remanded to EPA by the U.S. Court of Appeals for the District of Columbia Circuit, but it remained in effect.[82] In 2011, EPA issued a replacement for CAIR, the Cross-State Air Pollution Rule (CSAPR). 76 FR 48208 (Aug. 8, 2011). On August 21, 2012, the DC Circuit issued a decision to vacate CSAPR,[83] and the court ordered EPA to continue administering CAIR. On April 29, 2014, the U.S. Supreme Court reversed the judgment of the DC Circuit and remanded the case for further proceedings consistent with the Supreme Court's opinion.[84] On October 23, 2014, the DC Circuit lifted the stay of CSAPR.[85] Pursuant to this action, CSAPR went into effect (and CAIR ceased to be in effect) as of January 1, 2015.

EIA was not able to incorporate CSAPR into *AEO2015,* so it assumes implementation of CAIR. Although DOE's analysis used emissions factors that assume that CAIR, not CSAPR, is the regulation in force. However, the difference between CAIR and CSAPR is not relevant for the purpose of DOE's analysis of emissions impacts from energy conservation standards.

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

Beginning in 2016, however, SO_2 emissions will fall as a result of the Mercury and Air Toxics Standards (MATS) for power plants. 77 FR 9304 (Feb. 16, 2012). In the MATS rule, EPA established a standard for hydrogen chloride as a surrogate for acid gas hazardous air pollutants (HAP), and also established a standard for SO_2 (a non-HAP acid gas) as an alternative equivalent surrogate standard for acid gas HAP. The same controls are used to reduce HAP and non-HAP acid gas; thus, SO_2 emissions will be reduced as a result of the control technologies installed on coal-fired power plants to comply with the MATS requirements for acid gas. *AEO2015* assumes that, in order to continue operating, coal plants must have either flue gas desulfurization or dry sorbent injection systems installed by 2016. Both technologies, which are used to reduce acid gas emissions, also reduce SO_2 emissions. Under the MATS, emissions will be far below the cap established by CAIR, so it is unlikely that excess SO_2 emissions allowances resulting from the lower electricity demand would be needed or used to permit offsetting increases in SO_2 emissions by any regulated EGU.[86] Therefore, DOE believes that energy conservation standards will generally reduce SO_2 emissions in 2016 and beyond.

CAIR established a cap on NO_X emissions in 28 eastern States and the District of Columbia.[87] Energy conservation standards are expected to have little effect on NO_X emissions in those States covered by CAIR because excess NO_X emissions allowances resulting from the lower electricity demand could be used to permit offsetting increases in NO_X emissions from other facilities. However, standards would be expected to reduce NO_X emissions in the States not affected by the caps, so DOE estimated NO_X emissions reductions from the standards considered in this final rule for these States.

The MATS limit mercury emissions from power plants, but they do not include emissions caps and, as such, DOE's energy conservation standards would likely reduce Hg emissions. DOE estimated mercury emissions reduction using emissions factors based on *AEO2015,* which incorporates the MATS.

K. Monetizing Carbon Dioxide and Other Emissions Impacts

As part of the development of this 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

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

[82] 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).

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

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

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

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

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

calculation analogous to the calculation of the NPV of consumer benefit, DOE considered the reduced emissions expected to result over the lifetime of products shipped in the forecast period for each TSL. This section summarizes the basis for the monetary values used for each of these emissions and presents the values considered in this final rule.

For this final rule, DOE relied on a set of values for the SCC that was developed by a Federal interagency process. The basis for these values is summarized in the next section, and a more detailed description of the methodologies used is provided as an appendix to chapter 14 of the final rule TSD.

1. Social Cost of Carbon

The SCC is an estimate of the monetized damages associated with an incremental increase in carbon emissions in a given year. It is intended to include (but is not limited to) climate-change-related 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 CO_2. A domestic SCC value is meant to reflect the value of damages in the United States resulting from a unit change in CO_2 emissions, while a global SCC value is meant to reflect the value of damages worldwide.

Under section 1(b) 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 these 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 CO_2 emissions, the analyst faces a number of challenges. A report from the National Research Council [88] points out that any assessment will suffer from uncertainty, speculation, and lack of information about (1) future emissions of GHGs; (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 CO_2 emissions. The agency can estimate the benefits from reduced (or costs from increased) emissions in any future year by multiplying the change in emissions in that year by the SCC values appropriate for that year. The NPV of the benefits can then be calculated by multiplying each of these 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 Federal 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. Specially, 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. Three sets of values are based on the average SCC

[88] National Research Council, *Hidden Costs of Energy: Unpriced Consequences of Energy Production and Use,* National Academies Press: Washington, DC (2009).

from the three integrated assessment models, at discount rates of 2.5, 3, and 5 percent. The fourth set, which represents the 95th percentile SCC estimate across all three models at a 3-percent discount rate, was 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,[89] although preference is given to consideration of the global benefits of reducing CO_2 emissions. Table IV.9 presents the values in the 2010 interagency group report,[90] which is reproduced in appendix 14A of the final rule TSD.

TABLE IV.9—ANNUAL SCC VALUES FROM 2010 INTERAGENCY REPORT, 2010–2050

[2007$ 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 final rule were generated using the most recent versions of the three integrated assessment models that have been published in the peer-reviewed literature, as described in the 2013 update from the interagency working group (revised July 2015).[91] Table IV.10 shows the updated sets of SCC estimates from the latest interagency update in 5-year increments from 2010 to 2050. The full set of annual SCC values between 2010 and 2050 is reported in appendix 14B of the final rule TSD. The central value that emerges is the average SCC across models at the 3-percent discount rate. However, for purposes of capturing the uncertainties involved in regulatory impact analysis, the interagency group emphasizes the importance of including all four sets of SCC values.

TABLE IV.10—ANNUAL SCC VALUES FROM 2013 INTERAGENCY UPDATE (REVISED JULY 2015), 2010–2050

[2007$ per metric ton CO_2]

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

It is important to recognize that a number of key uncertainties remain, and that current SCC estimates should be treated as provisional and revisable because 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 previously points out that there is tension between the goal of producing quantified estimates of the economic damages from an incremental ton of carbon and the limits of existing efforts to model these effects. There are a number of analytical challenges that are being addressed by the research community, including research programs housed in many of the Federal agencies participating in the interagency process to estimate the SCC. The interagency group intends to periodically review and reconsider those estimates to reflect increasing

[89] It is recognized that this calculation for domestic values is approximate, provisional, and highly speculative. There is no *a priori* reason why domestic benefits should be a constant fraction of net global damages over time.

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

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

knowledge of the science and economics of climate impacts, as well as improvements in modeling.

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

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

In responding to the NOPR, AHRI criticized DOE's use of SCC estimates that are subject to considerable uncertainty. (AHRI, No. 19 at pp. 19–21) The Associations[92] objected to DOE's use of the SCC in the cost-benefit analysis performed in the NOPR, and expressed the belief that the SCC should not be used in any rulemaking or policymaking until it undergoes a more rigorous notice, review, and comment process. (The Associations, No. 17 at p. 4)

In conducting the interagency process that developed the SCC values, technical experts from numerous agencies met on a regular basis to consider public comments, explore the technical literature in relevant fields, and discuss key model inputs and assumptions. Key uncertainties and model differences transparently and consistently inform the range of SCC estimates. These uncertainties and model differences are discussed in the interagency working group's reports, which are reproduced in appendices 14A and 14B of the final rule TSD, as are the major assumptions. Specifically, uncertainties in the assumptions regarding climate sensitivity, as well as other model inputs such as economic growth and emissions trajectories, are discussed and the reasons for the specific input assumptions chosen are explained. However, the three integrated assessment models used to estimate the SCC are frequently cited in the peer-reviewed literature and were used in the last assessment of the IPCC. In addition, new versions of the models that were used in 2013 to estimate revised SCC values were published in the peer-reviewed literature (see appendix 14B of the final rule TSD for discussion). Although uncertainties remain, the revised estimates that were issued in November 2013 are based on the best available scientific information on the impacts of climate change. The current estimates of the SCC have been developed over many years, using the best science available, and with input from the public.[93] DOE stands ready to work with OMB and the other members of the interagency working group on further review and revision of the SCC estimates as appropriate.

AHRI criticized DOE's reliance on the impact of CO_2 emissions over a time period greatly exceeding that used to measure the economic costs. (AHRI, No. 19 at pp. 19–21)

For the analysis of national impacts of standards, DOE considers the lifetime impacts of equipment shipped in a 30-year period. With respect to energy cost savings, impacts continue until all of the equipment shipped in the 30-year period is retired. Emissions impacts occur over the same period. With respect to the valuation of CO_2 emissions reductions, the SCC estimates developed by the interagency working group are meant to represent the full discounted value (using an appropriate range of discount rates) of emissions reductions occurring in a given year. For example, CO_2 emissions in 2050 have a long residence time in the atmosphere, and thus contribute to radiative forcing, which affects global climate, for a long time. In the case of both consumer economic costs and benefits and the value of CO_2 emissions reductions, DOE is accounting for the lifetime impacts of equipment shipped in the same 30-year period.

AHRI also criticized DOE's use of global rather than domestic SCC values, pointing out that EPCA references weighing of the need for national energy conservation. (AHRI, No. 19 at p. 20)

DOE's analysis estimates both global and domestic benefits of CO_2 emissions reductions. Following the recommendation of the interagency working group, the December 2014 NOPR and this final rule focus on a global measure of SCC. As discussed in appendix 14A of the final rule TSD, the climate change problem is highly unusual in at least two respects. First, it involves a global externality: Emissions of most GHGs contribute to damages around the world even when they are emitted in the United States. Consequently, to address the global nature of the problem, the SCC must incorporate the full (global) damages caused by GHG emissions. Second, climate change presents a problem that the United States alone cannot solve. Even if the United States were to reduce its GHG emissions to zero, that step would be far from enough to avoid substantial climate change. Other countries would also need to take action to reduce emissions if significant changes in the global climate are to be avoided. Emphasizing the need for a global solution to a global problem, the United States has been actively involved in seeking international agreements to reduce emissions and in encouraging other nations, including emerging major economies, to take significant steps to reduce emissions. When these considerations are taken as a whole, the interagency group concluded that a global measure of the benefits from reducing U.S. emissions is preferable. DOE's approach is not in contradiction of the requirement to weigh the need for national energy conservation, as one of the main reasons for national energy conservation is to contribute to efforts to mitigate the effects of global climate change.

AHRI disputed DOE's assumption that SCC values will increase over time. It suggested that adaptation and mitigation efforts would work in the opposite direction. (AHRI, No. 19 at p. 21) As discussed in appendix 14A of the final rule TSD, SCC increases over time because future emissions are expected to produce larger incremental damages as physical and economic systems become more stressed in response to greater climatic change. The approach used by the interagency working group allowed estimation of the growth rate of the SCC directly using the three integrated assessment models, which helps to ensure that the estimates are internally consistent with other modeling assumptions. Adaptation and mitigation efforts, while necessary and important, are not without cost,

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[92] The U.S. Chamber of Commerce, the American Chemistry Council, the American Forest & Paper Association, the American Fuel & Petrochemical Manufacturers, the American Petroleum Institute, the Brick Industry Association, the Council of Industrial Boiler Owners, the National Association of Manufacturers, the National Mining Association, the National Oilseed Processors Association, and the Portland Cement Association (collectively, ''the Associations'').

[93] In November 2013, OMB announced a new opportunity for public comment on the interagency technical support document underlying the revised SCC estimates. 78 FR 70586. In July 2015 OMB published a detailed summary and formal response to the many comments that were received. *https://www.whitehouse.gov/blog/2015/07/02/estimating-benefits-carbon-dioxide-emissions-reductions.*

particularly if their implementation is delayed.

1. Social Cost of Other Air Pollutants

As noted previously, DOE has estimated how the considered energy conservation standards would decrease power sector NO_X emissions in those 22 States not affected by the CAIR. DOE estimated the monetized value of net NO_X emissions reductions resulting from each of the TSLs considered for this final rule based on estimates developed by EPA for 2016, 2020, 2025, and 2030.[94] The values reflect estimated mortality and morbidity per ton of directly emitted NO_X reduced by electricity generating units. EPA developed estimates using a 3-percent and a 7-percent discount rate to discount future emissions-related costs. The values in 2016 are $5,562/ton using a 3-percent discount rate and $4,920/ton using a 7-percent discount rate (2014$). DOE extrapolated values after 2030 using the average annual rate of growth in 2016–2030. DOE multiplied the emissions reduction (tons) in each year by the associated $/ton values, and then discounted each series using discount rates of 3 percent and 7 percent as appropriate.

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

L. Utility Impact Analysis

The utility impact analysis estimates several effects on the electric power industry that would result from the adoption of new or amended energy conservation standards. The utility impact analysis estimates the changes in installed electrical capacity and generation that would result for each TSL. The analysis is based on published output from the NEMS associated with *AEO2015*. NEMS produces the *AEO* Reference case, as well as a number of side cases that estimate the economy-wide impacts of changes to energy supply and demand. DOE uses published side cases to estimate the marginal impacts of reduced energy demand on the utility sector. These marginal factors are estimated based on the changes to electricity sector generation, installed capacity, fuel consumption, and emissions in the *AEO* Reference case and various side cases. Details of the methodology are provided in the appendices to chapters 13 and 15 of the final rule TSD.

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

M. Employment Impact Analysis

Employment impacts include direct and indirect impacts. Direct employment impacts are any changes in the number of employees of manufacturers of the products 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 appliances. Indirect employment impacts from standards consist of the jobs created or eliminated in the national economy due to (1) reduced spending by end users on energy; (2) reduced spending on new energy supply by the utility industry; (3) increased customer spending on the purchase of new products; and (4) the effects of those three factors throughout the economy.

One method for assessing the possible effects on the demand for labor of such shifts in economic activity is to compare sector employment statistics developed by the Labor Department's Bureau of Labor Statistics (BLS). BLS regularly publishes its estimates of the number of jobs per million dollars of economic activity in different sectors of the economy, as well as the jobs created elsewhere in the economy by this same economic activity. Data from BLS indicate that expenditures in the utility sector generally create fewer jobs (both directly and indirectly) than expenditures in other sectors of the economy.[95] 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 customer utility bills. Because reduced customer 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 energy conservation standards for SPVUs.

For the amended standard levels considered in the final rule, DOE estimated indirect national employment impacts using an input/output model of the U.S. economy called Impact of Sector Energy Technologies version 3.1.1 (ImSET).[96] ImSET is a special-purpose version of the ''U.S. Benchmark National Input-Output'' (I–O) model, which was designed to estimate the national employment and income effects of energy-saving technologies. The ImSET software includes a computer-based I–O model having structural coefficients that characterize economic flows among the 187 sectors. ImSET's national economic I–O structure is based on a 2002 U.S. benchmark table, specially aggregated to the 187 sectors most relevant to industrial, commercial, and residential building energy use. DOE notes that ImSET is not a general equilibrium forecasting model, and understands the uncertainties involved in projecting employment impacts, especially changes in the later years of the analysis. Because ImSET does not incorporate price changes, the employment effects predicted by ImSET may over-estimate actual job impacts over the long run. For the final rule, DOE used ImSET only to estimate short-term (through 2023) employment impacts.

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

AHRI commented that the employment analysis ignores the immediately apparent effects on employment and relies on unsupported analysis for effects on the general economy. AHRI claimed that DOE's current approach ignores the ripple effects of the burdens on manufacturers (on suppliers, their employees, and investors). (AHRI, No. 19 at pp. 24–26)

DOE conducts two separate analyses of employment impacts of standards. The MIA looks at the potential impacts of amended energy conservation standards on direct employment in manufacturing of particular covered

[94] *http://www2.epa.gov/benmap/sector-based-pm25-benefit-ton-estimates.*

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

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

products. As described in section V.B.2.b of this document, DOE estimates that the adopted standards could either slightly increase or decrease the number of SPVU production workers. To estimate employment impacts in the general economy, DOE used ImSET, an I–O model that was specifically designed to estimate the national employment effects of energy-saving technologies. Here too the estimated impacts of the amended standards for SPVUs are negligible. DOE did not have sufficient information to estimate how suppliers to SPVU manufacturers would be affected by the standards, but it is likely that any additional costs would be passed on in the price of goods sold to the manufacturers.

V. Analytical Results

The following section addresses the results from DOE's analyses with respect to the considered energy conservation standards for SPVAC and SPVHP equipment. It addresses the TSLs examined by DOE and the projected impacts of each of these levels if adopted as energy conservation standards for SPVAC and SPVHP equipment. Additional details regarding DOE's analyses are contained in the final rule TSD supporting this document.

A. Trial Standard Levels

DOE developed TSLs that combine efficiency levels for each equipment class of SPVACs and SPVHPs. Table V.1 presents the efficiency EERs for each equipment class in the EPCA and ASHRAE baseline and each TSL. TSL 1 consists of efficiency level 1 for equipment classes less than 65,000 Btu/h. TSL 2 consists of efficiency level 2 for equipment classes less than 65,000 Btu/h. TSL 3 consists of efficiency level 3 for equipment classes less than 65,000 Btu/h. TSL 4 consists of efficiency level 4 (max-tech) for equipment classes less than 65,000 Btu/h. For SPVACs between 65,000 and 135,000 Btu/h, there are no models on the market above the ASHRAE level, and for SPVHPs between 65,000 and 135,000 Btu/h and SPVUs greater than or equal to 135,000 Btu/h and less than 240,000 Btu/h, there are no models on the market at all, and, therefore, DOE had no basis with which to develop higher efficiency levels or conduct analyses. As a result, for each TSL, the EER (and COP) for these equipment classes is shown as the ASHRAE standard level of 10.0 EER (and 3.0 COP for heat pumps).

TABLE V.1—EPCA BASELINE, ASHRAE BASELINE, AND TRIAL STANDARD LEVELS FOR SPVUS

Equipment class	EPCA baseline	ASHRAE baseline	Trial standard levels EER(/COP)			
			1	2	3	4
SPVACs <65,000 Btu/h	9.0	10.0	10.5	11.0	11.75	12.0
SPVHPs <65,000 Btu/h	9.0/3.0	10.0/3.0	10.5/3.2	11.0/3.3	11.75/3.9	12.0/3.9
SPVACs ≥65,000 Btu/h and <135,000 Btu/h	8.9	10.0	10.0	10.0	10.0	10.0
SPVHPs ≥65,000 Btu/h and <135,000 Btu/h	8.9/3.0	10.0/3.0	10.0/3.0	10.0/3.0	10.0/3.0	10.0/3.0
SPVACs ≥135,000 Btu/h and <240,000 Btu/h	8.6	10.0	10.0	10.0	10.0	10.0
SPVHPs ≥135,000 Btu/h and <240,000 Btu/h	8.6/2.9	10.0/3.0	10.0/3.0	10.0/3.0	10.0/3.0	10.0/3.0

For clarity, DOE has also summarized the different design options that would be introduced across equipment classes at each TSL in Table V.2.

TABLE V.2—DESIGN OPTIONS AT EACH TRIAL STANDARD LEVEL FOR SPVUS

Equipment class	ASHRAE baseline	Trial standard levels			
		1	2	3	4
Design Options for Each TSL (options are cumulative—TSL 4 includes all preceding options)					
SPVACs <65,000 Btu/h	BPM indoor motor, increased HX face area.	Addition of HX tube row.	Addition of HX tube row.	Improved compressor efficiency, increased HX face area.	BPM outdoor motor, high-efficiency outdoor fan blade, dual condensing heat exchangers.
SPVHPs <65,000 Btu/h	BPM indoor motor, increased HX face area.	Addition of HX tube row.	Addition of HX tube row.	Improved compressor efficiency, increased HX face area.	BPM outdoor motor, high-efficiency outdoor fan blade, dual condensing heat exchangers.
*SPVACs ≥65,000 Btu/h and <135,000 Btu/h.	BPM indoor motor, increased HX face area.	No change	No change	No change	No change.
*SPVHPs ≥65,000 Btu/h and <135,000 Btu/h.	BPM indoor motor, increased HX face area.	No change	No change	No change	No change.
SPVACs ≥135,000 Btu/h and <240,000 Btu/h.	No change	No change	No change	No change	No change.
SPVHPs ≥135,000 Btu/h and <240,000 Btu/h.	No change	No change	No change	No change	No change.

* TSL 1 through TSL 4 are marked as "no change" because for these equipment classes, each TSL consists of the ASHRAE efficiency level.

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 SPVACs and SPVHPs is economically justified. (42 U.S.C. 6313(a)(6)(B)(ii)) The following sections generally discuss how DOE has addressed each of those factors in this rulemaking.

1. Economic Impacts on Commercial Consumers

DOE analyzed the economic impacts on SPVAC and SPVHP equipment consumers by looking at the effects that amended standards would have on the LCC and PBP. DOE also examined the impacts of potential standards on consumer subgroups. These analyses are discussed below.

a. Life-Cycle Cost and Payback Period

Customers affected by new standards usually incur higher purchase prices and lower operating costs. DOE evaluates these impacts on individual customers by calculating changes in LCC and the PBP associated with the TSLs. The results of the LCC analysis for each TSL were obtained by comparing the installed and operating costs of the equipment in the base-case scenario (EPCA and ASHRAE baselines) against the standards-case scenarios at each TSL. It is important to note that for equipment less than 65,000 Btu/h, efficiency levels higher than ASHRAE were compared against ASHRAE-level equipment. Inputs used for calculating the LCC include total installed costs (*i.e.,* equipment price plus installation costs), operating expenses (*i.e.,* annual energy savings, energy prices, energy price trends, repair costs, and maintenance costs), equipment lifetime, and discount rates.

The LCC analysis is carried out using Monte Carlo simulations. Consequently, the results of the LCC analysis are distributions covering a range of values, as opposed to a single deterministic value. DOE presents the mean or median values, as appropriate, calculated from the distributions of results. The LCC analysis also provides information on the percentage of consumers for whom an increase in the minimum efficiency standard would have a positive impact (net benefit), a negative impact (net cost), or no impact.

DOE also performed a PBP analysis as part of the LCC analysis. The PBP is the number of years it would take for the consumer to recover the increased costs of higher-efficiency equipment as a result of energy savings based on the operating cost savings. The PBP is an economic benefit-cost measure that uses benefits and costs without discounting. Chapter 8 of the final rule TSD provides detailed information on the LCC and PBP analysis.

As described in section IV.G, DOE used a ''roll-up'' scenario in this rulemaking. Under the roll-up scenario, DOE assumes that the market shares of the efficiency levels (in the ASHRAE base-case) that do not meet the standard level under consideration would be ''rolled up'' into (meaning ''added to'') the market share of the efficiency level at the standard level under consideration, and the market shares of efficiency levels that are above the standard level under consideration would remain unaffected. Customers in the ASHRAE base-case scenario who buy the equipment at or above the TSL under consideration would be unaffected if the standard were to be set at that TSL. Customers in the ASHRAE base-case scenario who buy equipment below the TSL under consideration would be affected if the standard were to be set at that TSL. Among these affected customers, some may benefit from lower LCCs of the equipment and some may incur net cost due to higher LCCs, depending on the inputs to the LCC analysis such as electricity prices, discount rates, installation costs, and markups.

DOE's LCC and PBP analysis provided key outputs for each efficiency level above the baseline (*i.e.,* efficiency levels more stringent than those in ASHRAE 90.1–2013), as reported in Table V.3 and Table V.4.[97] DOE's results indicate that for SPVAC and SPVHP units, affected customer savings are positive at TSLs 1, 2, and 3. LCC and PBP results using the EPCA baseline are available in appendix 8B of the final rule TSD.

TABLE V.3—SUMMARY LCC AND PBP RESULTS FOR SPVACS, <65,000 BTU/H CAPACITY

TSL	Efficiency level	Life-cycle cost (2014$)			Life-cycle cost savings				Payback period (years)
		Installed cost	Discounted operating cost	LCC	Average savings (2014$*)	% of customers that experience			Median
						Net cost	No impact	Net benefit	
	ASHRAE Baseline	4,708	13,029	17,737	....	....	....	....	....
1	1	4,871	12,750	17,621	115	28	26	47	9.1
2	2	5,035	12,499	17,534	174	39	1	59	9.6
3	3	5,386	12,190	17,576	130	53	0	47	12.7
4	4	6,151	12,232	18,384	(678)	85	0	15	25.2

* Parentheses indicate negative values.

TABLE V.4—SUMMARY LCC AND PBP RESULTS FOR SPVHPS, <65,000 BTU/H CAPACITY

TSL	Efficiency level	Life-cycle cost (2014$)			Life-cycle cost savings				Payback period (years)
		Installed cost	Discounted operating cost	LCC	Average savings (2014$*)	% of customers that experience			Median
						Net cost	No impact	Net benefit	
	ASHRAE Baseline	5,314	32,799	38,112	....	....	....	....	....
1	1	5,505	32,231	37,736	375	0	26	74	4.5
2	2	5,697	31,887	37,584	435	2	1	96	5.8
3	3	6,102	31,095	37,197	817	4	0	95	6.2

[97] Because there are no units above the ASHRAE baseline in the classes greater than or equal to 65,000 Btu/h and less than 135,000 Btu/h, and no units greater than or equal to 135,000 Btu/h and less than 240,000 Btu/h, there are no LCC savings for these classes.

TABLE V.4—SUMMARY LCC AND PBP RESULTS FOR SPVHPS, <65,000 BTU/H CAPACITY—Continued

TSL	Efficiency level	Life-cycle cost (2014$)			Life-cycle cost savings				Payback period (years)
		Installed cost	Discounted operating cost	LCC	Average savings (2014$*)	% of customers that experience			Median
						Net cost	No impact	Net benefit	
4	4	6,989	31,176	38,165	(153)	69	0	31	14.4

* Parentheses indicate negative values.

b. Consumer Subgroup Analysis

As described in section IV.H of this final rule, DOE estimated the impact of the considered TSLs on three consumer subgroups. Table V.5 and Table V.6 show the results using the ASHRAE baseline for SPVAC and SPVHP consumer subgroups. In most cases, the average LCC savings and PBP for the subgroup at the considered efficiency levels are not substantially different from the average for all businesses. Chapter 11 of the final rule TSD presents the complete LCC and PBP results for the subgroups.

TABLE V.5—COMPARISON OF IMPACTS FOR CONSUMER SUBGROUPS WITH ALL CONSUMERS, SPVACS <65,000 BTU/H

TSL	Energy efficiency level	LCC Savings (2014$ *)				Median payback period (years)			
		Construction and mining	Education	High rate	All	Construction and mining	Education	High rate	All
1	1	(40)	90	98	115	15.5	10.3	9.0	9.1
2	2	(84)	131	146	174	16.5	10.9	9.6	9.6
3	3	(312)	48	84	130	22.4	14.5	12.6	12.7
4	4	(1,158)	(802)	(719)	(678)	49.1	33.0	25.4	25.2

* Parentheses indicate negative values.

TABLE V.6—COMPARISON OF IMPACTS FOR CONSUMER SUBGROUPS WITH ALL CONSUMERS, SPVHPS <65,000 BTU/H

TSL	Energy efficiency level	LCC Savings (2014$ *)				Median payback period (years)			
		Construction and mining	Education	High rate	All	Construction and mining	Education	High rate	All
1	1	273	459	359	375	4.9	4.4	4.5	4.5
2	2	279	562	413	435	6.1	5.3	5.8	5.8
3	3	533	1,047	772	817	6.8	6.0	6.3	6.2
4	4	(431)	78	(192)	(153)	15.6	13.5	14.3	14.4

* Parentheses indicate negative values.

c. Rebuttable Presumption Payback

As discussed above, 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. In calculating a rebuttable presumption PBP for each of the considered TSLs, DOE used discrete values rather than distributions for input values, and, as required by EPCA, based the energy use calculation on the DOE test procedures for SPVAC and SPVHP equipment. As a result, DOE calculated a single rebuttable presumption payback value, and not a distribution of PBPs, for each efficiency level. Table V.7 presents the rebuttable-presumption PBPs for the considered TSLs. While DOE examined the rebuttable-presumption criterion, it considered whether the standard levels considered for this rule are economically justified through a more detailed analysis of the economic impacts of those levels, pursuant to 42 U.S.C. 6295(o)(2)(B)(i), that considers the full range of impacts to the consumer, manufacturer, Nation, and environment. The results of that analysis serve as the basis for DOE to definitively evaluate the economic justification for a potential standard level, thereby supporting or rebutting the results of any preliminary determination of economic justification. Table V.7 shows the rebuttable presumption PBPs for the considered TSLs for SPVAC and SPVHP equipment using the ASHRAE baseline.

TABLE V.7—REBUTTABLE-PRESUMPTION PAYBACK PERIOD (YEARS) FOR SPVAC AND SPVHP EQUIPMENT

Equipment class	Rebuttable presumption payback *(years)*			
	TSL 1	TSL 2	TSL 3	TSL 4
SPVACs <65,000 Btu/h	5.1	5.3	6.7	12.8
SPVHPs <65,000 Btu/h	3.6	4.4	4.8	9.7

2. Economic Impacts on Manufacturers

DOE performed an MIA to estimate the impact of amended energy conservation standards on SPVAC and SPVHP manufacturers. DOE calculated manufacturer impacts relative to a base case, defined as DOE adoption of the efficiency levels specified by ASHRAE Standard 90.1–2013. Consequently, when comparing the INPV impacts under the GRIM model, the baseline technology is at an efficiency of 10 EER/3.0 COP. The following subsection describes the expected impacts on manufacturers at each considered TSL. Chapter 12 of the final rule TSD explains the analysis in further detail, and also contains results using the EPCA baseline.

a. Industry Cash Flow Analysis Results

Table V.8 depicts the estimated financial impacts on manufacturers and the conversion costs that DOE expects manufacturers would incur at each TSL. The financial impacts on manufacturers are represented by changes in INPV.

As discussed in section IV.I.2, DOE modeled two different markup scenarios to evaluate the range of cash flow impacts on the SPVAC and SPVHP industry: (1) The preservation of gross margin percentage markup scenario; and (2) the preservation of per unit operating profit markup scenario.

To assess the 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. DOE assumed the nonproduction cost markup—which includes SG&A expenses, R&D expenses, interest, and profit—to be a factor of 1.28. These markups are consistent with the ones DOE assumed in the engineering analysis and in the base case of the GRIM. Manufacturers have indicated that it is optimistic to assume that as their production costs increase in response to an amended energy conservation standard, they would be able to maintain the same gross margin percentage markup. Therefore, DOE assumes that this scenario represents a high bound to industry profitability under an amended energy conservation standard.

To assess the more severe end of the range of potential impacts, DOE modeled the preservation of per unit operating profit markup scenario, which reflects manufacturer concerns about their inability to maintain their margins as manufacturing production costs increase to reach more-stringent efficiency levels. In this scenario, while manufacturers make the necessary investments required to convert their facilities to produce new standards-compliant equipment, operating profit does not change in absolute dollars and decreases as a percentage of revenue.

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 results a comparison of free cash flow between the base case and the standards case at each TSL in the year before amended 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.

The following tables present results for both the preservation of gross margin percentage markup scenario and the preservation of per-unit operating profit markup scenario. As noted, the preservation of operating profit scenario accounts for the more severe impacts presented.

TABLE V.8—MANUFACTURER IMPACT ANALYSIS RESULTS FOR SPVACS AND SPVHPS, GROSS MARGIN PERCENTAGE MARKUP SCENARIO

	Units	Base case	Trial standard level *			
			1	2	3	4
INPV	2014$M	41.2	36.7	37.0	34.8	20.4
Change in INPV	2014$M		(4.5)	(4.3)	(6.5)	(20.9)
	% Change	(10.9)	(10.3)	(15.7)	(50.6)	
Product Conversion Costs	2014$M		5.6	6.3	16.3	27.8
Capital Conversion Costs	2014$M		2.9	2.9	3.5	13.0
Total Conversion Costs	2014$M		8.5	9.2	19.8	40.9
Free Cash Flow **	2014$M	3.4	0.5	0.3	(2.8)	(12.0)
	% Change	(84.5)	(90.7)	(182.2)	(451.4)	

* Parentheses indicate negative values.
** DOE presents free cash flow impacts in 2018, the year before the 2019 compliance date for SPVACs in the standards case.

TABLE V.9—MANUFACTURER IMPACT ANALYSIS RESULTS FOR SPVACS AND SPVHPS, PRESERVATION OF OPERATING PROFIT MARKUP SCENARIO

	Units	Base case	Trial standard level *			
			1	2	3	4
INPV	2014$M	41.2	35.7	33.9	26.3	5.0
Change in INPV	2014$M		(5.5)	(7.4)	(15.0)	(36.2)
	% Change	(13.3)	(17.9)	(36.3)	(87.8)	
Product Conversion Costs	2014$M		5.6	6.3	16.3	27.8
Capital Conversion Costs	2014$M		2.9	2.9	3.5	13.0
Total Conversion Costs	2014$M		8.5	9.2	19.8	40.9
Free Cash Flow **	2014$M	3.4	0.5	0.3	(2.8)	(12.0)

TABLE V.9—MANUFACTURER IMPACT ANALYSIS RESULTS FOR SPVACS AND SPVHPS, PRESERVATION OF OPERATING PROFIT MARKUP SCENARIO—Continued

	Units	Base case	Trial standard level*			
			1	2	3	4
	% Change	(84.5)	(90.7)	(182.2)	(451.4)	

* Parentheses indicate negative values.
** DOE presents free cash flow impacts in 2018, the year before the 2019 compliance date for SPVACs in the standards case.

At TSL 1, the standard for all equipment classes with capacity less than 65,000 Btu/h is set at 10.5 EER/3.2 COP. The standard for all equipment classes with capacity greater than or equal to 65,000 Btu/h and less than 135,000 Btu/h and greater than or equal to 135,000 Btu/h and less than 240,000 Btu/h is set at the baseline (*i.e.,* 10.0 EER/3.0 COP). DOE estimates the change in INPV to range from −$5.5 to −$4.5 million, or a change of −13.3 percent to −10.9 percent. At this level, free cash flow is estimated to decrease to $0.5 million, or a decrease of 84.5 percent compared to the base-case value of $3.4 million in the year 2018, the year before the standards year. DOE does expect a standard at this level to require changes to manufacturing equipment, thereby resulting in capital conversion costs. The engineering analysis suggests that manufacturers would reach this amended standard by increasing heat exchanger size. Roughly 61 percent of the SPVU models listed in the AHRI Directory would need to be updated to meet this amended standard level. Estimated industry conversion costs total $8.5 million.

At TSL 2, the standard for all equipment classes with capacity less than 65,000 Btu/h is set at 11.0 EER/3.3 COP. The standards for all equipment classes with capacity greater than or equal to 65,000 Btu/h and less than 135,000 Btu/h and greater than or equal to 135,000 Btu/h and less than 240,000 Btu/h remain at baseline as in TSL 1. DOE estimates impacts on INPV to range from −$7.4 million to −$4.3 million, or a change in INPV of −17.9 percent to −10.3 percent. At this level, free cash flow is estimated to decrease to $0.3, or a change of −90.7 percent compared to the base-case value of $3.4 million in the year 2018. Based on the engineering analysis, DOE expects manufacturers to reach this level of efficiency by further increasing the size of the heat exchanger. Seventy-one percent of the SPVU models listed in the AHRI Directory would require redesign at this amended standard level. Product updates and associated testing expenses would further increase conversion costs for the industry to $9.2 million.

At TSL 3, the standard increases to 11.75 EER/3.7 COP for equipment with capacity less than 65,000 Btu/h. The standards for SPVAC and SPVHP equipment with capacity greater than or equal to 65,000 Btu/h and less than 135,000 Btu/h and greater than or equal to 135,000 Btu/h and less than 240,000 Btu/h remain at baseline as in TSLs 1 and 2. DOE estimates impacts on INPV to range from −$15.0 million to −$6.5 million, or a change in INPV of −36.3 percent to −15.7 percent. At this level, free cash flow is estimated to decrease to less than zero, to −$2.8 million, or a change of −182.2 percent compared to the base-case value of $3.4 million in the year 2018. The engineering analysis suggests that manufacturers would reach this amended standard by once again increasing heat exchanger size and by switching to more-efficient two-stage compressors. Manufacturers that produce heat exchangers in-house may need to add coil fabrication equipment to accommodate the size of the heat exchanger necessary to meet the standard. Additionally, the new heat exchanger size may require manufacturers to invest additional capital into their sheet metal bending lines. Ninety-six percent of the SPVU models listed in the AHRI Directory would require redesign at this amended standard level. DOE estimates total conversion costs to be $19.8 million for the industry.

At TSL 4, the standard increases to 12.0 EER/COP of 3.7 for SPVAC and SPVHP equipment with capacity less than 65,000 Btu/h. The standards for SPVAC and SPVHP equipment with capacity greater than or equal to 65,000 Btu/h and less than 135,000 Btu/h and greater than or equal to 135,000 Btu/h and less than 240,000 Btu/h remain at baseline as in TSLs 1, 2, and 3. DOE estimates impacts on INPV to range from −$36.2 million to −$20.9 million, or a change in INPV of −87.8 percent to −50.6 percent. At this level, free cash flow is estimated to decrease to −$12.0 million, or a decrease of 451.4 percent compared to the base-case value of $3.4 million in the year 2018. TSL 4 represents the max-tech standard level. DOE expects manufacturers to meet the amended standard by dramatically increasing the size of the evaporating heat exchanger and incorporating two condensing heat exchangers. Ninety-seven percent of all SPVU models listed in the AHRI Directory would require redesign at this amended standard level. Additionally, DOE expects designs to use BPMs for both the indoor and outdoor motors. Total conversion costs are expected to reach $40.9 million for the industry.

b. Direct Impacts on Employment

To quantitatively assess the potential impacts of amended energy conservation standards on direct employment, DOE used the GRIM to estimate the domestic labor expenditures and number of direct employees in the base case and at each TSL from 2014 through 2048. DOE used statistical data from the U.S. Census Bureau's 2011 Annual Survey of Manufacturers,[98] the results of the engineering analysis, and interviews with manufacturers to determine the inputs necessary to calculate industry-wide labor expenditures and domestic direct employment levels. Labor expenditures related to producing the equipment are a function of the labor intensity of producing the equipment, 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. DOE estimates that 95 percent of SPVAC and SPVHP units are produced domestically.

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 Annual Survey of Manufacturers). The production worker estimates in this section only cover workers up to the line-supervisor level

[98] U.S. Census Bureau, Annual Survey of Manufacturers: General Statistics: Statistics for Industry Groups and Industries (2011) (Available at *http://www.census.gov/manufacturing/asm/index.html*).

who are directly involved in fabricating and assembling a product within an original equipment manufacturer 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.

To estimate an upper bound to employment change, DOE assumes all domestic manufacturers would choose to continue producing products in the U.S. and would not move production to foreign countries. To estimate a lower bound to employment, DOE estimated the maximum portion of the industry that would choose to leave the industry rather than make the necessary product conversions. A complete description of the assumptions used to generate these upper and lower bounds can be found in chapter 12 of the final rule TSD.

As noted above, DOE estimates that 95 percent of SPVAC and SPVHP units sold in the United States are manufactured domestically. In the absence of amended energy conservation standards, DOE estimates that the SPVAC and SPVHP industry would employ 310 domestic production workers in 2019.

Table V.10 shows the range of the impacts of potential amended energy conservation standards on U.S. production workers of SPVUs.

TABLE V.10—POTENTIAL CHANGES IN THE TOTAL NUMBER OF STANDARD SIZE SPVAC AND SPVHP PRODUCTION WORKERS IN 2019

	Trial standard level *				
	Base case †	1	2	3	4
Total Number of Domestic Production Workers in 2019	310	294 to 314	294 to 325	260 to 337	223 to 403
Potential Changes in Domestic Production Workers in 2019	—	(16) to 4	(16) to 15	(50) to 27	(87) to 93

* Parentheses indicate negative values.
† Base case assumes 310 domestic production workers in the SPVAC and SPVHP industry in 2019.

The upper end of the range estimates the maximum increase in the number of production workers in the SPVAC and SPVHP industry after implementation of an amended energy conservation standard. It assumes manufacturers would continue to produce the same scope of covered equipment within the United States and would require some additional labor to produce more-efficient equipment.

The lower end of the range indicates the total number of U.S. production workers in the industry who could lose their jobs if all existing production were moved outside of the United States. The lower end of the range represents the maximum decrease to the total number of U.S. production workers in the industry due to manufacturers choosing to leave the industry or due to moving production to other countries.

This conclusion is independent of any conclusions regarding indirect employment impacts in the broader United States economy, which are documented in chapter 16 of the final rule TSD.

c. Impacts on Manufacturing Capacity

According to SPVAC and SPVHP manufacturers interviewed, demand for SPVACs and SPVHPs, which roughly correlates to trends in telecommunications spending and construction of new schools, peaked in the 2001–2006 time frame. As a result, excess capacity exists in the industry today.

Except at the max-tech level, any necessary redesign of SPVAC and SPVHP models would not fundamentally change the assembly of the equipment. Any bottlenecks are more likely to come from the redesign, testing, and certification process rather than from production capacity. To that end, some interviewed manufacturers expressed concern that the redesign of all products to include BPM motors would require a significant portion of their engineering resources, taking resources away from customer responsiveness and R&D efforts. Furthermore, some manufacturers noted that an amended standard requiring BPMs would monopolize their testing resources and facilities—to the point where some manufacturers anticipated the need to build new psychometric test labs to have enough in-house testing capacity to meet an amended standard. Once all products have been redesigned to meet an amended energy conservation standard, manufacturers did not anticipate any production constraints.

d. Impacts on Subgroups of Manufacturers

As discussed above, using average cost assumptions to develop an industry cash flow estimate is not adequate for assessing differential impacts among subgroups of manufacturers. Small manufacturers, niche equipment manufacturers, and manufacturers exhibiting a cost structure substantially different from the industry average could be affected disproportionately. As discussed in section IV.I, using average cost assumptions developed for an industry cash-flow estimate is inadequate to assess differential impacts among manufacturer subgroups.

For SPVAC and SPVHP equipment, DOE identified and evaluated the impact of amended energy conservation standards on one subgroup, specifically 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 two domestic manufacturers in the industry that qualify as small businesses. The SPVAC and SPVHP small business subgroup analysis is discussed in chapter 12 of the final rule TSD and in section VI.C of this document.

e. Cumulative Regulatory Burden

While any one regulation may not impose a significant burden on manufacturers, the combined effects of several 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. Multiple regulations affecting the same manufacturer can strain profits and can 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 SPVAC and SPVHP manufacturers that will take effect approximately 3 years before or after the compliance date of amended energy conservation standards for these products. For equipment with standards that are more stringent than those contained in ASHRAE Standard 90.1–2013, the compliance date is 4 years after publication of an energy conservation standards final rule (*i.e.,* compliance date assumed to be 2019 for the purposes of MIA). For equipment with standards that are set at the levels contained in ASHRAE Standard 90.1–2013, the compliance date is 2 or 3 years after the effective date of the requirements in ASHRAE Standard 90.1–2013, depending on equipment size (*i.e.,* 2015 or 2016). For this cumulative regulatory burden analysis, DOE considered regulations that could affect SPVAC and SPVHP manufacturers that take effect from 2012 to 2022, to account for the range of compliance years.

In interviews, manufacturers cited Federal regulations on equipment other than SPVACs and SPVHPs that contribute to their cumulative regulatory burden. In particular, manufacturers noted that some of them also produce residential central air conditioners and heat pumps, residential furnaces, room air conditioners, and water-heating equipment. These products have amended energy conservation standards that go into effect within 3 years of the compliance date for any amended SPVAC and SPVHP standards. The compliance years and expected industry conversion costs are listed in the following table.

TABLE V.11—COMPLIANCE DATES AND EXPECTED CONVERSION EXPENSES OF FEDERAL ENERGY CONSERVATION STANDARDS AFFECTING SPVAC AND SPVHP MANUFACTURERS

Federal energy conservation standards	Approximate compliance date	Estimated total industry conversion expense
2008 Packaged Terminal Air Conditioners and Heat Pumps 73 FR 58772 (Oct. 7, 2008).	2012	$33.7M (2007$)
2011 Room Air Conditioners 76 FR 22454 (April 21, 2011); 76 FR 52854 (August 24, 2011).	2014	$171M (2009$)
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 79 FR 32050 (June 3, 2014)	2017	$33.6M (2012$)
Packaged Terminal Air Conditioners and Heat Pumps 80 FR 43162 (July 21, 2015).	2017	N/A ***
Dishwashers∞	2018	TBD
Commercial Warm-Air Furnaces∞ 80 FR 6181 (February 4, 2015).	2018	$19.9M (2013$)
Commercial Packaged Air Conditioners and Heat Pumps∞79 FR 58948 (September 18, 2014).	2019	$226.4M (2013$)
Furnace Fans 79 FR 38130 (July 3, 2014)	2019	$40.6M (2013$)
Miscellaneous Residential Refrigeration∞	2019	TBD
Commercial Water Heaters∞	2019	TBD
Commercial Packaged Boilers∞	2020	TBD
Residential Water Heaters∞	2021	TBD
Clothes Dryers∞	2022	TBD
Central Air Conditioners∞	2022	TBD
Room Air Conditioners∞	2022	TBD

* Conversion expenses for manufacturers of oil-fired furnaces and gas-fired 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-fired 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 April 24, 2014 remand 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 costs associated with this rule reflect implementation of the amended standards for the remaining furnace product classes (*i.e.,* oil-fired furnaces).

*** This rule adopted the efficiency levels established in ASHRAE Standard 90.1–2013. DOE does not conduct economic analysis for this level, as it is the minimum level that DOE is statutorily required to adopt. ∞ The final rule for this energy conservation standard has not been published. The compliance date and analysis of conversion costs have not been finalized at this time. (If a value is provided for total industry conversion expense, this value represents an estimate from the NOPR.)

Some stakeholders have expressed concern regarding potential conflicts with other certification programs, in particular EPA ENERGY STAR requirements. DOE realizes that the cumulative effect of several regulations on an industry may significantly increase the burden faced by manufacturers who need to comply with multiple certification programs from different organizations and levels of government. However, the Department does not consider ENERGY STAR in its presentation of cumulative regulatory burden, because ENERGY STAR is a voluntary program and is not Federally mandated.

Some stakeholders also noted that The Clean Air Act has historically affected their products. The Clean Air Act defines the EPA's responsibilities for protecting and improving the nation's air quality and the stratospheric ozone layer. For SPVU manufacturers, the most significant of these additional regulations are the EPA mandated phase-out of hydrochlorofluorocarbons (HCFCs). The Act demands on a quarterly basis that any person who produced, imported, or exported certain ozone-depleting substances, including HCFC refrigerants, must report the amount produced, imported, and exported. Additionally, effective January 1, 2015, selling, manufacturing, and using any ozone-depleting substance is banned unless such substance has been used, recovered, and recycled; is used and entirely consumed in the production of other chemicals; or is used as a refrigerant in appliances manufactured prior to January 1, 2020. Finally, production phase-outs will continue until January 1, 2030, when such production will be illegal. For HCFC–22, which is commonly used in older air-conditioning equipment, EPA regulations make it illegal to manufacture a new appliance using virgin HCFC–22 refrigerant or pre-charge any appliance or appliance component with HCFC–22 as of January 1, 2010. Additionally, HCFC–22 production will stop by January 1, 2020. These bans could trigger design changes to low GWP refrigerants.

3. National Impact Analysis

a. Significance of Energy Savings

To estimate the energy savings attributable to potential amended standards for SPVUs, DOE compared the energy consumption of those products under the ASHRAE base case to their anticipated energy consumption under each TSL. DOE also compared the energy consumption of SPVUs under the ASHRAE Standard 90.1–2013 efficiency levels to energy consumption of SPVUs under the EPCA base case (*i.e.,* the current Federal standard). The savings are measured over the entire lifetime of products purchased in the 30-year period that begins in the year of anticipated compliance with amended standards (2015–2044 for the ASHRAE level and 2019–2048 for higher efficiency levels). Table V.12 presents DOE's projections of the NES for the ASHRAE level and for each TSL considered for SPVUs. The savings were calculated using the approach described in section IV.G.1 of this final rule.

TABLE V.12—CUMULATIVE NATIONAL ENERGY SAVINGS FOR SPVUS SHIPPED IN 2015–2044 (ASHRAE) OR 2019–2048 (HIGHER)

	ASHRAE Standard 90.1–2013 *	Trial standard level ** (quads)			
		1	2	3	4
Primary energy	0.15	0.06	0.14	0.21	0.21
FFC energy	0.16	0.06	0.15	0.22	0.22

* Energy savings determined from comparing SPVU energy consumption at the ANSI/ASHRAE/IES Standard 90.1–2013 efficiency level to that at the Federal minimum efficiency level.
** Energy savings determined from comparing SPVU energy consumption at each TSL to that at the ASHRAE 90.1–2013 efficiency level.

Each TSL that is more stringent than the corresponding levels in ANSI/ASHRAE/IES Standard 90.1–2013 results in additional energy savings. The NES from adopting the ANSI/ASHRAE/IES Standard 90.1–2013 for SPVUs saves 0.16 quad over the Federal minimum standards.

OMB Circular A–4 [99] requires agencies to present analytical results, including separate schedules of the monetized benefits and costs that show the type and timing of benefits and costs. Circular A–4 also directs agencies to consider the variability of key elements underlying the estimates of benefits and costs. For this rulemaking, DOE undertook a sensitivity analysis using nine, rather than 30, years of product 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.[100] The review timeframe established in EPCA is generally not synchronized with the product lifetime, product manufacturing cycles, or other factors specific to SPVUs. Thus, such results are presented for informational purposes only and are not indicative of any change in DOE's analytical methodology. The NES sensitivity analysis results based on a 9-year analytical period are presented in Table V.13. The impacts are counted over the lifetime of SPVUs purchased in 2015–2023 for the ASHRAE level and for 2019–2027 for higher levels.

TABLE IV.13—CUMULATIVE NATIONAL ENERGY SAVINGS FOR SPVUS; 9 YEARS OF SHIPMENTS
[2015–2023 (ASHRAE) or 2019–2027 (Higher)]

	ASHRAE Standard 90.1–2013 *	Trial standard level ** (quads)			
		1	2	3	4
Primary energy	0.046	0.018	0.038	0.068	0.069
FFC energy	0.049	0.018	0.039	0.071	0.072

* Energy savings determined from comparing SPVU energy consumption at the ANSI/ASHRAE/IES Standard 90.1–2013 efficiency level to that at the Federal minimum efficiency level.
** Energy savings determined from comparing SPVU energy consumption at each TSL to that at the ASHRAE 90.1–2013 efficiency level.

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

[100] Section 325(m) of EPCA requires DOE to review its standards at least once every 6 years, and requires, for certain products, a 3-year period after any new standard is promulgated before compliance is required, except that in no case may any new standards be required within 6 years of the compliance date of the previous standards. While adding a 6-year review to the 3-year compliance period adds up to 9 years, DOE notes that it may undertake reviews at any time within the 6-year period and that the 3-year compliance date may yield to the 6-year backstop. A 9-year analysis period may not be appropriate given the variability that occurs in the timing of standards reviews and the fact that for some consumer products, the compliance period is 5 years rather than 3 years.

b. Net Present Value of Consumer Costs and Benefits

DOE estimated the cumulative NPV of the total costs and savings for consumers that would result from the TSLs considered for SPVAC and SPVHP equipment. In accordance with OMB's guidelines on regulatory analysis,[101] DOE calculated the NPV using both a 7-percent and a 3-percent real discount rate.

Table V.14 shows the consumer NPV results using the ASHRAE baseline with impacts counted over the lifetime of equipment purchased in 2019–2048. Results using the EPCA baseline can be found in chapter 10 of the final rule TSD.

TABLE V.14—CUMULATIVE NET PRESENT VALUE OF CONSUMER BENEFITS FOR SPVUS SHIPPED IN 2019–2048

Discount rate	Trial standard level ** (billion 2014$)			
	1	2	3	4
3 percent	0.20	0.38	(0.33)	(0.55)
7 percent	0.07	0.11	(0.27)	(0.43)

* Parentheses indicate negative values.

The NPV results based on the aforementioned 9-year analytical period are presented in Table V.15. The impacts are counted over the lifetime of SPVU equipment purchased in 2019–2027. As mentioned previously, such results are presented for informational purposes only and is not indicative of any change in DOE's analytical methodology or decision criteria.

TABLE V.15—CUMULATIVE NET PRESENT VALUE OF CONSUMER BENEFITS FOR SPVUS: 9 YEARS OF SHIPMENTS 2019–2027

Discount rate	Trial standard level ** (billion 2014$)			
	1	2	3	4
3 percent	0.08	0.15	0.06	(0.15)
7 percent	0.04	0.06	(0.03)	(0.19)

* Parentheses indicate negative values.

The above results reflect the use of a constant price trend over the analysis period (see section IV.G.1.b of this document). DOE also conducted a sensitivity analysis that considered one scenario with price decrease and one scenario with a price increase. The results of these alternative cases are presented in appendix 10B of the final rule TSD. In the price increase case, the NPV of consumer benefits is lower than in the default case. In the price decrease case, the NPV of consumer benefits is higher than in the default case.

c. Indirect Impacts on Employment

DOE expects energy conservation standards for SPVUs to reduce energy bills for consumers of those products, with the resulting net savings being redirected to other forms of economic activity. These expected shifts in spending and economic activity could affect the demand for labor. As described in section IV.M of this document, DOE used an input/output model of the U.S. economy to estimate indirect employment impacts of the TSLs that DOE considered 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 (2019–2023), where these uncertainties are reduced.

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

4. Impact on Utility or Performance of Equipment

In performing the engineering analysis, DOE considered efficiency levels that may be achieved using design options that would not lessen the utility or performance of the individual classes of equipment. (42 U.S.C. 6316(a); 42 U.S.C. 6295(o)(2)(B)(i)(IV)) As presented in section III.C of this document, DOE concluded that the efficiency levels adopted in this final rule are technologically feasible and would not reduce the utility or performance of SPVACs and SPVHPs. SPVAC and SPVHP manufacturers currently offer equipment that meets or exceeds the amended standard levels.

5. Impact of Any Lessening of Competition

EPCA directs DOE to consider the impact of any lessening of competition, as determined in writing by the Attorney General, that is likely to result from a standard. It also directs the Attorney General to determine the impact, if any, of any lessening of competition likely to result from a standard and to transmit such determination to the Secretary within 60 days of the publication of a proposed rule, together with an analysis of the nature and extent of the impact. DOE transmitted a copy of its proposed rule to the Attorney General with a request that the Department of Justice (DOJ) provide its determination on this issue. In its assessment letter responding to DOE, received on March 2, 2015, DOJ expressed concerns that the proposed changes could have an effect on competition and urged DOE to take this into account in determining its final

[101] ''OMB Circular A–4, section E,'' U.S. Office of Management and Budget, September 2003. Available online at *http://www.whitehouse.gov/omb/circulars_a004_a-4.*

standards. Part of this concern was based on an understanding that the proposed standards would require manufacturers to increase the size and footprint of SPVUs, which may not be feasible or acceptable to consumers. In response to DOJ concerns, DOE notes that the technologies required to reach the adopted level are not proprietary, are understood by the industry, and are generally available to all manufacturers. In its engineering analysis, DOE concluded that the typical design path would require changes the size of the heat exchanger but would not affect the outer dimensions of the product. Due to the accessible nature of these technologies and equipment form factors, as well as their current, proven implementation through existing designs currently available in the marketplace, DOE has concluded that the standard levels included in this final rule will not result in the lessening of competition. DOE is publishing the Attorney General's assessment at the end of this final rule.

6. Need of the Nation To Conserve Energy

Enhanced energy efficiency, where economically justified, improves the Nation's energy security, strengthens the economy, and reduces the environmental impacts (costs) of energy production. Reduced electricity demand due to energy conservation standards is also likely to reduce the cost of maintaining the reliability of the electricity system, particularly during peak-load periods. As a measure of this reduced demand, chapter 15 in the final rule TSD presents the estimated reduction in generating capacity, relative to both the ASHRAE and EPCA base case, for the TSLs that DOE considered in this rulemaking.

Energy conservation from amended standards for SPVUs is expected to yield environmental benefits in the form of reduced emissions of air pollutants and GHGs. Table V.16 provides DOE's estimate of cumulative emissions reductions expected to result from the TSLs considered in this rulemaking using the ASHRAE baseline, while results using the EPCA baseline can be found in chapter 13 of the final rule TSD. The table includes both power sector emissions and upstream emissions. The emissions were calculated using the multipliers discussed in section IV.J. DOE reports annual emissions reductions for each TSL in chapter 13 of the final rule TSD.

TABLE V.16—CUMULATIVE EMISSIONS REDUCTIONS FOR SPVUS SHIPPED IN 2019–2048

	Trial standard level			
	1	2	3	4
Power Sector Emissions				
CO_2 (*million metric tons*)	3.65	8.39	12.8	12.9
SO_2 (*thousand tons*)	2.11	4.85	7.47	7.52
NO_X (*thousand tons*)	4.06	9.35	14.3	14.3
Hg (*tons*)	0.008	0.018	0.028	0.028
CH_4 (*thousand tons*)	0.303	0.697	1.07	1.08
N_2O (thousand tons)	0.043	0.099	0.152	0.153
Upstream Emissions				
CO_2 (*million metric tons*)	0.206	0.475	0.720	0.722
SO_2 (*thousand tons*)	0.038	0.088	0.134	0.134
NO_X (*thousand tons*)	2.95	6.82	10.32	10.3
Hg (*tons*)	0.000	0.000	0.000	0.000
CH_4 (*thousand tons*)	16.3	37.6	57.0	57.1
N_2O (thousand tons)	0.002	0.004	0.007	0.007
Total FFC Emissions				
CO_2 (*million metric tons*)	3.85	8.87	13.6	13.6
SO_2 (*thousand tons*)	2.15	4.94	7.60	7.66
NO_X (*thousand tons*)	7.01	16.2	24.6	24.7
Hg (*tons*)	0.01	0.02	0.03	0.03
CH_4 (*thousand tons*)	16.6	38.3	58.1	58.2
CH_4 (thousand *tons CO_2eq*)*	465	1,074	1,626	1,629
N_2O (thousand tons)	0.04	0.10	0.16	0.16
N_2O (*thousand tons CO_2eq*)*	11.9	27.3	41.9	42.2

* CO_2eq is the quantity of CO_2 that would have the same GWP.

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 considered TSLs for SPVUs. As discussed in section IV.K of this document, for CO_2, DOE used the most recent values for the SCC developed by an interagency process. The four sets of SCC values for CO_2 emissions reductions in 2015 resulting from that process (expressed in 2014$) are represented by $12.2/metric ton (the average value from a distribution that uses a 5-percent discount rate), $40.0/metric ton (the average value from a distribution that uses a 3-percent discount rate), $62.3/metric ton (the average value from a distribution that uses a 2.5-percent discount rate), and $117/metric ton (the 95th-percentile value from a distribution that uses a 3-percent discount rate). The values for later years are higher due to increasing damages (public health, economic and environmental) as the projected magnitude of climate change increases.

Table V.17 presents the global value of CO_2 emissions reductions at each TSL using the ASHRAE baseline, while results using the EPCA baseline are available in chapter 14 of the final rule TSD. 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; these results are presented in chapter 14 of the final rule TSD for both the ASHRAE and EPCA baselines.

TABLE V.17—ESTIMATES OF GLOBAL PRESENT VALUE OF CO2 EMISSIONS REDUCTION FOR PRODUCTS SHIPPED IN 2019–2048

TSL	SCC Case * million 2014$			
	5% Discount rate, average *	3% Discount rate, average *	2.5% Discount rate, average *	3% Discount rate, 95th percentile *
Power Sector Emissions				
1	24.9	115	183	350
2	56.8	263	418	801
3	89.8	410	650	1,248
4	90.8	413	655	1,258
Upstream Emissions				
1	1.38	6.41	10.2	19.6
2	3.16	14.7	23.5	45.0
3	4.95	22.8	36.2	69.4
4	4.99	22.9	36.3	69.7
Total FFC Emissions				
1	26.3	121	193	369
2	60.0	278	442	846
3	94.7	433	686	1,317
4	95.8	436	692	1,328

* For each of the four cases, the corresponding SCC value for emissions in 2015 is 12.0, $40.0, $62.3, and $117 per metric ton (2014$). The values are for CO_2 only (*i.e.,* not CO_{2eq} of other GHGs).

DOE is well aware that scientific and economic knowledge about the contribution of CO_2 and other GHG emissions to changes in the future global climate and the potential resulting damages to the world economy continues to evolve rapidly. Thus, any value placed on reduced 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 rule the most recent values and analyses resulting from the interagency review process.

DOE also estimated the cumulative monetary value of the economic benefits associated with NO_X emissions reductions anticipated to result from the considered TSLs for SPVUs. The dollar-per-ton value that DOE used is discussed in section IV.K of this document. Table V.18 presents the cumulative present values for NO_X emissions for each TSL using the ASHRAE baseline calculated using 7-percent and 3-percent discount rates. Results using the EPCA baseline are available in chapter 14 of the final rule TSD.

TABLE V.18—ESTIMATES OF PRESENT VALUE OF NO_X EMISSIONS REDUCTION FOR SPVUS SHIPPED IN 2019–2048

TSL	million 2014$	
	3% discount rate	7% discount rate
Power Sector Emissions		
1	14.3	5.69
2	32.8	12.8
3	51.4	21.0
4	51.8	21.4
Upstream Emissions		
1	10.3	3.99
2	23.7	9.01
3	36.8	14.7
4	37.0	14.9
Total FFC Emissions		
1	24.7	9.68
2	56.5	21.8
3	88.2	35.6
4	88.8	36.3

7. Other Factors

The Secretary of Energy, in determining whether a standard is economically justified, may consider any other factors that the Secretary deems to be relevant. (42 U.S.C. 6313(a)(6)(B)(ii)(VII)) No other factors were considered in this analysis.

8. Summary of National Economic Impacts

The NPV of the monetized benefits associated with emissions reductions can be viewed as a complement to the NPV of the consumer savings calculated for each TSL considered in this rulemaking. Table V.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 consumer savings calculated for each TSL considered in this rulemaking using the ASHRAE baseline, at both a 7-percent and 3-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 CONSUMER SAVINGS COMBINED WITH PRESENT VALUE OF MONETIZED BENEFITS FROM CO_2 AND NO_X EMISSIONS REDUCTIONS

TSL	SCC Case $12.0/Metric ton and medium NO_X value	SCC Case $40.0/Metric ton and medium NO_X value	SCC Case $62.3/Metric ton and medium NO_X value	SCC Case $117/Metric ton and medium NO_X value
Consumer NPV at 3% Discount Rate Added with: (million 2014$)				
1	0.25	0.34	0.42	0.59
2	0.49	0.71	0.88	1.28
3	(0.14)	0.20	0.45	1.08
4	(0.37)	(0.03)	0.23	0.86
Consumer NPV at 7% Discount Rate Added with: (million 2014$)				
1	0.10	0.20	0.27	0.45
2	0.20	0.41	0.58	0.98
3	(0.14)	0.20	0.46	1.09
4	(0.30)	0.04	0.30	0.93

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

In considering the above results, two issues are relevant. First, the national operating cost savings are domestic U.S. monetary savings that occur as a result of market transactions, while the value of CO_2 reductions is based on a global value. Second, the assessments of operating cost savings and the SCC are performed with different methods that use different time frames for analysis. The national operating cost savings is measured for the lifetime of products shipped in 2019 to 2048. Because CO_2 emissions have a very long residence time in the atmosphere,[102] the SCC values in future years reflect future climate-related impacts that continue beyond 2100.

C. Conclusions

Any new or amended energy conservation standard for any class of SPVAC and SPVHP equipment must demonstrate that adoption of a uniform national standard more stringent than the amended ASHRAE Standard 90.1 for SPVAC and SPVHP equipment would result in significant additional conservation of energy, is technologically feasible and economically justified, and is supported by clear and convincing evidence. (42 U.S.C. 6313(a)(6)(A)(i)(II)) In determining whether a standard is economically justified, the Secretary must determine whether the benefits of the standard exceed its burdens to the greatest extent practicable, considering the seven statutory factors discussed previously. (42 U.S.C. 6313(a)(6)(B)(ii))

DOE considered the impacts of potential standards at each TSL, beginning with the maximum technologically feasible level, to determine whether that level met the evaluation criteria. If the max-tech level was not justified, DOE then considered the next most-efficient level and undertook the same evaluation until it reached the highest efficiency level that is both technologically feasible and economically justified, results in significant additional conservation of energy, and is supported by clear and convincing evidence.

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

1. Benefits and Burdens of TSLs Considered for SPVU Standards

Table V.20 and Table V.21 summarize the quantitative impacts estimated for each TSL for SPVAC and SPVHP equipment using the ASHRAE baseline. The national impacts are measured over the lifetime of SPVAC and SPVHP equipment purchased in the 30-year period that begins in the anticipated year of compliance with amended standards (2019–2048). The energy savings, emissions reductions, and value of emissions reductions refer to full-fuel-cycle results. The efficiency levels contained in each TSL are described in section V.A. Results for the amended standard level using the EPCA baseline can be found in Table V.23 through Table V.27.

TABLE V.20—SUMMARY OF ANALYTICAL RESULTS FOR SPVAC AND SPVHP EQUIPMENT: NATIONAL IMPACTS

Category	TSL 1	TSL 2	TSL 3	TSL 4
Cumulative FFC National Energy Savings (quads)				
	0.06	0.15	0.22	0.22
NPV of Consumer Costs and Benefits* (2014$ billion)**				
3% discount rate	0.20	0.38	(0.33)	(0.55)
7% discount rate	0.07	0.11	(0.27)	(0.43)

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

TABLE V.20—SUMMARY OF ANALYTICAL RESULTS FOR SPVAC AND SPVHP EQUIPMENT: NATIONAL IMPACTS—Continued

Category	TSL 1	TSL 2	TSL 3	TSL 4
Cumulative FFC Emissions Reduction (Total FFC Emissions)				
CO_2 (*million metric tons*)	3.85	8.87	13.6	13.6
SO_2 (*thousand tons*)	2.15	4.94	7.60	7.66
NO_X (*thousand tons*)	7.01	16.2	24.6	24.7
Hg (*tons*)	0.01	0.02	0.03	0.03
CH_4 (*thousand tons*)	16.6	38.3	58.1	58.2
CH_4 (*thousand tons CO_2eq*) *	465	1,074	1,626	1,629
N_2O (*thousand tons*)	0.04	0.10	0.16	0.16
N_2O (*thousand tons CO_2eq*) *	11.9	27.3	41.9	42.2
Value of Emissions Reduction (Total FFC Emissions)				
CO_2 (*2014$ billion*) **	0.03 to 0.37	0.06 to 0.85	0.09 to 1.32	0.10 to 1.33
NO_X—3% discount rate (*2014$ million*)	24.7	56.5	88.2	88.8
NO_X—7% discount rate (*2014$ million*)	9.68	21.8	35.6	36.3

* CO_2eq is the quantity of CO_2 that would have the same global warming potential (GWP) as the subject emission.
** Range of the economic value of CO_2 reductions is based on estimates of the global benefit of reduced CO_2 emissions.
*** Parentheses indicate negative values.
† Energy and emissions savings determined from comparing SPVU energy consumption and emissions at the ANSI/ASHRAE/IES Standard 90.1–2013 efficiency level to that at the Federal minimum efficiency level.

TABLE V.21—SUMMARY OF ANALYTICAL RESULTS FOR SPVAC AND SPVHP EQUIPMENT: MANUFACTURER AND CONSUMER IMPACTS

Category	TSL 1 *	TSL 2 *	TSL 3 *	TSL 4 *
Manufacturer Impacts				
Industry NPV (2014$ million) (No-new-standards case INPV = 41.2)	35.7 to 36.7	33.9 to 37.0	26.3 to 34.8	5.0 to 20.4
Industry NPV *(% change*)	(13.3) to (10.9)	(17.9) to (10.3)	(36.3) to (15.7)	(87.8) to (50.6)
Consumer Average LCC Savings (2014$)				
SPVACs <65,000 Btu/h	115	174	130	(678)
SPVHPs <65,000 Btu/h	375	435	817	(153)
Consumer Median PBP (years)				
SPVACs <65,000 Btu/h	9.1	9.6	12.7	25.2
SPVHPs <65,000 Btu/h	4.5	5.8	6.2	14.4
% of Consumers that Experience Net Cost				
SPVACs <65,000 Btu/h	28	39	53	85
SPVHPs <65,000 Btu/h	0	2	4	69

* Parentheses indicate negative (−) values.

DOE first considered TSL 4, which represents the max-tech efficiency levels. TSL 4 would save an estimated 0.22 quads of energy, an amount DOE considers significant. Under TSL 4, the NPV of consumer benefit would be negative $0.43 billion using a discount rate of 7 percent, and negative $0.55 billion using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 4 are 13.6 Mt of CO_2, 7.66 thousand tons of SO_2, 24.7 thousand tons of NO_X, 58.2 thousand tons of CH_4, and 0.16 thousand tons of N_2O. The estimated monetary value of the CO_2 emissions reduction at TSL 4 ranges from $0.10 billion to $1.33 billion.

At TSL 4, the average LCC savings for SPVAC and SPVHP equipment are −$678 and −$153, respectively. On average, these consumers have a higher LCC over the lifetime of the equipment than consumers of less-efficient equipment. The median PBPs are 25.2 and 14.4 years for SPVAC and SPVHP consumers, respectively. The fraction of SPVAC and SPVHP consumers experiencing a net LCC cost are 85 and 69 percent, respectively.

At TSL 4, the projected change in INPV ranges from a decrease of $36.2 million to a decrease of $20.9 million, which represent a decrease of 87.8 percent and a decrease of 50.6 percent, respectively. DOE estimates 97% of models on the market would require redesign. Industry conversion costs are expected to total $40.9 million.

The Secretary concluded that at TSL 4 for SPVAC and SPVHP equipment, the benefits of energy savings, emission reductions, and the estimated monetary value of the emissions reductions would be outweighed by the negative NPV of consumer benefits, economic burden on many consumers, and the impacts on manufacturers, including the conversion costs and profit margin impacts that could result in a large reduction in INPV. Consequently, the Secretary has concluded that TSL 4 is not economically justified.

DOE then considered TSL 3, which would save an estimated 0.22 quads of energy, an amount DOE considers significant. Under TSL 3, the NPV of consumer benefit would be negative $0.27 billion using a discount rate of 7 percent, and negative $0.33 billion using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 3 are 13.6 Mt of CO_2, 7.60 thousand tons of SO_2, 24.6 thousand tons of NO_X, 58.1 thousand tons of CH_4, and 0.16 thousand tons of N_2O. The estimated monetary value of the CO_2 emissions reduction at TSL 3 ranges from $0.09 billion to $1.32 billion.

At TSL 3, the average LCC savings for SPVAC and SPVHP equipment are $130 and $817, respectively. The median PBPs are 12.7 and 6.2 years for SPVAC and SPVHP consumers, respectively. The fraction of SPVAC and SPVHP consumers experiencing a net LCC cost are 53 and 4 percent, respectively.

At TSL 3, the projected change in INPV ranges from a decrease of $15.0 million to a decrease of $6.5 million, which represent decreases of 36.3 percent and 15.7 percent, respectively. DOE estimates 96 percent of models on the market would require redesign. Industry conversion costs are expected to total $19.8 million.

The Secretary concluded that at TSL 3 for SPVAC and SPVHP equipment, the benefits of energy savings, emission reductions, and the estimated monetary value of the emissions reductions would be outweighed by the economic burden on many SPVAC consumers, and the impacts on manufacturers, including the conversion costs and profit margin impacts that could result in a large reduction in INPV. Consequently, the Secretary has concluded that TSL 3 is not economically justified.

DOE then considered TSL 2, which would save an estimated 0.15 quads of energy, an amount DOE considers significant. Under TSL 2, the NPV of consumer benefit would be $0.11 billion using a discount rate of 7 percent, and $0.38 billion using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 2 are 8.87 Mt of CO_2, 4.94 thousand tons of SO_2, 16.2 thousand tons of NO_X, 38.3 thousand tons of CH_4, and 0.10 thousand tons of N_20. The estimated monetary value of the CO_2 emissions reduction at TSL 2 ranges from $0.6 billion to $0.85 billion.

At TSL 2, the average LCC savings for SPVAC and SPVHP equipment are $174 and $435, respectively. The median PBPs are 9.6 and 5.8 years for SPVAC and SPVHP consumers, respectively. The fraction of SPVAC and SPVHP consumers experiencing a net LCC cost are 39 and 2 percent, respectively.

At TSL 2, the projected change in INPV ranges from a decrease of $7.4 million to a decrease of $4.3 million, which represent a decrease of 17.9 percent and a decrease of 10.3 percent, respectively. DOE estimates 71 percent of models on the market would require redesign. Industry conversion costs are expected to total $9.2 million.

After considering the analysis and weighing the benefits and burdens, the Secretary has concluded that at TSL 2 for SPVUs, the benefits of energy savings, positive NPV of consumer benefits, emission reductions, the estimated monetary value of the emissions reductions, and positive average LCC savings would outweigh the negative impacts on some consumers and on manufacturers, including the conversion costs that could result in a reduction in INPV for manufacturers. The Secretary has concluded that TSL 2 would save a significant amount of energy, is technologically feasible and economically justified, and is supported by clear and convincing evidence.

Therefore, based on the above considerations, DOE adopts the energy conservation standards for SPVUs at TSL 2. Table V.22 presents the amended energy conservation standards for SPVUs. As mentioned previously, for SPVHPs greater than or equal to 65,000 Btu/h and less than 135,000 Btu/h and for SPVUs greater than or equal to 135,000 Btu/h and less than 240,000 Btu/h, there are no models on the market, and, therefore, DOE had no basis with which to develop higher efficiency levels or conduct analyses. For SPVACs greater than or equal to 65,000 Btu/h and less than 135,000 Btu/h, there are no models on the market higher than the ASHRAE 90.1–2013 level, and, therefore, DOE has no clear and convincing evidence with which to adopt higher levels. As a result, DOE is adopting amended standards for SPVUs equivalent to those in ASHRAE Standard 90.1–2013 for these four equipment classes, as required by law.

TABLE V.22—AMENDED ENERGY CONSERVATION STANDARDS FOR SPVUS

Equipment type	Cooling capacity	Efficiency level	Compliance date: Products manufactured on and after . . .
Single Package Vertical Air Conditioner.	<65,000 Btu/h	EER =11.0	September 23, 2019.
	≥65,000 Btu/h and <135,000 Btu/h	EER = 10.0	October 9, 2015.
	≥135,000 Btu/h and <240,000 Btu/h	EER = 10.0	October 9, 2016.
Single Package Vertical Heat Pump	<65,000 Btu/h	EER = 11.0 COP = 3.3	September 23, 2019.
	≥65,000 Btu/h and <135,000 Btu/h	EER = 10.0 COP = 3.0	October 9, 2015.
	≥135,000 Btu/h and <240,000 Btu/h	EER = 10.0 COP = 3.0	October 9, 2016.

Table V.23 through Table V.27 present the benefits and burdens on the consumer, the manufacturer, and the Nation in comparison to a base case including the current Federal standards (*i.e.,* the EPCA baseline), although only the incremental quantitative impacts from the ASHRAE baseline to the various TSL standard levels under consideration was used to amend these standards. The results compared to the ASHRAE baseline are also included for comparison.

TABLE V.23—CONSUMER IMPACT RESULTS FOR SPVU AMENDED STANDARDS (TSL 2) (BASELINE COMPARISON)

Equipment class	Baseline	Life-cycle cost, all customers (2014$)			Life-cycle cost savings				Median payback period years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings (2014$)	% of consumers that experience: Net cost	No impact	Net benefit	
SPVACs <65 kBtu/h	ASHRAE	5,035	12,499	17,534	174	39	1	59	9.6
	EPCA	5,034	12,350	17,384	280	43	1	56	10.6
SPVHPs <65 kBtu/h	ASHRAE	5,697	31,887	37,584	435	2	1	96	5.8
	EPCA	5,696	30,968	36,664	392	22	1	77	9.9
SPVACs 65–135 kBtu/h	ASHRAE								
	EPCA	6,617	20,776	27,393	833	14	29	57	7.3
SPVHPs 65–135 kBtu/h	ASHRAE								
	EPCA	7,430	58,777	66,207	287	31	29	40	11.3

TABLE V.24—MANUFACTURER IMPACT ANALYSIS RESULTS FOR SPVU AMENDED STANDARDS (TSL 2) (BASELINE COMPARISON)

	ASHRAE baseline	EPCA baseline
Base Case INPV (2014$ millions)	41.2	38.8
Standards Case INPV (2014$ millions)	33.9 to 37.0	27.5 to 34.9
Change in INPV (% Change)	(17.9) to (10.3)	(29.1) to (10.0)

TABLE V.25—CUMULATIVE NATIONAL PRIMARY AND FULL-FUEL-CYCLE ENERGY SAVINGS AND NET PRESENT VALUE OF CUSTOMER BENEFIT FOR SPVU AMENDED STANDARDS (TSL 2) FOR UNITS SOLD IN 2019–2048

[Baseline comparison]

	ASHRAE baseline	EPCA baseline
National Primary Energy Savings (quads)	0.14	0.29
National FFC Energy Savings (quads)	0.15	0.31
NPV at 3% (billion 2014$)	0.38	0.82
NPV at 7% (billion 2014$)	0.11	0.22

TABLE V.26—CUMULATIVE EMISSIONS REDUCTION, GLOBAL PRESENT VALUE OF CO_2 EMISSIONS REDUCTION, AND PRESENT VALUE OF NO_X EMISSIONS REDUCTION FOR AMENDED STANDARDS (TSL 2) FOR SPVUS (BASELINE COMPARISON)

	Power sector and site emissions*		Upstream emissions		Total FFC emissions	
	ASHRAE baseline	EPCA baseline	ASHRAE baseline	EPCA baseline	ASHRAE baseline	EPCA baseline
Cumulative Emissions Reductions						
CO_2 (million metric tons)	8.39	17.6	0.475	0.996	8.87	18.6
SO_2 (thousand tons)	4.85	10.2	0.088	0.185	4.94	10.4
NO_X (thousand tons)	9.35	19.6	6.82	14.3	16.2	33.9
Hg (tons)	0.018	0.038	0.000	0.000	0.02	0.04
CH_4 (thousand tons)	0.697	1.46	37.6	78.8	38.3	80.3
N_2O (thousand tons)	0.099	0.207	0.004	0.009	0.10	0.22
Global Present Value of CO_2 Emissions Reduction, SCC Scenario (million 2014$)**						
5% discount rate, average	56.8	120	3.16	6.67	60.0	127
3% discount rate, average	263	555	14.7	31.0	278	586
2.5% discount rate, average	418	882	23.5	49.4	442	932
3% discount rate, 95th percentile	801	1690	45.0	94.6	846	1785
Present Value of NO_X Emissions Reduction (million 2014$)						
3% discount rate	32.8	69.4	23.7	49.8	56.5	119
7% discount rate	12.8	27.4	9.01	19.2	21.8	46.6

* Includes site emissions associated with additional use of natural gas by more-efficient SPVUs.
** For each of the four cases, the corresponding SCC value for emissions in 2015 is $12.0, $40.0, $62.3 and $117 per metric ton (2014$).

TABLE V.27—SPVU AMENDED STANDARDS (TSL 2): NET PRESENT VALUE OF CONSUMER SAVINGS COMBINED WITH NET PRESENT VALUE OF MONETIZED BENEFITS FROM CO_2 AND NO_X EMISSIONS REDUCTIONS (BASELINE COMPARISON)

	(Billion 2014$)							
	SCC value of $12.0/metric ton CO_2* and medium value for NO_X		SCC value of $40.0/metric ton CO_2* and medium value for NO_X		SCC value of $62.3/metric ton CO_2* and medium value for NO_X		SCC value of $117/metric ton CO_2* and medium value for NO_X	
	ASHRAE baseline	EPCA baseline	ASHRAE baseline	EPCA baseline	ASHRAE baseline	EPCA baseline	ASHRAE baseline	EPCA baseline
Consumer NPV at 3% Discount Rate added with each SCC and NO_X value	0.49	1.06	0.71	1.52	0.88	1.87	1.28	2.72
Consumer NPV at 7% Discount Rate added with each SCC and NO_X value	0.20	0.40	0.41	0.86	0.58	1.20	0.98	2.06

Note: Parentheses indicate negative values.
* These label values represent the global SCC in 2015, in 2014$.

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

The benefits and costs of the adopted standards can also be expressed in terms of annualized values. The annualized net benefit is the sum of (1) the annualized national economic value (expressed in 2014$) of the benefits from operating products that meet the adopted standards (consisting primarily of operating cost savings from using less energy, minus increases in product purchase costs, and (2) the annualized monetary value of the benefits of CO_2 and NO_X emission reductions.[103]

Table V.28 shows the annualized values for SPVUs under TSL 2, expressed in 2014$, compared to the ASHRAE baseline. Using a 7-percent discount rate for benefits and costs other than CO_2 reduction, (for which DOE used a 3-percent discount rate along with the SCC series that has a value of $40.0/t in 2015),[104] the estimated cost of the standards in this rule is $20 million per year in increased equipment costs, while the estimated annual benefits are $28 million in reduced equipment operating costs, $13 million in CO_2 reductions, and $1.6 million in reduced NO_X emissions. In this case, the net benefit amounts to $24 million per year. Using a 3-percent discount rate for all benefits and costs and the SCC series has a value of $40.0/t in 2015, the estimated cost of the standards is $24 million per year in increased equipment costs, while the estimated annual benefits are $43 million in reduced operating costs, $13 million in CO_2 reductions, and $2.7 million in reduced NO_X emissions. In this case, the net benefit amounts to $35 million per year.

TABLE V.28—ANNUALIZED BENEFITS AND COSTS OF ADOPTED STANDARDS (TSL 2) FOR SPVUS

	Discount rate	Primary estimate	Low net benefits estimate	High net benefits estimate
		Million 2014$/year		
Benefits				
Consumer Operating Cost Savings	7%	28	26	28
	3%	43	39	44
CO_2 Reduction Value ($12.2/t case) **	5%	3.7	3.6	3.7
CO_2 Reduction Value ($40.0/t case) **	3%	13	13	14
CO_2 Reduction Value ($62.3/t case) **	2.5%	20	20	20
CO_2 Reduction Value ($117/t case) **	3%	41	41	41
NO_X Reduction Value †	7%	1.6	1.6	1.6
	3%	2.7	2.7	2.7
Total Benefits ††	7% plus CO_2 range	33 to 71	31 to 68	34 to 71
	7%	43	41	43
	3% plus CO_2 range	49 to 86	45 to 83	50 to 87
	3%	59	55	60
Costs				
Consumer Incremental Product Costs	7%	20	25	19
	3%	24	32	24
Net Benefits				
Total ††	7% plus CO_2 range	14 to 51	6 to 44	14 to 52
	7%	24	16	24
	3% plus CO_2 range	25 to 62	14 to 51	26 to 63

[103] To convert the time-series of costs and benefits into annualized values, DOE calculated a present value in 2014, the year used for discounting the NPV of total consumer costs and savings. For the benefits, DOE calculated a present value associated with each year's shipments in the year in which the shipments occur (2020, 2030, etc.), and then discounted the present value from each year to 2015. The calculation uses discount rates of 3 and 7 percent for all costs and benefits except for the value of CO_2 reductions, for which DOE used case-specific discount rates. Using the present value, DOE then calculated the fixed annual payment over a 30-year period, starting in the compliance year that yields the same present value.

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

TABLE V.28—ANNUALIZED BENEFITS AND COSTS OF ADOPTED STANDARDS (TSL 2) FOR SPVUs—Continued

	3%	35	23	36

* This table presents the annualized costs and benefits associated with SPVUs shipped in 2019–2048. These results include benefits to consumers which accrue after 2048 from the SPVUs purchased from 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 *AEO2015* Reference case, Low Economic Growth case, and High Economic Growth case, respectively. In addition, incremental product costs reflect a constant rate in the Primary Estimate, an increasing rate in the Low Benefits Estimate, and a decline in the High Benefits Estimate. The methods used to derive projected price trends are explained in section IV.F.2.a.

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

† The $/ton values used for NO_X are described in section IV.K.

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

VI. Procedural Issues and Regulatory Review

A. Review Under Executive Orders 12866 and 13563

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

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

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

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

The Administrator of the Office of Information and Regulatory Affairs (OIRA) in the OMB has determined that the proposed regulatory action is not a significant regulatory action under section (3)(f) of Executive Order 12866. Accordingly, this rule was not reviewed by OIRA.

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

DOE emphasizes as well that Executive Order 13563 requires agencies to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible. In its guidance, OIRA has emphasized that such techniques may include identifying changing future compliance costs that might result from technological innovation or anticipated behavioral changes. For the reasons stated in the preamble, DOE believes that this final rule is consistent with these principles, including the requirement that, to the extent permitted by law, benefits justify costs and that net benefits are maximized.

B. Administrative Procedure Act

The Administrative Procedure Act, 5 U.S.C. 553, establishes the procedural requirements for rulemaking. It requires, generally, that an agency publish notice and provide opportunity for public comment before adopting a rule. In this final rule, DOE has adopted regulatory text applicable to packaged terminal air conditioners and packaged terminal heat pumps that corrects table number references in current regulatory text. This text is being adopted without providing prior notice and an opportunity for public comment pursuant to authority at 5 U.S.C. 553(b)(B), which authorizes an agency to waive those requirements when there is good cause to do so because such procedures are unnecessary, impracticable or contrary to the public interest. Because these corrections, merely correcting table references, are non-substantive in nature, DOE finds good cause to waive the requirement for providing prior notice and an opportunity for public comment as such procedures are unnecessary.

C. Review Under the Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*) requires preparation of an final regulatory flexibility analysis (FRFA) for any rule that by law must be 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 (Aug. 16, 2002), DOE published procedures and policies on February 19, 2003 to ensure that the potential impacts of its rules on small entities are properly considered during the rulemaking process. 68 FR 7990. DOE has made its procedures and policies available on the Office of the General Counsel's Web site (*www.energy.gov/gc/office-general-counsel*). DOE has prepared the following FRFA for the products that are the subject of this rulemaking.

For manufacturers of SPVACs and SPVHPs, the SBA has set a size threshold, which defines those entities classified as ''small businesses'' for the purposes of the statute. DOE used the SBA's small business size standards to determine whether any small entities would be subject to the requirements of the rule. 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 NAICS code and industry description and are available at *http://www.sba.gov/sites/default/files/files/Size_Standards_Table.pdf*. SPVAC and SPVHP manufacturing 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

DOE reviewed the potential standard levels considered in this final rule under the provisions of the Regulatory Flexibility Act and the procedures and policies published on February 19, 2003. To better assess the potential impacts of this rulemaking on small entities, DOE conducted a more focused inquiry of the companies that could be small business manufacturers of equipment covered by this rulemaking. During its market survey, DOE used available public information to identify potential small manufacturers. DOE's research involved industry trade association membership directories (*e.g.,* AHRI), information from previous rulemakings, individual company Web sites, and market research tools (*e.g.,* Hoover's reports) to create a list of companies that manufacture or sell SPVAC and SPVHP equipment covered by this rulemaking. DOE also asked stakeholders and industry representatives if they were aware of any additional small manufacturers during manufacturer interviews and at DOE public meetings. DOE reviewed publicly available data and contacted various companies on its complete list of manufacturers, as necessary, to determine whether they met the SBA's definition of a small business manufacturer. DOE screened out companies that do not offer equipment impacted by this rulemaking, do not meet the definition of a ''small business,'' or are foreign owned and operated.

DOE identified nine companies that produce equipment covered under the SPVU energy conservation standard rulemaking. Three of the nine companies are foreign-owned and operated. Of the remaining six domestic businesses, two companies met the SBA definition of a ''small business.'' One small business manufacturer has the largest market share in the SPVU industry and approximately 37 percent of the active listings in the AHRI Directory.[105] Based on marketing literature and product offerings, the second small domestic manufacturer focuses on industrial capacities. However, no data on the product efficiency or market share was publicly available for the second small manufacturer.

2. Description and Estimate of Compliance Requirements

At the time of analysis, the domestic small manufacturer with the largest market share had 347 active listings. One hundred and twenty three of those listings, or 35 percent, would meet the standards. The other 65 percent of the listings would not meet the standard. The small manufacturer would need to either redesign those products or drop those products and move their customers to more-efficient offerings. However, DOE notes that the small manufacturer had more product listings than any other manufacturer that could meet the standard.

The domestic small manufacturer with the smaller market share had 40 active listings. However, this manufacturer is not a member of AHRI and does not publish any efficiency data on its product offerings. Thus, DOE was unable to determine what portion of products would require redesign for amended energy conservation standard. At the standard level, this manufacturer would need to redesign its entire product offering or leave the SPVU market.

If small manufacturers chose to redesign their products that do not meet the standard, they would need to make capital conversion and product conversion investments. DOE estimated an average total conversion cost of $1.0 million per manufacturer. DOE expects this investment, which is roughly 8 percent of an average manufacturer's annual revenue, to be made over the 4-year period between the publication of the final rule and the effective date of the standard. Since small businesses may have a greater difficulty obtaining credit or may obtain less favorable terms than larger businesses, the small manufacturers may face higher overall costs if they choose to finance the conversion costs resulting from the change in standard.

DOE notes that the small manufacturer with the larger market share produces more SPVU units than its larger competitors. The company could potentially spread the conversion costs over a larger number of units than its competitors. However, the small manufacturer did express concern in MIA interviews that such an effort would tie up their available engineering resources and prevent them from focusing on technology advancements and customer-driven feature requests. Larger manufacturers, which do not have the same shipment volumes as the small manufacturer, may have fewer engineers dedicated to SPVU equipment but potentially could marshal engineering and testing resources across their organization. The concern about adequate availability of engineering resources would also likely apply to the small manufacturer with the smaller market share.

Smaller manufacturers generally pay higher prices for purchased parts, such as BPM motors, relative to larger competitors. Even the small manufacturer with the larger market share and the highest number of SPVU shipments of any manufacturer in the industry, could pay higher prices for component than the larger competition. If their competitors have centralized sourcing, those companies could combine component purchases for SPVU product lines with purchases for other non-SPVU product lines and obtain higher volume discounts than those available to small manufacturers.

Due to the potential conversion costs, the potential engineering and testing effort, and the potential increases in component prices that result from a standard, DOE conducted this regulatory flexibility analysis. Based on DOE's analysis, including interviews

[105] Based on model listings in the AHRI directory accessed on June 6, 2012 (Available at: *http://www.ahridirectory.org/ahridirectory/pages/ac/defaultSearch.aspx*).

with manufacturers, the Department believes one of the identified small businesses would be able to meet the standard. That small manufacturer has the strong market share, technical expertise, and production capability to meet the amended standard. The company successfully competes in both the current baseline-efficiency and premium-efficiency market segments. No data on the efficiency or market share of the second small manufacturer is available to analyze.

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 this final rule.

4. Significant Alternatives to the Rule

The discussion above analyzes impacts on small businesses that would result from DOE's rule. In addition to the other TSLs being considered, the final rule TSD includes an analysis of the following policy alternatives: (1) No change in standard; (2) consumer rebates; (3) consumer tax credits; (4) manufacturer tax credits; (5) voluntary energy efficiency targets; (6) early replacement; and (7) bulk government purchases. While these alternatives may mitigate to some varying extent the economic impacts on small entities compared to the adopted standards, DOE does not intend to consider these alternatives further because DOE has determined that the energy savings of these alternatives are significantly smaller than those that would be expected to result from adoption of the standards (ranging from approximately 0.01 to 0.5 percent of the energy savings from the adopted standards). Accordingly, DOE is declining to adopt any of these alternatives and is adopting the standards set forth in this document. (See chapter 17 of the final rule TSD for further detail on the policy alternatives DOE considered.)

Additional compliance flexibilities may be available through other means. For example, individual manufacturers may petition for a waiver of the applicable test procedure. Further, EPCA provides that a manufacturer whose annual gross revenue from all of its operations does not exceed $8 million may apply for an exemption from all or part of an energy conservation standard for a period not longer than 24 months after the effective date of a final rule establishing the standard. Additionally, section 504 of the Department of Energy Organization Act, 42 U.S.C. 7194, provides authority for the Secretary to adjust a rule issued under EPCA in order to prevent ''special hardship, inequity, or unfair distribution of burdens'' that may be imposed on that manufacturer as a result of such rule. Manufacturers should refer to 10 CFR part 430, subpart E, and part 1003 for additional details.

D. Review Under the Paperwork Reduction Act

Manufacturers of SPVACs and SPVHPs must certify to DOE that their equipment complies with any applicable energy conservation standards. In certifying compliance, manufacturers must test their equipment according to the DOE test procedures for SPVACs and SPVHPs, 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 SPVACs and SPVHPs. See generally, 10 CFR part 429. The collection-of-information requirement for the certification and recordkeeping is subject to review and approval by OMB under the Paperwork Reduction Act (PRA). This requirement has been approved by OMB under OMB control number 1910–1400. Public reporting burden for the certification is estimated to average 30 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

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

E. Review Under the National Environmental Policy Act of 1969

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

F. Review Under Executive Order 13132

Executive Order 13132, ''Federalism,'' 64 FR 43255 (Aug. 10, 1999), imposes certain requirements on Federal agencies formulating and implementing policies or regulations that preempt State law or that have Federalism implications. The Executive Order requires agencies to examine the constitutional and statutory authority supporting any action that would limit the policymaking discretion of the States and to carefully assess the necessity for such actions. The Executive Order also requires agencies to have an accountable process to ensure meaningful and timely input by State and local officials in the development of regulatory policies that have Federalism implications. On March 14, 2000, DOE published a statement of policy describing the intergovernmental consultation process it will follow in the development of such regulations. 65 FR 13735. DOE has examined this rule and has determined that it would not have a substantial direct effect on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. EPCA governs and prescribes Federal preemption of State regulations as to energy conservation for the equipment that are the subject of this final rule. States can petition DOE for exemption from such preemption to the extent, and based on criteria, set forth in EPCA. (42 U.S.C. 6297) Therefore, no further action is required by Executive Order 13132.

G. Review Under Executive Order 12988

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

H. Review Under the Unfunded Mandates Reform Act of 1995

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA) requires each Federal agency to assess the effects of Federal regulatory actions on State, local, and Tribal governments and the private sector. Public Law 104–4, sec. 201 (codified at 2 U.S.C. 1531). For a regulatory action likely to result in a rule that may cause the expenditure by State, local, and Tribal governments, in the aggregate, or by the private sector of $100 million or more in any one year (adjusted annually for inflation), section 202 of UMRA requires a Federal agency to publish a written statement that estimates the resulting costs, benefits, and other effects on the national economy. (2 U.S.C. 1532(a),(b)) The UMRA also requires a Federal agency to develop an effective process to permit timely input by elected officers of State, local, and Tribal governments on a ''significant intergovernmental mandate,'' and requires an agency plan for giving notice and opportunity for timely input to potentially affected small governments before establishing any requirements that might significantly or uniquely affect them. On March 18, 1997, DOE published a statement of policy on its process for intergovernmental consultation under UMRA. 62 FR 12820. DOE's policy statement is also available at *http://energy.gov/sites/prod/files/gcprod/documents/umra_97.pdf*.

DOE has concluded that although this final rule does not contain a Federal intergovernmental mandate, it may require expenditures of $100 million or more in any one year on the private sector. Such expenditures may include (1) investment in research and development and in capital expenditures by SPVU 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 SPVUs.

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

Under section 205 of UMRA, the Department is obligated to identify and consider a reasonable number of regulatory alternatives before promulgating a rule for which a written statement under section 202 is required. (2 U.S.C. 1535(a)) DOE is required to select from those alternatives the most cost-effective and least burdensome alternative that achieves the objectives of the rule unless DOE publishes an explanation for doing otherwise, or the selection of such an alternative is inconsistent with law. As required by 42 U.S.C. 6295(d), (f), and (o), 6313(e), and 6316(a), this final rule would establish amended energy conservation standards for SPVAC and SPVHP 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 final rule.

I. 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.

J. Review Under Executive Order 12630

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

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

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

L. Review Under Executive Order 13211

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

DOE has concluded that this regulatory action, which sets forth amended energy conservation standards for SPVAC and SPVHP equipment, is not a significant energy action because the standards are not likely to have a significant adverse effect on the supply, distribution, or use of energy, nor has it been designated as such by the Administrator at OIRA. Accordingly, DOE has not prepared a Statement of Energy Effects on this final rule.

M. Review Under the Information Quality Bulletin for Peer Review

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

In response to OMB's Bulletin, DOE conducted formal in-progress peer reviews of the energy conservation standards development process and analyses and has prepared a Peer Review Report pertaining to the energy conservation standards rulemaking analyses. Generation of this report involved a rigorous, formal, and documented evaluation using objective criteria and qualified and independent reviewers to make a judgment as to the technical/scientific/business merit, the actual or anticipated results, and the productivity and management effectiveness of programs and/or projects. The ''Energy Conservation Standards Rulemaking Peer Review Report'' dated February 2007 has been disseminated and is available at the following Web site: *www1.eere.energy.gov/buildings/appliance_standards/peer_review.html.*

N. Congressional Notification

As required by 5 U.S.C. 801, DOE will report to Congress on the promulgation of this rule prior to its effective date. The report will state that it has been determined that the rule is not a ''major rule'' as defined by 5 U.S.C. 804(2).

VII. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of this final 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, Small businesses.

Issued in Washington, DC, on August 28, 2015.

David T. Danielson,

Assistant Secretary, Energy Efficiency and Renewable Energy.

For the reasons set forth in the preamble, DOE amends 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. Redesignating Table 8 in paragraph (e) as Table 10, and Table 9 in paragraph (f) as Table 11; and

■ b. Revising paragraph (d).

The revisions read as follows:

§ 431.97 Energy efficiency standards and their compliance dates.

* * * * *

(d)(1) Each single package vertical air conditioner and single package vertical heat pump manufactured on or after January 1, 2010, but before October 9, 2015 (for models ≥65,000 Btu/h and <135,000 Btu/h) or October 9, 2016 (for models ≥135,000 Btu/h and <240,000 Btu/h), must meet the applicable minimum energy conservation standard level(s) set forth in Table 7 of this section.

TABLE 7 TO § 431.97—MINIMUM EFFICIENCY STANDARDS FOR SINGLE PACKAGE VERTICAL AIR CONDITIONERS AND SINGLE PACKAGE VERTICAL HEAT PUMPS

Equipment type	Cooling capacity	Sub-category	Efficiency level	Compliance date: products manufactured on and after . . .
Single package vertical air conditioners and single package vertical heat pumps, single-phase and three-phase.	<65,000 Btu/h	AC	EER = 9.0	January 1, 2010
		HP	EER = 9.0 COP = 3.0	January 1, 2010
Single package vertical air conditioners and single package vertical heat pumps.	≥65,000 Btu/h and <135,000 Btu/h.	AC	EER = 8.9	January 1, 2010
		HP	EER = 8.9 COP = 3.0	January 1, 2010
Single package vertical air conditioners and single package vertical heat pumps.	≥135,000 Btu/h and <240,000 Btu/h.	AC	EER = 8.6	January 1, 2010
		HP	EER = 8.6 COP = 2.9	January 1, 2010

(2) Each single package vertical air conditioner and single package vertical heat pump manufactured on and after October 9, 2015 (for models ≥65,000 Btu/h and <135,000 Btu/h) or October 9, 2016 (for models ≥135,000 Btu/h and <240,000 Btu/h), but before September 23, 2019 must meet the applicable minimum energy conservation standard level(s) set forth in Table 8 of this section.

TABLE 8 TO § 431.97—MINIMUM EFFICIENCY STANDARDS FOR SINGLE PACKAGE VERTICAL AIR CONDITIONERS AND SINGLE PACKAGE VERTICAL HEAT PUMPS

Equipment type	Cooling capacity	Sub-category	Efficiency level	Compliance date: Products manufactured on and after . . .
Single package vertical air conditioners and single package vertical heat pumps, single-phase and three-phase.	<65,000 Btu/h	AC	EER = 9.0	January 1, 2010
		HP	EER = 9.0 COP = 3.0	January 1, 2010
Single package vertical air conditioners and single package vertical heat pumps.	≥65,000 Btu/h and <135,000 Btu/h.	AC	EER = 10.0	October 9, 2015
		HP	EER = 10.0 COP = 3.0	October 9, 2015
Single package vertical air conditioners and single package vertical heat pumps.	≥135,000 Btu/h and <240,000 Btu/h.	AC	EER = 10.0	October 9, 2016
		HP	EER = 10.0 COP = 3.0	October 9, 2016

(3) Each single package vertical air conditioner and single package vertical heat pump manufactured on and after September 23, 2019 must meet the applicable minimum energy conservation standard level(s) set forth in Table 9 of this section.

TABLE 9 TO § 431.97—UPDATED MINIMUM EFFICIENCY STANDARDS FOR SINGLE PACKAGE VERTICAL AIR CONDITIONERS AND SINGLE PACKAGE VERTICAL HEAT PUMPS

Equipment type	Cooling capacity	Sub-category	Efficiency level	Compliance date: products manufactured on and after . . .
Single package vertical air conditioners and single package vertical heat pumps, single-phase and three-phase.	<65,000 Btu/h	AC	EER = 11.0	September 23, 2019.
		HP	EER = 11.0 COP = 3.3	September 23, 2019.
Single package vertical air conditioners and single package vertical heat pumps.	≥65,000 Btu/h and <135,000 Btu/h.	AC	EER = 10.0	October 9, 2015.
		HP	EER = 10.0 COP = 3.0	October 9, 2015.
Single package vertical air conditioners and single package vertical heat pumps.	≥135,000 Btu/h and <240,000 Btu/h.	AC	EER = 10.0	October 9, 2016.
		HP	EER = 10.0 COP = 3.0	October 9, 2016.

* * * * *

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

U.S. Department of Justice
Antitrust Division
William J. Baer
Assistant Attorney General
RFK Main Justice Building
950 Pennsylvania Ave. NW
Washington, DC 20530–0001
(202) 514–2401/(202) 616–2645 (Fax)

March 2, 2015

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

RE: SPVU Energy Conservation Standards

Dear Deputy General Counsel Harkavy:

I am responding to your December 12, 2014 letter seeking the views of the Attorney General about the potential impact on competition of proposed energy conservation standards for, and a possible revised definition of, single package vertical air conditioners (SPVACs) and single package vertical heat pumps (SPVHPs), collectively referred to as single package vertical units (SPVUs).

Your request was submitted under Section 325(o)(2)(B)(i)(V) of the Energy Policy and Conservation Act, as amended (ECPA), 42 U.S.C. 6295(o)(2)(B)(i)(V), which requires the Attorney General to make a determination of the impact of any lessening of competition that is likely to result from the imposition of proposed energy conservation standards. The Attorney General 's responsibility for responding to requests from other departments about the effect of a program on competition has been delegated to the Assistant Attorney General for the Antitrust Division in 28 CFR 0.40(g).

In conducting its analysis the Antitrust Division examines whether a proposed standard may lessen competition, for example, by substantially limiting consumer choice, by placing ce1tain manufacturers at an unjustified competitive disadvantage, or by inducing avoidable inefficiencies in production or distribution of particular products. A lessening of competition could result in higher prices to manufacturer s and consumers.

We have reviewed the proposed standards, as well as DOE's tentative conclusion not to create a space-constrained equipment class for SPVUs, contained in the Notice of Proposed Rulemaking (79 FR 78614, December 30, 2014) (NOPR) and the related Technical Support Documents. We also have reviewed information provided by industry participants and have listened to the Webinar of the Public Meeting held on 2/06/2015.

Based on our review, it appears that many SPVU manufacturers are concerned about their ability to meet DOE's proposed energy conservation standards for SPVUs in the less than 65,000 Btu/h category, where DOE is recommending a standard more stringent than that set out by the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE). In particular, manufacturers are concerned that the costs of compliance may be prohibitive, and that higher costs may necessitate higher prices to consumers who may opt to switch to other potentially less efficient products or solutions. Manufacturers are also concerned that the proposed standards will require them to increase the size and footp1int of SPVUs, which may not be feasible or acceptable to consumers, thereby potentially limiting the range of competitive alternatives available to consumers. Although the Department of Justice is not in a position to judge whether individual manufacturers will be able to meet the proposed standards, we have some concerns that these proposed changes could have an effect on competition and we urge the Department of Energy to take this into account in determining its final energy efficiency standards for SPVUs.

In addition, it appears that DOE intends to reclassify space-constrained SPVUs in conjunction with the promulgation of the proposed standards, which would subject these products to more stringent residential energy efficiency standards. Given the lack of analysis and data available in the record on this issue, we can offer no view on the likely competitive impact of this reclassification.

Sincerely,

William J. Baer

[FR Doc. 2015–23029 Filed 9–22–15; 8:45 am]

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