DEPARTMENT OF ENERGY

10 CFR Part 431

[Docket No. EERE–2014–BT–STD–0015]

RIN 1904–AD23

Energy Conservation Program for Certain Industrial Equipment: Energy Conservation Standards and Test Procedures for Commercial Heating, Air-Conditioning, and Water-Heating Equipment

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

ACTION: Final rule.

SUMMARY: The U.S. Department of Energy (DOE) is amending its energy conservation standards for small three-phase commercial air-cooled air conditioners (single package only) and heat pumps (single package and split system) less than 65,000 Btu/h; water-source heat pumps; and commercial oil-fired storage water heaters. Pursuant to the Energy Policy and Conservation Act of 1975 (EPCA), as amended, DOE must assess whether the uniform national standards for these covered equipment need to be updated each time the corresponding industry standard—the American National Standards Institute (ANSI)/American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)/Illuminating Engineering Society of North America (IESNA) Standard 90.1 (ASHRAE Standard 90.1)—is amended, which most recently occurred on October 9, 2013. Under EPCA, DOE may only adopt more stringent standards if there is clear and convincing evidence showing that more stringent amended standards would be technologically feasible and economically justified, and would save a significant additional amount of energy. The levels DOE is adopting are the same as the efficiency levels specified in ASHRAE Standard 90.1–2013. DOE has determined that the ASHRAE Standard 90.1–2013 efficiency levels for the equipment types listed above are more stringent than existing Federal energy conservation standards and will result in economic and energy savings compared existing energy conservation standards. Furthermore, DOE has concluded that clear and convincing evidence does not exist that would justify more-stringent standard levels than the efficiency levels in ASHRAE Standard 90.1–2013 for any of the equipment classes. DOE has also determined that the standards for small three-phase commercial air-cooled air conditioners (split system) do not need to be amended. DOE is also updating the current Federal test procedure for commercial warm-air furnaces to incorporate by reference the most current version of the American National Standards Institute (ANSI) Z21.47, *Gas-fired central furnaces,* specified in ASHRAE Standard 90.1, and the most current version of ASHRAE 103, *Method of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers.*

DATES: The effective date of this rule is September 15, 2015. Compliance with the amended standards established for water-source heat pumps and commercial oil-fired storage water heaters in this final rule is required on and after October 9, 2015. Compliance with the amended standards established for small three-phase commercial air-cooled air conditioners (single package only) and heat pumps (single package and split system) less than 65,000 Btu/h in this final rule is required on and after January 1, 2017. The incorporation by reference of certain publications listed in this rule was approved by the Director of the Federal Register as of September 15, 2015.

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

A link to the docket Web page can be found at: *www.regulations.gov/#!docketDetail;D=EERE-2014-BT-STD-0015*. The *www.regulations.gov* Web page will contain instructions on how to access all documents, including public comments, in the docket.

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

FOR FURTHER INFORMATION CONTACT:

Ms. Ashley Armstrong, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Office, EE–5B, 1000 Independence Avenue SW., Washington, DC 20585–0121. Telephone: (202) 586–6590. Email: *Ashley.Armstrong@ee.doe.gov*.

Ms. Johanna Hariharan, U.S. Department of Energy, Office of the General Counsel, GC–33, 1000 Independence Avenue SW., Washington, DC 20585–0121. Telephone: (202) 287–6307. Email: *Johanna.Hariharan@hq.doe.gov*.

SUPPLEMENTARY INFORMATION: This final rule incorporates by reference the following industry standards into part 431:

• ANSI Z21.47–2012, ''*Standard for Gas-Fired Central Furnaces'',* approved on March 27, 2012.

Copies of ANSI Z21.47–2012 can be obtained from *ANSI.* American National Standards Institute. 25 W. 43rd Street, 4th Floor, New York, NY 10036. (212) 642–4900, or by going to *http://www.ansi.org*.

• ASHRAE Standard 103–2007, ''Method of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers,'' sections 7.2.2.4, 7.8, 9.2, and 11.3.7, approved on June 27, 2007.

Copies of ASHRAE Standard 103–2007 can be obtained from *ASHRAE.* American Society of Heating, Refrigerating and Air-Conditioning Engineers Inc., 1791 Tullie Circle NE., Atlanta, Georgia 30329. (404) 636–8400, or by going to *http://www.ashrae.org*.

These standards are described in section IX.N.

Table of Contents

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. 6311–6317, as codified), 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] These encompass several types of commercial heating, air-conditioning, and water-heating equipment, including those that are the subject of this rulemaking. (42 U.S.C. 6311(1)(B) and (K)) EPCA, as amended, also requires the U.S. Department of Energy (DOE) to consider amending the existing Federal energy conservation standard for certain types of listed commercial and industrial equipment (generally, commercial water heaters, commercial packaged boilers, commercial air-conditioning and heating equipment, and packaged terminal air conditioners and heat pumps) each time the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 90.1, *Energy Standard for Buildings Except Low-Rise Residential Buildings,* is amended with respect to such equipment. (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 adopt amended energy conservation standards at the new efficiency level in ASHRAE Standard 90.1, unless clear and convincing evidence supports a determination that adoption of a more-stringent efficiency level as a national standard would produce significant additional energy savings and be technologically feasible and economically justified. (42 U.S.C. 6313(a)(6)(A)(ii)) If DOE decides to adopt as a national standard the efficiency levels specified in the amended ASHRAE Standard 90.1, DOE must establish such standard not later than 18 months after publication of the amended industry standard. (42 U.S.C. 6313(a)(6)(A)(ii)(I)) If DOE determines that a more-stringent standard is appropriate under the statutory criteria, DOE must establish such more-stringent standard not later than 30 months after publication of the revised ASHRAE Standard 90.1. (42 U.S.C. 6313(a)(6)(B)) ASHRAE officially released ASHRAE Standard 90.1–2013 on October 9, 2013, thereby triggering DOE's previously referenced obligations pursuant to EPCA to determine for those types of equipment with efficiency level or design requirement changes beyond the current Federal standard, whether: (1) The amended industry standard should be adopted; or (2) clear and convincing evidence exists to justify more-stringent standard levels.

DOE published a notice of proposed rulemaking on January 8, 2015, in the **Federal Register**, describing DOE's determination of scope for considering amended energy conservation standards with respect to certain heating, ventilating, air-conditioning, and water-

[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 2014, Public Law 112–210 (Apr. 30, 2015).

heating equipment addressed in ASHRAE Standard 90.1–2013. 80 FR 1171, 1180–1186. ASHRAE Standard 90.1–2013 amended its efficiency levels for small three-phase air-cooled air conditioners (single package only) and heat pumps (single package and split system) less than 65,000 Btu/h, water-source heat pumps, commercial oil-fired storage water heaters, single package vertical units, and packaged terminal air conditioners. ASHRAE Standard 90.1–2013 also updated its referenced test procedures for several equipment types.

In determining the scope of the rulemaking, DOE is statutorily required to ascertain whether the revised ASHRAE efficiency levels have become more stringent, thereby ensuring that any new amended national standard would not result in prohibited ''backsliding.'' For those equipment classes for which ASHRAE set more-stringent efficiency levels [3] (*i.e.,* small three-phase air-cooled air conditioners (single package only) and heat pumps (single package and split system) less than 65,000 Btu/h; water-source heat pumps; commercial oil-fired storage water heaters; single package vertical units; and packaged terminal air conditioners), DOE analyzed the energy savings potential of amended national energy conservation standards (at both the new ASHRAE Standard 90.1 efficiency levels and more-stringent efficiency levels) in the April 11, 2014 notice of data availability (NODA) (79 FR 20114) and, except for single package vertical units and packaged terminal air conditioners, which are considered in separate rulemakings,[4] in the January 8, 2015 NOPR (80 FR 1171). For equipment where more-stringent standard levels than the ASHRAE efficiency levels would result in significant energy savings (*i.e.,* small three-phase air-cooled air conditioners and heat pumps less than 65,000 Btu/h and water-source heat pumps), DOE analyzed the economic justification for more-stringent levels in the January 2015 NOPR. 80 FR 1171, 1213–1220 (Jan. 15, 2015).

This final rule applies to three classes of small three-phase air-cooled air conditioners and heat pumps less than 65,000 Btu/h, three classes of water-source heat pumps, and one class of commercial oil-fired storage water heaters, which satisfy all applicable requirements of EPCA and will result in energy savings where models exist below the revised efficiency levels. DOE has concluded that, based on the information presented and its analyses, there is not clear and convincing evidence justifying adoption of more-stringent efficiency levels for this equipment.

It is noted that DOE's current regulations for have a single equipment class for small, three-phase commercial air-cooled air conditioners less than 65,000 Btu/h, which covers both split-system and single-package models. Although ASHRAE Standard 90.1–2013 did not amend standard levels for the split-system models within that equipment class, it did so for the single-package models. Given this split, in this final rule, DOE is once again separating these two types of equipment into separate equipment classes. However, following the evaluation of amended standards for split-system models under the six-year-lookback provision at 42 U.S.C. 6313(a)(6)(C), DOE has concluded that there is not clear and convincing evidence that would justify adoption of more-stringent efficiency levels for small three-phase split-system air-cooled air conditioners less than 65,000 Btu/h, where the efficiency level in ASHRAE 90.1–2013 is the same as the current Federal energy conservation standards.

Thus, in accordance with the criteria discussed elsewhere in this document, DOE is amending the energy conservation standards for three classes of small three-phase air-cooled air conditioners and heat pumps less than 65,000 Btu/h, three classes of water-source heat pumps, and one class of commercial oil-fired storage water heaters by adopting the efficiency levels specified by ASHRAE Standard 90.1–2013, as shown in Table I.1. Pursuant to EPCA, the amended standards apply to all equipment listed in Table I.1 and manufactured in, or imported into, the United States on or after the date two years after the effective date specified in ASHRAE Standard 90.1–2013 (*i.e.,* by January 1, 2017 for small air-cooled air conditioners and heat pumps and by October 9, 2015 for water-source heat pumps and oil-fired storage water heaters). (42 U.S.C. 6313(a)(6)(D)(i)) DOE is making a determination that standards for split-system air-cooled air conditioners less than 65,000 Btu/h do not need to be amended.

TABLE I.1—CURRENT AND AMENDED ENERGY CONSERVATION STANDARDS FOR SPECIFIC TYPES OF COMMERCIAL EQUIPMENT

Equipment class	Current Federal Energy Conservation standard	Amended Federal Energy Conservation standard	Compliance date of amended Federal Energy Conservation standard
Three-Phase Air-Cooled Single-Package Air Conditioners <65,000 Btu/h.	13.0 SEER	14.0 SEER	January 1, 2017.
Three-Phase Air-Cooled Single-Package Heat Pumps <65,000 Btu/h.	13.0 SEER, 7.7 HSPF	14.0 SEER, 8.0 HSPF	January 1, 2017.
Three-Phase Air-Cooled Split-System Heat Pumps <65,000 Btu/h.	13.0 SEER, 7.7 HSPF	14.0 SEER, 8.2 HSPF	January 1, 2017.
Oil-Fired Storage Water Heaters >105,000 Btu/h and <4,000 Btu/h/gal.	78% E_t	80% E_t	October 9, 2015.
Water-Source (Water-to-Air, Water-Loop) Heat Pumps <17,000 Btu/h.	11.2 EER, 4.2 COP	12.2 EER, 4.3 COP	October 9, 2015.
Water-Source (Water-to-Air, Water-Loop) Heat Pumps ≥17,000 and <65,000 Btu/h.	12.0 EER, 4.2 COP	13.0 EER, 4.3 COP	October 9, 2015.
Water-Source (Water-to-Air, Water-Loop) Heat Pumps ≥65,000 and <135,000 Btu/h.	12.0 EER, 4.2 COP	13.0 EER, 4.3 COP	October 9, 2015.

[3] ASHRAE Standard 90.1–2013 did not change any of the design requirements for the commercial (HVAC) and water-heating equipment covered by EPCA.

[4] See Packaged Terminal Air Conditioners and Heat Pumps Standards Rulemaking Web page: *www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/64* and Single Package Vertical Air Conditioners and Heat Pumps Standards Rulemaking Web page: *www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx?ruleid=107.*

In addition, DOE is adopting amendments to its test procedures for commercial warm-air furnaces, which manufacturers will be required to use to certify compliance with energy conservation standards mandated under EPCA. See 42 U.S.C. 6314(a)(1)(A) and (4)(B)) and 10 CFR parts 429 and 431. Specifically, these amendments, which were proposed in the January 2015 NOPR, update the citations and incorporations by reference in DOE's regulations to the most recent version of American National Standards Institute (ANSI) Z21.47, *Standard for Gas-Fired Central Furnaces* (*i.e.,* ANSI Z21.47–2012), and to the most recent version of ASHRAE 103, *Method of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boiler* (*i.e.,* ASHRAE 103–2007). This final rule satisfies the requirement to review the test procedures for commercial warm-air furnaces within seven years. 42 U.S.C. 6314(a)(1)(A).

II. Introduction

The following section briefly discusses the statutory authority underlying today's proposal, as well as some of the relevant historical background related to the establishment of standards for small three-phase air-cooled air conditioners and heat pumps less than 65,000 Btu/h, water-source heat pumps, and commercial oil-fired storage water heaters.

A. Authority

Title III, Part C [5] of the Energy Policy and Conservation Act of 1975 (EPCA or the Act), Public Law 94–163 (42 U.S.C. 6311–6317, as codified), added by Public Law 95–619, Title IV, section 441(a), established the Energy Conservation Program for Certain Industrial Equipment, which includes the commercial heating, air-conditioning, and water-heating equipment that is the subject of this rulemaking.[6] In general, this program addresses the energy efficiency of certain types of commercial and industrial equipment. Relevant provisions of the Act specifically 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. (42 U.S.C. 6313(a)) Specifically, the statute sets standards for small, large, and very large commercial package air-conditioning and heating equipment, packaged terminal air conditioners (PTACs), packaged terminal heat pumps (PTHPs), warm-air furnaces, packaged boilers, storage water heaters, instantaneous water heaters, and unfired hot water storage tanks. *Id.* In doing so, 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 Standard 90.1–1989), for each type of covered equipment listed in 42 U.S.C. 6313(a). The Energy Independence and Security Act of 2007 (EISA 2007) amended EPCA by adding definitions and setting minimum energy conservation standards for single-package vertical air conditioners (SPVACs) and single-package vertical heat pumps (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.

In acknowledgement of technological changes that yield energy efficiency benefits, the U.S. Congress further directed DOE through EPCA to consider amending the existing Federal energy conservation standard for each type of equipment listed, each time ASHRAE Standard 90.1 is amended with respect to such equipment. (42 U.S.C. 6313(a)(6)(A)) For each type of equipment, EPCA directs that if ASHRAE Standard 90.1 is amended,[7] 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 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)) If DOE decides to adopt as a national standard the efficiency levels specified in the amended ASHRAE Standard 90.1, DOE must establish such standard not later than 18 months after publication of the amended industry standard. (42 U.S.C. 6313(a)(6)(A)(ii)(I)) However, if DOE determines that a more-stringent standard is justified under 42 U.S.C. 6313(a)(6)(A)(ii)(II), then it must establish such more-stringent standard not later than 30 months after publication of the amended ASHRAE Standard 90.1. (42 U.S.C. 6313(a)(6)(B)) In addition, DOE notes that pursuant to the EISA 2007 amendments to EPCA, under 42 U.S.C. 6313(a)(6)(C), the agency must periodically review its already-established energy conservation standards for ASHRAE equipment. 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

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

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

[7] Although EPCA does not explicitly define the term ''amended'' in the context of ASHRAE Standard 90.1, DOE provided its interpretation of what would constitute an ''amended standard'' in a final rule published in the **Federal Register** on March 7, 2007 (hereafter referred to as the ''March 2007 final rule''). 72 FR 10038. In that rule, DOE stated that the statutory trigger requiring DOE to adopt uniform national standards based on ASHRAE action is for ASHRAE to change a standard for any of the equipment listed in EPCA section 342(a)(6)(A)(i) (42 U.S.C. 6313(a)(6)(A)(i)) by increasing the energy efficiency level for that equipment type. *Id.* at 10042. In other words, if the revised ASHRAE Standard 90.1 leaves the standard level unchanged or lowers the standard, as compared to the level specified by the national standard adopted pursuant to EPCA, DOE does not have the authority to conduct a rulemaking to consider a higher standard for that equipment pursuant to 42 U.S.C. 6313(a)(6)(A). DOE subsequently reiterated this position in a final rule published in the **Federal Register** on July 22, 2009 (74 FR 36312, 36313) and again on May 16, 2012 (77 FR 28928, 28937). However, in the AEMTCA amendments to EPCA in 2012, Congress modified several provisions related to ASHRAE Standard 90.1 equipment. In relevant part, DOE now must act whenever ASHRAE Standard 90.1's ''standard levels or design requirements under that standard'' are amended. (42 U.S.C. 6313(a)(6)(A)(i)) Furthermore, DOE is now required to conduct an evaluation of each class of covered equipment in ASHRAE Standard 90.1 ''every 6 years.'' (42 U.S.C. 6313(a)(6)(C)(i)) For any covered equipment for which more than 6 years has elapsed since issuance of the most recent final rule establishing or amending a standard for such equipment, DOE must publish either the required notice of determination that standards do not need to be amended or a NOPR with proposed standards by December 31, 2013. (42 U.S.C. 6313(a)(6)(C)(vi)) DOE has incorporated these new statutory mandates into its rulemaking process for covered ASHRAE 90.1 equipment.

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:

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

(2) The savings in operating costs throughout the estimated average life of the 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;

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

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

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

(6) The need for national energy conservation; and

(7) Other factors the Secretary considers relevant. (42 U.S.C. 6313(a)(6)(B)(ii))

EPCA also requires that if a test procedure referenced in ASHRAE Standard 90.1 is updated, DOE must update its test procedure to be consistent with the amended test procedure in ASHRAE Standard 90.1, unless DOE determines that the amended test procedure is not reasonably designed to produce test results that reflect the energy efficiency, energy use, or estimated operating costs of the ASHRAE equipment during a representative average use cycle. In addition, DOE must determine that the amended test procedure is not unduly burdensome to conduct. (42 U.S.C. 6314(a)(2) and(4))

Additionally, EISA 2007 amended EPCA to require that at least once every seven years, DOE must conduct an evaluation of the test procedures for all covered equipment and either amend test procedures (if the Secretary determines that amended test procedures would more accurately or fully comply with the requirements of 42 U.S.C. 6314(a)(2)–(3)) or publish notice in the **Federal Register** of any determination not to amend a test procedure. (42 U.S.C. 6314(a)(1)(A)) This final rule resulting satisfies the requirement to review the test procedures for commercial warm-air furnaces within seven years.

On October 9, 2013 ASHRAE officially released and made public ASHRAE Standard 90.1–2013. This action triggered DOE's obligations under 42 U.S.C. 6313(a)(6), as outlined previously.

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 such standard would likely 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 at the time of the Secretary's finding. (42 U.S.C. 6313(a)(6)(B)(iii)(II)(aa))

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 (and, as applicable, water) savings during the first year that the consumer will receive as a result of the standard, as calculated under the applicable test procedure.

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. 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. DOE plans to follow a similar process in the context of this rulemaking.

B. Background

1. ASHRAE Standard 90.1–2013

As noted previously, ASHRAE released a new version of ASHRAE Standard 90.1 on October 9, 2013 (ASHRAE Standard 90.1–2013). The ASHRAE standard addresses efficiency levels for many types of commercial heating, ventilating, air-conditioning (HVAC), and water-heating equipment covered by EPCA. ASHRAE Standard 90.1–2013 revised its efficiency levels for certain commercial equipment, but for the remaining equipment, ASHRAE left in place the preexisting levels (*i.e.,* the efficiency levels in ASHRAE Standard 90.1–2010). Specifically, ASHRAE updated its efficiency levels for small three-phase air-cooled air conditioners (single package only) and heat pumps (single package and split system) less than 65,000 Btu/h; water-source heat pumps; commercial oil-fired storage water heaters; single package vertical units; and packaged terminal air conditioners. ASHRAE Standard 90.1–2013 did not change any of the design requirements for the commercial HVAC and water heating equipment covered by EPCA. *See* 80 FR 1171, 1177–1178 (Jan. 8, 2015).

2. Previous Rulemaking Documents

On April 11, 2014, DOE published a notice of data availability (April 2014 NODA) in the **Federal Register** and requested public comment as a preliminary step required pursuant to EPCA when DOE considers amended energy conservation standards for certain types of commercial equipment covered by ASHRAE Standard 90.1. 79 FR 20114. Specifically, the April 2014 NODA presented for public comment DOE's analysis of the potential energy savings estimates related to amended national energy conservation standards for the types of commercial equipment for which DOE was triggered by ASHRAE action, based on: (1) The modified efficiency levels contained within ASHRAE Standard 90.1–2013; and (2) more-stringent efficiency levels. *Id.* at 20134–20136. DOE has described these analyses and preliminary conclusions and sought input from interested parties, including the submission of data and other relevant information. *Id.*

In addition, DOE presented a discussion in the April 2014 NODA of the changes found in ASHRAE Standard 90.1–2013. *Id.* at 20119–20125. The April 2014 NODA includes a description of DOE's evaluation of each

ASHRAE equipment type in order for DOE to determine whether the amendments in ASHRAE Standard 90.1–2013 have increased efficiency levels or changed design requirements. As an initial matter, DOE sought to determine which requirements for covered equipment in ASHRAE Standard 90.1, if any: (1) Have been revised solely to reflect the level of the current Federal energy conservation standard (where ASHRAE is merely ''catching up'' to the current national standard); (2) have been revised but with a reduction in stringency; or (3) have had any other revisions made that do not change the standard's stringency, in which case, DOE is not triggered to act under 42 U.S.C. 6313(a)(6) for that particular equipment type. For those types of equipment in ASHRAE Standard 90.1 for which ASHRAE actually increased efficiency levels above the current Federal standard, DOE subjected that equipment to the potential energy savings analysis discussed previously and presented the results in the April 2014 NODA for public comment. 79 FR 20114, 20134–20136 (April 11, 2014). Lastly, DOE presented an initial assessment of the test procedure changes included in ASHRAE Standard 90.1–2013. *Id.* at 20124–20125.

Following the NODA, DOE published a notice of proposed rulemaking (NOPR) in the **Federal Register** on January 8, 2015 (the January 2015 NOPR), and requested public comment. 80 FR 1171. In the January 2015 NOPR, DOE proposed amended energy conservation standards for small three-phase air-cooled air conditioners (single package only) and heat pumps (single package and split system) less than 65,000 Btu/h; water-source heat pumps; and commercial oil-fired storage water heaters. As noted previously, packaged terminal air conditioners and single package vertical units were considered in separate rulemakings.

In addition, DOE's NOPR also proposed adopting amended test procedures for commercial warm-air furnaces.

3. Compliance Dates for Amended Federal Test Procedures, Amended Federal Energy Conservation Standards, and Representations for Certain ASHRAE Equipment

This final rule specifies the compliance dates for amended energy conservation standards as shown in Table I.1. In addition, compliance with the amended test procedure for commercial warm-air furnaces is required on or after July 11, 2016.

III. General Discussion of Comments Received

In response to its request for comment on the January 2015 NOPR, DOE received eight comments from manufacturers, trade associations, utilities, and energy efficiency advocates. Commenters included: Lennox International Inc.; Goodman Global, Inc.; California Investor-Owned Utilities (CA IOUs); a group including Appliance Standards Awareness Project (ASAP), the American Council for an Energy-Efficient Economy (ACEEE), Alliance to Save Energy (ASE), and the Natural Resources Defense Council (NRDC) (jointly referred to as the Advocates); the Air-conditioning, Heating, and Refrigeration Institute (AHRI); United Technologies (UTC)—Carrier; Northwest Energy Efficiency Alliance (NEEA); and a group of 12 associations led by the U.S. Chamber of Commerce (jointly referred to as the Associations). As discussed previously, these comments are available in the docket for this rulemaking and may be reviewed as described in the **ADDRESSES** section. The following section summarizes the issues raised in these comments, along with DOE's responses.

A. General Discussion of the Changes in ASHRAE Standard 90.1–2013 and Determination of Scope for Further Rulemaking Activity

As discussed previously, before beginning an analysis of the potential economic impacts and energy savings that would result from adopting the efficiency levels specified by ASHRAE Standard 90.1–2013 or more-stringent efficiency levels, DOE first sought to determine whether or not the ASHRAE Standard 90.1–2013 efficiency levels actually represented an increase in efficiency above the current Federal standard levels. DOE discussed each equipment class for which the ASHRAE Standard 90.1–2013 efficiency level differs from the current Federal standard level, along with DOE's preliminary conclusion as to the action DOE is taking with respect to that equipment in the January 2015 NOPR. *See* 80 FR 1171, 1180–1185 (Jan. 8, 2015). (Once again, DOE notes that ASHRAE Standard 90.1–2013 did not change any of the design requirements for the commercial HVAC and water-heating equipment covered by EPCA, so DOE did not conduct further analysis in the NOPR on that basis.) DOE tentatively concluded from this analysis that the only efficiency levels that represented an increase in efficiency above the current Federal standards were those for small three-phase air-cooled air conditioners (single package only) and heat pumps (single package and split system) less than 65,000 Btu/h; water-source heat pumps, commercial oil-fired storage water heaters; single package vertical units, and packaged terminal air conditioners. For a more detailed discussion of this approach, readers should refer to the preamble to the January 2015 NOPR. *See Id.* DOE did not receive any comments on this approach.

B. The Proposed Energy Conservation Standards

In the January 2015 NOPR, DOE proposed to adopt the efficiency levels in ASHRAE Standard 90.1–2013 for small three-phase air-cooled air conditioners (single package only) and heat pumps (single package and split system) less than 65,000 Btu/h; water-source heat pumps; and commercial oil-fired storage water heaters. 80 FR 1171, 1224–1227 (Jan. 8, 2015). Several commenters expressed support for DOE's proposal to adopt the efficiency levels in ASHRAE 90.1–2013 for small three-phase commercial air conditioners and heat pumps less than 65,000 Btu/h (*e.g.,* AHRI, No. 38 at p. 1; Goodman Global, Inc., No. 42 at p. 1; Lennox International Inc., No. 36 at p. 2). AHRI and Lennox International also agreed that standards for split-system air-cooled air conditioners less than 65,000 Btu/h do not need to be amended (AHRI, No. 38 at p. 2; Lennox International Inc., No. 36 at p. 3), Finally, AHRI supported the ASHRAE 90.1–2013 levels for water-source heat pumps and commercial oil-fired storage water heaters as well (AHRI, No. 38 at p. 1).

On the other hand, the Advocates, NEEA, and the CA IOUs commented that DOE should adopt higher standards than those in ASHRAE 90.1–2013 for water-source heat pumps between 17,000 and 65,000 Btu/h. (Advocates, No. 39 at p. 2; CA IOUs, No. 40 at p. 2; NEEA, No. 41 at p. 2) The Advocates and CA IOUs noted that for that equipment class, efficiency level 2 is cost effective at both 3 and 7 percent discount rates, while efficiency level 3, which would save additional energy, would not result in a net cost to consumers. (Advocates, No. 39 at p. 2; CA IOUs, No. 40 at p. 2) NEEA noted that the energy savings available supported a more in depth analysis of the economic justification and energy analysis for this equipment class (NEEA, No. 41 at p. 2)

In response to the submitted comments, DOE maintains its position of adopting the efficiency levels in ASHRAE 90.1–2013 for all equipment in this rulemaking and not amending the standards for split-system air-cooled air conditioners less than 65,000 Btu/h. DOE notes that despite the positive economic benefits for water-source heat pumps 17,000 to 65,000 Btu/h at efficiency levels higher than those in ASHRAE 90.1–2013, the uncertainty present in the energy use, shipments, and national impact analyses are too great to provide clear and convincing evidence to adopt more stringent energy conservation standards. Furthermore, following the NOPR, DOE did not receive any additional data or information that would allow it to conduct more in-depth analysis for this equipment. See section VIII.D.2 for further information.

IV. Test Procedure Amendments and Discussion of Related Comments

EPCA requires the Secretary to amend the DOE test procedures for covered ASHRAE equipment to the latest version of those generally accepted industry testing procedures or the rating procedures developed or recognized by AHRI or by ASHRAE, as referenced by ASHRAE/IES Standard 90.1, unless the Secretary determines by rule published in the **Federal Register** and supported by clear and convincing evidence that the latest version of the industry test procedure does not meet the requirements for test procedures described in paragraphs (2) and (3) of 42 U.S.C. 6314(a).[8] (42 U.S.C. 6314(a)(4)(B))

In the January 2015 NOPR, in keeping with EPCA's mandate to incorporate the latest version of the applicable industry test procedure pursuant to 42 U.S.C. 6314(a)(4)(B), DOE proposed to update its commercial warm air furnace test procedure by incorporating by reference ANSI (American National Standards Institute) Z21.47–2012, *Standard for Gas-Fired Central Furnaces.* 80 FR 1171, 1185–1186 (Jan. 8, 2015). DOE determined that the changes to the 2012 version do not impact those provisions of that industry test procedure that are used under the DOE test procedure for gas-fired warm air furnaces, and, therefore, such changes do not affect the energy efficiency ratings for gas-fired furnaces. As such, DOE anticipated no substantive change or increase in test burden to be associated with this test procedure amendment for warm air furnaces.

DOE is also required to review the test procedures for covered ASHRAE equipment at least once every seven years. (42 U.S.C. 6314(a)(1)(A)) In addition to the updates to the referenced standards discussed previously, In the January 2015 NOPR, DOE also proposed to update the citations and incorporations by reference in DOE's regulations for commercial warm-air furnaces to the most recent version of ASHRAE 103, *Method of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boiler* (*i.e.,* ASHRAE 103–2007). 80 FR 1171, 1185–1186 (Jan. 8, 2015). The applicable sections of this standard include measurement of condensate and calculation of additional heat gain and heat losses for condensing furnaces. DOE noted that the most recent version does not contain any updates to the sections currently referenced by the DOE test procedure, so no additional burden would be expected to result from this test procedure update.

In response to the NOPR, Lennox International agreed with DOE's proposal to incorporate the latest versions of ANSI Z21.47 and ASHRAE 103 by reference as the applicable test procedure for commercial warm-air furnaces. (Lennox International Inc., No. 36 at p. 2) DOE adopts these updates in this final rule.

DOE is aware that some commercial furnaces are designed for make-up air heating (*i.e.,* heating 100 percent outdoor air). DOE defines ''commercial warm air furnace'' at 10 CFR 431.72 as self-contained oil-fired or gas-fired furnaces designed to supply heated air through ducts to spaces that require it, with a capacity (rated maximum input) at or above 225,000 Btu/h. Further, DOE's definitions specify that this equipment includes combination warm air furnace/electric air conditioning units but does not include unit heaters and duct furnaces. Given the characteristics of this category of commercial furnaces, DOE concludes that gas-fired and oil-fired commercial furnaces that are designed for make-up air heating and that have input ratings at or above 225,000 Btu/h meet the definition of ''commercial warm air furnace'' because they are self-contained units that supply heated air through ducts. Consequently, DOE is clarifying that commercial warm air furnaces that are designed for make-up air heating are subject to DOE's regulatory requirements, including being tested according to the test procedure specified in 10 CFR 431.76.

V. Methodology for Small Commercial Air-Cooled Air Conditioners and Heat Pumps Less Than 65,000 Btu/h

This section addresses the analyses DOE has performed for this rulemaking with respect to small commercial air-cooled air conditioners and heat pumps less than 65,000 Btu/h. A separate subsection addresses each analysis. In overview, DOE used a spreadsheet to calculate the life-cycle cost (LCC) and payback periods (PBPs) of potential energy conservation standards. DOE used another spreadsheet to provide shipments projections and then calculate national energy savings and net present value impacts of potential amended energy conservation standards.

A. Market Assessment

To begin its review of the ASHRAE Standard 90.1–2013 efficiency levels, DOE developed information that provides an overall picture of the market for the equipment concerned, including the purpose of the equipment, the industry structure, and market characteristics. This activity included both quantitative and qualitative assessments based primarily on publicly available information. The subjects addressed in the market assessment for this rulemaking include equipment classes, manufacturers, quantities, and types of equipment sold and offered for sale. The key findings of DOE's market assessment are summarized in the following sections. For additional detail, see chapter 2 of the final rule technical support document (TSD).

1. Equipment Classes

The Federal energy conservation standards for air-cooled air conditioners and heat pumps are differentiated based on the cooling capacity (*i.e.,* small, large, or very large). For small equipment, there is an additional disaggregation into: (1) equipment less than 65,000 Btu/h and (2) equipment greater than or equal to 65,000 Btu/h and less than 135,000 Btu/h. ASHRAE Standard 90.1–2013 also differentiates the equipment that is less than 65,000 Btu/h into split system and single package subcategories. In the past, DOE has followed the same disaggregation. However, when EISA 2007 increased the efficiency levels to identical levels across single package and split system equipment, effective in 2008, DOE

[8] (2) Test procedures prescribed in accordance with this section shall be reasonably designed to produce test results which reflect energy efficiency, energy use, and estimated operating costs of a type of industrial equipment (or class thereof) during a representative average use cycle (as determined by the Secretary), and shall not be unduly burdensome to conduct. (3) If the test procedure is a procedure for determining estimated annual operating costs, such procedure shall provide that such costs shall be calculated from measurements of energy use in a representative average-use cycle (as determined by the Secretary), and from representative average unit costs of the energy needed to operate such equipment during such cycle. The Secretary shall provide information to manufacturers of covered equipment respecting representative average unit costs of energy.

combined the equipment classes in the CFR, resulting in only two equipment classes, one for air conditioners and one for heat pumps. 74 FR 12058, 12074 (March 23, 2009). Because ASHRAE 90.1–2013 has increased the standard for only single package air conditioners, and has increased the HSPF level to a more stringent level for split system heat pumps than for single package heat pumps, and DOE is obligated to adopt, at a minimum, the increased level in ASHRAE 90.1–2013 for that equipment class, DOE proposed in the January 2015 NOPR re-creating separate equipment classes for single package and split system equipment in the overall equipment classes of small commercial package air conditioners and heat pumps (three-phase air-cooled) less than 65,000 Btu/h. 80 FR 1171, 1186–1187 (Jan. 8, 2015). In response, AHRI supported DOE's proposal to re-create separate equipment classes for single package and split system air conditioning and heating equipment (air-cooled, three-phase). (AHRI, No. 38 at p. 1). In this final rule, DOE adopts these amended equipment classes, as shown in Table V.1.

TABLE V.1—AMENDED EQUIPMENT CLASSES FOR SMALL COMMERCIAL PACKAGED AIR-CONDITIONING AND HEATING EQUIPMENT <65,000 Btu/h

Product	Cooling capacity	Sub-category
Small Commercial Packaged Air Conditioning and Heating Equipment (Air-Cooled, 3-Phase, Split System).	<65,000 Btu/h	AC. HP.
Small Commercial Packaged Air Conditioning and Heating Equipment (Air-Cooled, 3-Phase, Single Package).	<65,000 Btu/h	AC. HP.

2. Review of Current Market

In order to obtain the information needed for the market assessment for this rulemaking, DOE consulted a variety of sources, including manufacturer literature, manufacturer Web sites, and the AHRI-certified directory.[9] The information DOE gathered serves as resource material throughout the rulemaking. The sections below provide an overview of the market assessment, and chapter 2 of the final rule TSD provides additional detail on the market assessment, including citations to relevant sources.

a. Trade Association Information

DOE researched various trade groups representing manufacturers, distributors, and installers of the various types of equipment being analyzed in this rulemaking. AHRI is one of the largest trade associations for manufacturers of space heating, cooling, and water heating equipment, representing more than 90 percent of the residential and commercial air conditioning, space heating, water heating, and commercial refrigeration equipment manufactured in the United States.[10] AHRI also develops and publishes test procedure standards for measuring and certifying the performance of residential and commercial HVAC equipment and coordinates with the International Organization for Standardization (ISO) to help harmonize U.S. standards with international standards, if feasible. AHRI also maintains the AHRI Directory of Certified Product Performance, which is a database that lists all the products and equipment that have been certified by AHRI, thereby providing equipment ratings for all manufacturers who elect to participate in the program. DOE utilized this database in developing base-case efficiency distributions.

The Heating, Air-conditioning and Refrigeration Distributors International (HARDI) is a trade association that represents over 450 wholesale heating, ventilating, air-conditioning, and refrigeration (HVACR) companies, plus over 300 manufacturing associates and nearly 140 manufacturing representatives. HARDI estimates that 80 percent of the revenue of HVACR systems goes through its members.[11] DOE did not utilize HARDI data for this rule.

The Air Conditioning Contractors of America (ACCA) is another trade association whose members include over 4,000 contractors and 60,000 professionals in the indoor environment and energy service community. According to their Web site, ACCA provides contractors with technical, legal, and market resources, helping to promote good practices and to keep buildings safe, clean, and affordable.[12] DOE did not use ACCA data for this rule.

b. Manufacturer Information

DOE reviewed data for air-cooled commercial air conditioners and heat pumps currently on the market by examining the AHRI Directory of Certified Product Performance. DOE identified 23 parent companies (comprising 61 manufacturers) of small three-phase air-cooled air conditioners and heat pumps, which are listed in chapter 2 of the final rule TSD. Of these manufacturers, five were identified as small businesses based upon number of employees and the employee thresholds set by the Small Business Administration. More details on this analysis can be found below in section IX.B.

c. Market Data

DOE reviewed the AHRI database to characterize the efficiency and performance of small commercial air-cooled air conditioners and heat pumps less than 65,000 Btu/h models currently on the market. The full results of this market characterization are found in chapter 2 of the final rule TSD. For split-system air conditioners, the average SEER value was 13.9, and 120 models (0.1 percent of the total models) have SEER ratings below the ASHRAE Standard 90.1–2013 level of 13.0 SEER. For single-package air conditioners, the average SEER value was 14.3, and 1,450 models (45 percent of the total models) have SEER ratings below the ASHRAE Standard 90.1–2013 level of 14.0 SEER.

For single-package heat pumps, the average SEER value is 14.0. Of the models identified by DOE, 653 models (54 percent of the total models) have SEER ratings below the ASHRAE Standard 90.1–2013 level of 14.0 SEER. The average HSPF value for this equipment class is 7.9. Of the models identified by DOE, 632 models (52 percent of the total models) have HSPF ratings below the ASHRAE Standard 90.1–2013 levels of 8.0. For split-system

[9] AHRI Directory of Certified Product Performance (2013) (Available at: *www.ahridirectory.org*) (Last accessed November 11, 2013).

[10] Air-Conditioning, Heating, and Refrigeration Institute Web site, *About Us* (2013) (Available at: *www.ari.org/site/318/About-Us*) (Last accessed December 18, 2014).

[11] Heating, Air-conditioning & Refrigeration Distributors International Web site, About HARDI (2014) (Available at: *www.hardinet.org/about-hardi-0*) (Last accessed February 10, 2014).

[12] Air Conditioning Contractors of America Web site, About ACCA (2014) (Available at: *www.acca.org/acca*) (Last accessed February 10, 2014).

heat pumps, the average SEER value for this equipment class is 13.7. Of the models identified by DOE, 30,009 models (64 percent of the total models) have SEER ratings below the ASHRAE Standard 90.1–2013 level of 14.0. The average HSPF for this equipment class is 7.9. Of the models identified by DOE, 36,902 models (79 percent of the total models) have HSPF ratings below the ASHRAE Standard 90.1–2013 level of 8.2. For more information on market performance data, see chapter 2 of the final rule TSD.

B. Engineering Analysis

The engineering analysis establishes the relationship between an increase in energy efficiency and the increase in cost (manufacturer selling price (MSP)) of a piece of equipment DOE is evaluating for potential amended energy conservation standards. This relationship serves as the basis for cost-benefit calculations for individual consumers, manufacturers, and the Nation. The engineering analysis identifies representative baseline equipment, which is the starting point for analyzing possible energy efficiency improvements. For covered ASHRAE equipment, DOE sets the baseline for analysis at the ASHRAE Standard 90.1 efficiency level, because by statute, DOE cannot adopt any level below the revised ASHRAE level. The engineering analysis then identifies higher efficiency levels and the incremental increase in product cost associated with achieving the higher efficiency levels. After identifying the baseline models and cost of achieving increased efficiency, DOE estimates the additional costs to the commercial consumer through an analysis of contractor costs and markups and uses that information in the downstream analyses to examine the costs and benefits associated with increased equipment efficiency.

DOE typically structures its engineering analysis around one of three methodologies: (1) The design-option approach, which calculates the incremental costs of adding specific design options to a baseline model; (2) the efficiency-level approach, which calculates the relative costs of achieving increases in energy efficiency levels without regard to the particular design options used to achieve such increases; and/or (3) the reverse-engineering or cost-assessment approach, which involves a ‘‘bottom-up’’ manufacturing cost assessment based on a detailed bill of materials derived from teardowns of the equipment being analyzed. A supplementary method called a catalog teardown uses published manufacturer catalogs and supplementary component data to estimate the major physical differences between a piece of equipment that has been physically disassembled and another piece of similar equipment for which catalog data are available to determine the cost of the latter equipment. Deciding which methodology to use for the engineering analysis depends on the equipment, the design options under study, and any historical data upon which DOE may draw.

1. Approach

As explained in the January 2015 NOPR, DOE used a combination of the efficiency-level and the cost-assessment approach for this analysis. 80 FR 1171, 1187–1188 (Jan. 8, 2015). DOE used the efficiency-level approach to identify incremental improvements in efficiency for each equipment class and the cost-assessment approach to develop a cost for each efficiency level. The efficiency levels that DOE considered in the engineering analysis were representative of three-phase central air conditioners and heat pumps currently produced by manufacturers at the time the engineering analysis was developed. DOE relied on data reported in the AHRI Directory of Certified Product Performance to select representative efficiency levels.

DOE generated a bill of materials (BOM) for each representative product that it disassembled. DOE did this for multiple manufacturers' products that span a range of efficiency levels for the equipment classes that are analyzed in this rulemaking. The BOMs describe the manufacture of the equipment in detail, listing all parts and including all manufacturing steps required to make each part and to assemble the unit. DOE also conducted catalog teardowns to supplement the information obtained directly from physical teardowns. Subsequently, DOE developed a cost model that calculates manufacturer production cost (MPC) for each unit, based on the detailed BOM data. Chapter 3 of the final rule TSD describes DOE's cost model in greater detail. The calculated costs were plotted as a function of the equipment efficiency levels (based on rated efficiency) to create cost-efficiency curves. DOE notes that the costs at some efficiency levels were interpolated or extrapolated based on the available physical and catalog teardown data.

DOE developed cost-efficiency curves for a representative capacity of three tons, which it decided well represents the range of capacities on the market for commercial three-phase products. Because other capacity levels had similar designs and efficiency levels, cost-efficiency curves were not developed for any other capacities. Instead, DOE was able to utilize the cost-efficiency curve for the representative capacity and apply it to all three-phase products.

DOE based the cost-efficiency relationship for three-phase central air conditioners and heat pumps on reverse engineering conducted for the June 2011 direct final rule (DFR) for single-phase central air conditioners and heat pumps. 76 FR 37408. DOE researched manufacturer literature and noticed that most model numbers between single-phase products and three-phase equipment were interchangeable, with only a single-digit difference in the model number for the supply voltage. Although three-phase equipment contains three-phase compressors instead of single-phase compressors, DOE did not notice any inconsistency in energy efficiency ratings between single-phase products and three-phase equipment. To supplement the 2011 DFR data (29 physical teardowns and 12 catalog teardowns), DOE completed one physical teardown and seven catalog teardowns of three-phase equipment. This approach allowed DOE to provide an estimate of equipment prices at different efficiencies and spanned a range of technologies currently on the market that are used to achieve the increased efficiency levels.

2. Baseline Equipment

DOE selected baseline efficiency levels as reference points for each equipment class, against which it measured changes resulting from potential amended energy conservation standards. DOE defined the baseline efficiency levels as reference points to compare the technology, energy savings, and cost of equipment with higher energy efficiency levels. Typically, units at the baseline efficiency level just meet Federal energy conservation standards and provide basic consumer utility. However, EPCA requires that DOE must adopt either the ASHRAE Standard 90.1–2013 levels or more-stringent levels. Therefore, because the ASHRAE Standard 90.1–2013 levels were the lowest levels that DOE could adopt, DOE used those levels as the reference points against which more-stringent levels were evaluated.

TABLE V.2—CURRENT BASELINE AND ASHRAE EFFICIENCY LEVELS FOR SMALL COMMERCIAL AIR-COOLED AIR CONDITIONERS AND HEAT PUMPS WITH RATED COOLING CAPACITIES LESS THAN 65,000 Btu/h

	Split-system AC	Single-package AC	Split-system HP	Single-package HP
SEER				
Baseline—Federal Standard	13.0	13.0	13.0	13.0
Baseline—ASHRAE Standard	13.0	14.0	14.0	14.0
HSPF				
Baseline—Federal Standard			7.7	7.7
Baseline—ASHRAE Standard			8.2	8.0

Table V.3 shows the current baseline and ASHRAE efficiency levels for each equipment class of small commercial air-cooled air conditioners and heat pumps <65,000 Btu/h.

TABLE V.3—BASELINE EFFICIENCY LEVELS FOR SMALL COMMERCIAL AIR-COOLED AIR CONDITIONERS (AC) AND HEAT PUMPS (HP) <65,000 Btu/h

	Split-system AC	Single-package AC	Split-system HP	Single-package HP
SEER				
Baseline—Federal Standard	13.0	13.0	13.0	13.0
Baseline—ASHRAE Standard	13.0	14.0	14.0	14.0
HSPF				
Baseline—Federal Standard			7.7	7.7
Baseline—ASHRAE Standard			8.2	8.0

3. Identification of Increased Efficiency Levels for Analysis

DOE analyzed several efficiency levels and obtained incremental cost data for the four equipment classes under consideration. Table V.44 presents the efficiency levels examined for each equipment class. As part of the engineering analyses, DOE considered up to six efficiency levels beyond the baseline for each equipment class. DOE derived the maximum technologically feasible (''max-tech'') level from the market maximum in the AHRI Certified Directory,[13] as of November 2013. The highest available efficiency level for split-system heat pumps was 16.2 SEER, compared to 18.05 SEER for single-package heat pumps. In the January 2014 NOPR, DOE tentatively determined the ''max-tech'' level for single-package air conditioners to be 19.15. 80 FR 1171, 1189 (Jan. 8, 2015). DOE also determined that split-system air conditioners are capable of reaching the same efficiency levels as single-package units. *Id.* For the engineering analysis, DOE rounded the ''max-tech'' levels to integer values of 18 and 19 for split-system and single-package heat pumps, and split-system and single-package air conditioners, respectively. The impact of this rounding, which results in efficiency levels that are whole-number values of SEER, is minimal. DOE did not receive any comments on its tentative determination for max-tech levels for single-package and split-system heat pumps and air conditioners and thus maintained its analysis in this final rule.

The final efficiency levels for each equipment class are presented below in Table V.4. For additional details on the efficiency levels selected for analysis, see chapter 3 of the final rule TSD.

TABLE V.4—EFFICIENCY LEVELS FOR SMALL COMMERCIAL AIR-COOLED AIR CONDITIONERS AND HEAT PUMPS <65,000

Efficiency level	Split-system AC	Single-package AC	Split-system HP		Single-package HP	
	SEER	SEER	SEER	HSPF	SEER	HSPF
Federal Baseline	13	13	13	7.7	13	7.7
0—ASHRAE Baseline *	14	14	14	8.2	14	8.0
1	15	15	15	8.5	15	8.4
2	16	16	16	8.7	16	8.8
3	17	17	17	9.0	17	8.9
4 **	18	18	18	9.2	18	9.1

[13] The AHRI Certified Directory is available at *http://www.ahridirectory.org/ahridirectory/pages/home.aspx.*

TABLE V.4—EFFICIENCY LEVELS FOR SMALL COMMERCIAL AIR-COOLED AIR CONDITIONERS AND HEAT PUMPS <65,000—Continued

Efficiency level	Split-system AC	Single-package AC	Split-system HP		Single-package HP	
	SEER	SEER	SEER	HSPF	SEER	HSPF
5 ***	19	19				

* For consistency across equipment classes, DOE refers to 14 SEER as EL 0, which is only the ASHRAE Baseline for three of the equipment classes, excluding split-system AC.
** Efficiency Level 4 is "Max-Tech" for HP equipment classes.
*** Efficiency Level 5 is "Max-Tech" for AC equipment classes.

4. Engineering Analysis Results

The results of the engineering analysis are cost-efficiency curves based on results from the cost models for analyzed units. DOE's calculated MPCs for small commercial air conditioners and heat pumps less than 65,000 Btu/h are shown in Table V.5 through Table V.8, and further details on the calculation of these curves can be found in chapter 3 of the final rule TSD. DOE used the cost-efficiency curves from the engineering analysis as an input for the life-cycle cost and payback period analyses.

TABLE V.5—MANUFACTURER PRODUCTION COSTS FOR THREE-TON SPLIT-SYSTEM COMMERCIAL AIR-COOLED AIR CONDITIONERS

SEER	MPC [2014$]
13	$855
14	937
15	1,023
16	1,115
17	1,212
18	1,316
19	1,427

TABLE V.6—MANUFACTURER PRODUCTION COSTS FOR THREE-TON SINGLE-PACKAGE COMMERCIAL AIR-COOLED AIR CONDITIONERS

SEER	MPC [2014$]
13	$1,003
14	1,122
15	1,241
16	1,361
17	1,480
18	1,599
19	1,719

TABLE V.7—MANUFACTURER PRODUCTION COSTS FOR THREE-TON SPLIT-SYSTEM COMMERCIAL AIR-COOLED HEAT PUMPS

SEER	HSPF	MPC [2014$]
13	7.7	$1,068
14	8.2	1,154
15	8.5	1,244
16	8.7	1,377
17	9.0	1,486
18	9.2	1,601

TABLE V.8—MANUFACTURER PRODUCTION COSTS FOR THREE-TON SINGLE-PACKAGE COMMERCIAL AIR-COOLED HEAT PUMPS

SEER	HSPF	MPC [2014$]
13	7.7	$1,239
14	8.0	1,372
15	8.4	1,504
16	8.8	1,637
17	8.9	1,769
18	9.1	1,902

a. Manufacturer Markups

DOE applies a non-production cost multiplier (the manufacturer markup) to the full MPC to account for corporate non-production costs and profit. The resulting manufacturer selling price (MSP) is the price at which the manufacturer can recover all production and nonproduction 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 manufacturer production costs. Depending on the competitive environment for these particular types of equipment, some or all of the increased production costs may be passed from manufacturers to retailers and eventually to commercial consumers 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 pass along the increased variable costs and some of the capital and product conversion costs (the one-time expenditures) to the consumer. A low markup suggests that manufacturers will not be able to recover as much of the necessary investment in plants and equipment.

For small commercial air-cooled air-conditioners and heat pumps, DOE used a manufacturer markup of 1.3, as developed for the 2011 direct final rule for single-phase central air conditioners and heat pumps. 76 FR 37408 (June 27, 2011). This markup was calculated using U.S. Security and Exchange Commission (SEC) 10–K reports for publicly-owned heating and cooling companies, as well as feedback from manufacturer interviews. See chapter 3 of the final rule TSD for more details about the methodology DOE used to determine the manufacturing markup.

b. Shipping Costs

Manufacturers of commercial HVAC products typically pay for freight (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 accounts for shipping costs separately from other non-production costs that comprise the manufacturer markup. DOE calculated the MSP for small commercial air-cooled air-conditioners and heat pumps by multiplying the MPC at each efficiency level (determined from the cost model) by the manufacturer markup and adding shipping costs for equipment at the given efficiency level. More specifically, DOE calculated shipping costs at each efficiency level based on a typical 53-foot straight-frame trailer with a storage volume of 4,240 cubic feet. DOE examined the sizes of small commercial air-cooled air-conditioners and heat pumps and determined the number of units that would fit in each trailer, based on assumptions about the arrangement of units in the trailer. See chapter 3 of the final rule TSD for more details about the methodology DOE used to determine the shipping costs.

C. Markups Analysis

The markups analysis develops appropriate markups in the distribution chain to convert the estimates of manufacturer selling price derived in the engineering analysis to commercial consumer prices. (''Commercial 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 commercial consumer price.

In the 2014 NOPR for Central Unitary Air Conditioners (CUAC), which includes equipment similar to but larger than that in this rulemaking, DOE determined that there are three types of distribution channels to describe how the equipment passes from the manufacturer to the commercial consumer. 79 FR 58948, 58975 (Sept. 30, 2014). In the new construction market, the manufacturer sells the equipment to a wholesaler. The wholesaler sells the equipment to a mechanical contractor, who sells it to a general contractor, who in turn sells the equipment to the commercial consumer or end user as part of the building. In the replacement market, the manufacturer sells to a wholesaler, who sells to a mechanical contractor, who in turn sells the equipment to the commercial consumer or end user. In the third distribution channel, used in both the new construction and replacement markets, the manufacturer sells the equipment directly to the customer through a national account.

In the analysis for this Final Rule and in the January 2015 NOPR, DOE used two of the three distribution channels described above to determine the markups. Given the small cooling capacities of air conditioners and heat pumps less than 65,000 Btu/h, DOE did not use the national accounts distribution chain in the markups analysis. National accounts are composed of large commercial consumers of HVAC equipment that negotiate equipment prices directly with the manufacturers, such as national retail chains. The end market consumers of three-ton central air conditioners and heat pumps are small offices and small retailers and do not fit the profile of large national chains. 80 FR 1171, 1191 (Jan. 8, 2015).

In the 2014 CUAC NOPR, based on information that equipment manufacturers provided, commercial consumers were estimated to purchase 50 percent of the covered equipment through small mechanical contractors, 32.5 percent through large mechanical contractors, and the remaining 17.5 percent through national accounts. 79 FR 58948, 58976 (Sept. 30, 2014). For this analysis, DOE removed the national accounts distribution channel and recalculated the size of the small and large mechanical contractor distribution channels assuming they make up the entire market. Therefore, the small mechanical distribution chain accounts for 61 percent of equipment purchases (*i.e.*, 50 percent divided by the sum of 50 percent and 32.5 percent), and the large mechanical contractor distribution chain represents 39 percent of purchases.

In this Final Rule and in the January 2015 NOPR, DOE used the markups from the 2014 CUAC NOPR, for which DOE utilized updated versions of: (1) The Heating, Air Conditioning & Refrigeration Distributors International *2010 Profit Report* to develop wholesaler markups; (2) the Air Conditioning Contractors of America's (ACCA) *2005 Financial Analysis for the HVACR Contracting Industry* to develop mechanical contractor markups; and (3) U.S. Census Bureau economic data for the commercial and institutional building construction industry to develop general contractor markups.[14] 80 FR 1171, 1191 (Jan. 8, 2015).

Chapter 5 of the final rule TSD provides further detail on the estimation of markups.

D. Energy Use Analysis

The energy use analysis provides estimates of the annual energy consumption of small air-cooled air conditioners and heat pumps with cooling capacities less than 65,000 btu/h at the considered efficiency levels. DOE uses these values in the LCC and PBP analyses and in the NIA.

The cooling unit energy consumption (UEC) by equipment type and efficiency level came from the national impact analysis associated with the 2011 direct final rule (DFR) for residential central air conditioners and heat pumps. (EERE–2011–BT–STD–0011–0011). Specifically, DOE used the UECs for single-phase equipment installed in commercial buildings. The UECs for split system and single package equipment were similar in the 2011 analysis for lower efficiency levels, but at higher efficiency levels, the only UEC s available were for split-system equipment. DOE assumed that the similarities at lower levels could be expected to hold at higher efficiency levels; therefore, DOE used the UECs for split equipment for all equipment classes in this final rule, including split system and single package.

In order to assess variability in the cooling UEC by region and building type, DOE used a Pacific Northwest National Laboratory report[15] that estimated the annual energy usage of space cooling and heating products using a Full Load Equivalent Operating Hour (FLEOH) approach. DOE normalized the provided FLEOHs to the UEC data discussed above to vary the average UEC across region and building type. The building types used in this analysis are small retail establishments and small offices.

DOE reviewed the results of the simulations for the 2011 DFR and determined that the heating loads for these small commercial applications are extremely low (less than 500 kwh/year). As a result, DOE did not include any energy savings in the analysis for this Final Rule due to the increase in HSPF for this equipment. Chapter 4 of the final rule TSD provides further detail on energy use analysis.

E. Life-Cycle Cost and Payback Period Analysis

The purpose of the LCC and PBP analysis is to analyze the effects of potential amended energy conservation standards on commercial consumers of small commercial air-cooled air conditioners and heat pumps less than 65,000 btu/h by determining how a potential amended standard affects their operating expenses (usually decreased) and their total installed costs (usually increased).

The LCC is the total consumer expense over the life of the equipment, consisting of equipment and installation costs plus operating costs (*i.e.*, expenses for energy use, maintenance, and repair). DOE discounts future operating costs to the time of purchase using commercial consumer discount rates. The PBP is the estimated amount of time (in years) it takes commercial consumers to recover the increased total installed cost (including equipment and

[14] U.S. Census Bureau, 2007 Economic Census, Construction Industry Series and Wholesale Trade Subject Series (Available at: *www.census.gov/econ/census/data/historical_data.html*).

[15] See Appendix D of the 2000 Screening Analysis for EPACT-Covered Commercial HVAC and Water-Heating Equipment. (EERE–2006–STD–0098–0015)

installation costs) of a more-efficient type of equipment through lower operating costs. DOE calculates the PBP by dividing the change in total installed cost (normally higher) due to a standard by the change in annual operating cost (normally lower) that results from the potential standard. However, unlike the LCC, DOE only considers the first year's operating expenses in the PBP calculation. Because the PBP does not account for changes in operating expenses over time or the time value of money, it is also referred to as a simple PBP.

For any given efficiency level, DOE measures the PBP and the change in LCC relative to an estimate of the base-case efficiency level. For split-system air conditioners, for which ASHRAE did not increase efficiency levels, the base-case estimate reflects the market in the absence of amended energy conservation standards, including the market for equipment that exceeds the current energy conservation standards. For single-package air conditioners, split-system heat pumps, and single-package heat pumps, the base-case estimate reflects the market in the case where the ASHRAE 90.1–2013 level becomes the Federal minimum, and the LCC calculates the LCC savings likely to result from higher efficiency levels compared with the ASHRAE base-case.

DOE conducted an LCC and PBP analysis for small commercial air-cooled air conditioners and heat pumps less than 65,000 btu/h using a computer spreadsheet model. When combined with Crystal Ball (a commercially-available software program), the LCC and PBP model generates a Monte Carlo simulation to perform the analyses by incorporating uncertainty and variability considerations in certain of the key parameters as discussed below. Inputs to the LCC and PBP analysis are categorized as: (1) Inputs for establishing the total installed cost and (2) inputs for calculating the operating expense. The following sections contain brief discussions of the inputs and key assumptions of DOE's LCC and PBP analysis. They are also described in detail in chapter 6 of the final rule TSD.

1. Equipment Costs

In the LCC and PBP analysis, the equipment costs faced by purchasers of small air-cooled air conditioning and heat pump equipment are derived from the MSPs estimated in the engineering analysis, the overall markups estimated in the markups analysis, and sales tax.

To develop an equipment price trend for the final rule, DOE derived an inflation-adjusted index of the producer price index (PPI) for ''unitary air-conditioners, except air source heat pumps'' from 1978 to 2013, which is the PPI series most relevant to small air-cooled air-conditioning equipment. The PPI index for heat pumps covered too short a time period to provide a useful picture of pricing trends, so the air-conditioner time series was used for both air conditioners and heat pumps. DOE expects this to be a reasonably accurate assessment for heat pumps because heat pumps are produced by the same manufacturers as air-conditioners and contain most of the same components. Although the overall PPI index shows a long-term declining trend, data for the last decade have shown a flat-to-slightly-rising trend. Given the uncertainty as to which of the trends will prevail in coming years, DOE chose to apply a constant price trend (at 2014 levels) for the final rule. See chapter 6 of the final rule TSD for more information on the price trends.

2. Installation Costs

DOE derived national average installation costs for small air-cooled air conditioning and heat pump equipment from data provided in RS Means 2013.[16] RS Means provides estimates for installation costs for the subject equipment by equipment capacity, as well as cost indices that reflect the variation in installation costs for 656 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.

Based on these data, DOE concluded that data for 3-ton rooftop air conditioners would be sufficiently representative of the installation costs for air conditioners less than 65,000 btu/h. For heat pumps, DOE used the installation costs for 3-ton air-source heat pumps.

DOE also varied installation cost as a function of equipment weight. Because weight tends to increase with equipment efficiency, installation cost increased with equipment efficiency. The weight of the equipment in each class and efficiency level was determined through the engineering analysis.

3. Unit Energy Consumption

The calculation of annual per-unit energy consumption by each class of the subject small air-cooled air conditioning and heating equipment at each considered efficiency level is based on the energy use analysis as described above in section V.D and in chapter 4 of the final rule TSD.

4. Electricity Prices and Electricity Price Trends

DOE used average and marginal electricity prices by Census Division based on tariffs from a representative sample of electric utilities. This approach calculates energy expenses based on actual commercial building average and marginal electricity prices that customers are paying.[17] The Commercial Buildings Energy Consumption Survey (CBECS) 1992 and CBECS 1995 surveys provide monthly electricity consumption and demand for a large sample of buildings. DOE used these values to help develop usage patterns associated with various building types. Using these monthly values in conjunction with the tariff data, DOE calculated monthly electricity bills for each building. The average price of electricity is defined as the total electricity bill divided by total electricity consumption. From this average price, the marginal price for electricity consumption was determined by applying a 5-percent decrement to the average CBECS consumption data and recalculating the electricity bill. Using building location and the prices derived from the above method, an average and marginal price was determined for each region of the U.S.

The average electricity price multiplied by the baseline electricity consumption for each equipment class defines the baseline LCC. For each efficiency level, the operating cost savings are calculated by multiplying the electricity consumption savings (relative to the baseline) by the marginal consumption price.

For this final rule, DOE updated the tariff-based prices to 2014 dollars and projected future electricity prices using trends in average commercial electricity price from *Annual Energy Outlook* (*AEO*) *2014*. An examination of data published by the Edison Electric Institute[18] indicates that the rate of increase of marginal and average prices is not significantly different, so the same factor was used for both pricing estimates.

For further discussion of electricity prices, see chapter 6 of the final rule TSD.

[16] RS Means Mechanical Cost Data 2013. *Reed Construction Data, LLC (2012).*

[17] Coughlin, K., C. Bolduc, R. Van Buskirk, G. Rosenquist and J.E. McMahon, ''Tariff-based Analysis of Commercial Building Electricity Prices'' (2008) Lawrence Berkeley National Laboratory: Berkeley, CA. Report No. LBNL–55551.

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

5. Maintenance Costs

Maintenance costs are costs to the commercial consumer of ensuring continued operation of the equipment (*e.g.*, checking and maintaining refrigerant charge levels and cleaning heat-exchanger coils). DOE derived annualized maintenance costs for small commercial air-cooled air conditioners and heat pumps from RS Means data.[19] These data provided estimates of person-hours, labor rates, and materials required to maintain commercial air-conditioning and heating equipment. The estimated annualized maintenance cost, in 2014 dollars, is $302 for air conditioners rated between 36,000 Btu/h and 288,000 Btu/h and $334 for heat pumps rated between 36,000 Btu/h and 288,000 Btu/h; this capacity range includes the equipment that is the subject of this final rule. DOE assumed that the maintenance costs do not vary with efficiency level.

6. Repair Costs

Repair costs are costs to the commercial consumer associated with repairing or replacing components that have failed. DOE utilized RS Means [20] to find the repair costs for small commercial air-cooled air conditioners and heat pumps. For air conditioners, DOE used the repair costs for a 3-ton, single-zone rooftop unit. For heat pumps, DOE took the repair costs for 1.5-ton, 5-ton, and 10-ton air-to-air heat pumps and linearly scaled the repair costs to derive a 3-ton repair cost. DOE assumed that the repair would be a one-time event in year 10 of the equipment life. DOE then annualized the present value of the cost over the average equipment life of 19 or 16 years (for air conditioners and heat pumps, respectively) to obtain an annualized equivalent repair cost. This value, in 2014 dollars, ranges from $143 to $157 at the baseline level, depending on equipment class. The materials portion of the repair cost was scaled with the percentage increase in manufacturers' production cost by efficiency level. The labor cost was held constant across efficiency levels. This annualized repair cost was then added to the maintenance cost to create an annual ''maintenance and repair cost'' for the lifetime of the equipment. For further discussion of how DOE derived and implemented repair costs, see chapter 6 of the final rule TSD.

[19] RS Means Facilities Maintenance & Repair Cost Data 2013. *Reed Construction Data, LLC. (2012).*

[20] *Id.*

7. Equipment Lifetime

Equipment lifetime is the age at which the subject small air-cooled air conditioners and heat pumps less than 65,000 Btu/h are retired from service. DOE based equipment lifetime on a retirement function in the form of a Weibull probability distribution. DOE used the inputs from the 2011 DFR technical support document for central air conditioners and heat pumps, which represented a mean lifetime of 19.01 years for air conditioners and 16.24 years for heat pumps, and used the same values for units in both residential and commercial applications. (EERE–2011–BT–STD–0011–0012) Given the similarity of such equipment types, DOE believes the lifetime for single-phase equipment is a reasonable approximation of the lifetime for similar three-phase equipment.

8. Discount Rate

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

DOE derived the discount rates by estimating the weighted-average cost of capital (WACC) of companies that purchase air-cooled air-conditioning equipment. More details regarding DOE's estimates of commercial consumer discount rates are provided in chapter 6 of the final rule TSD.

9. Base-Case Market Efficiency Distribution

For the LCC analysis, DOE analyzes the considered efficiency levels relative to a base case (*i.e.*, the case without amended energy efficiency standards, in this case the current Federal standards for split-system air conditioners, and the default scenario in which DOE is required to adopt the efficiency levels in ASHRAE 90.1–2013 for the three equipment classes triggered by ASHRAE). This analysis requires an estimate of the distribution of equipment efficiencies in the base case (*i.e.*, what consumers would have purchased in the compliance year in the absence of amended standards for split-system air conditioners, or amended standards more stringent than those in ASHRAE 90.1–2013 for the three triggered equipment classes). DOE refers to this distribution of equipment energy efficiencies as the base-case efficiency distribution. For more information on the development of the base-case distribution, see section V.F.3 and chapter 6 of the final rule TSD.

10. Compliance Date

DOE calculated the LCC and PBP for all commercial consumers as if each were to purchase new equipment in the year that compliance with amended standards is required. Generally, covered equipment to which a new or amended energy conservation standard applies must comply with the standard if such equipment is manufactured or imported on or after a specified date. EPCA states that compliance with any such standards shall be required on or after a date which is two or three years (depending on equipment size) after the compliance date of the applicable minimum energy efficiency requirement in the amended ASHRAE/IES standard. (42 U.S.C. 6313(a)(6)(D)) Given the equipment size at issue here, DOE has applied the two-year implementation period to determine the compliance date of any energy conservation standard equal to the efficiency levels specified by ASHRAE Standard 90.1–2013 proposed by this rulemaking. Thus, the compliance date of this final rule for small commercial air-cooled air conditioners and heat pumps less than 65,000 Btu/h manufactured on or after January 1, 2017, which is two years after the date specified in ASHRAE Standard 90.1–2013.

Economic justification is not required for DOE to adopt the efficiency levels in ASHRAE 90.1–2013, as DOE is statutorily required to, at a minimum, adopt those levels. Therefore, DOE did not perform an LCC analysis on the ASHRAE Standard 90.1–2013 levels, and for purposes of the LCC analysis, DOE used 2020 as the first year of compliance with amended standards.

11. Payback Period Inputs

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

Similar to the LCC, the inputs to the PBP calculation are the total installed cost of the equipment to the commercial consumer for each efficiency level and the average annual operating expenditures for each efficiency level for each building type and Census Division, weighted by the probability of shipment to each market. The PBP calculation uses the same inputs as the LCC analysis, except that discount rates are not needed. Because the simple PBP does not take into account changes in operating expenses 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 6 of the final rule TSD provides additional detail about the PBP.

F. National Impact Analysis—National Energy Savings and Net Present Value Analysis

The national impact analysis (NIA) evaluates the effects of a considered energy conservation standard from a national perspective rather than from the consumer perspective represented by the LCC. This analysis assesses the net present value (NPV) (future amounts discounted to the present) and the national energy savings (NES) of total commercial consumer costs and savings, which are expected to result from amended standards at specific efficiency levels. For each efficiency level analyzed, DOE calculated the NPV and NES for adopting more-stringent standards than the efficiency levels specified in ASHRAE Standard 90.1–2013.

The NES refers to cumulative energy savings from 2017 through 2046 for the three equipment classes triggered by ASHRAE; however when evaluating more-stringent standards, energy savings do not begin accruing until the later compliance date of 2020. DOE calculated new 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 split-system air conditioners, the NES refers to cumulative energy savings from 2019 through 2048 for all standards cases. DOE calculated new energy savings in each year relative to a base case, defined as the current Federal standards, which are equivalent to the efficiency levels specified by ASHRAE Standard 90.1–2013.

The NPV refers to cumulative monetary savings. DOE calculated net monetary savings in each year relative to the base case (ASHRAE Standard 90.1–2013) as the difference between total operating cost savings and increases in total installed cost. Cumulative savings are the sum of the annual NPV over the specified period. DOE accounted for operating cost savings until past 2100, when the equipment installed in the 30th year after the compliance date of the amended standards should be retired.

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.

With regard to estimating the NES, because more-efficient air conditioners and heat pumps are expected to gradually replace less-efficient ones, the energy per unit of capacity used by the air conditioners and heat pumps in service gradually decreases in the standards case relative to the base case. DOE calculated the NES by subtracting energy use under a standards-case scenario from energy use in a base-case scenario.

Unit energy savings 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 national site energy consumption (*i.e.,* the energy directly consumed by the units of equipment in operation) for each class of air conditioner and heat pumps for each year of the analysis period. The NES and NPV analysis periods begin with the earliest expected compliance date of amended Federal energy conservation standards (*i.e.,* 2017 for the equipment classes triggered by ASHRAE, since DOE is adopting the baseline ASHRAE Standard 90.1–2013 efficiency levels). For the analysis of DOE's potential adoption of more-stringent efficiency levels for the equipment classes triggered by ASHRAE, the earliest compliance date would be 2020, four years after DOE would likely issue a final rule requiring such standards. Second, DOE determined the annual site energy savings, consisting of the difference in site energy consumption between the base case and the standards case for each class of small commercial air conditioner and heat pump less than 65,000 Btu/h. Third, DOE converted the annual site energy savings into the annual primary and FFC energy savings using annual conversion factors derived from the *AEO 2014* version of the Energy Information Administration's (EIA) National Energy Modeling System (NEMS). Finally, DOE summed the annual primary and FFC energy savings from 2017 to 2046 to calculate the total NES for that period. DOE performed these calculations for each efficiency level considered for small commercial air conditioners and heat pumps in this rulemaking.

DOE considered whether a rebound effect is applicable in its NES analysis. A rebound effect occurs when an increase in equipment efficiency leads to an increased demand for its service. The NEMS model assumes a certain elasticity factor to account for an increased demand for service due to the increase in cooling (or heating) efficiency.[21] EIA refers to this as an efficiency rebound. For the small commercial air conditioning and heating equipment 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 they are installed; and (2) additional instances of air conditioning of building spaces that were not being cooled before.

DOE does not expect either of these instances to occur because the annual energy use for this equipment is very low; therefore, the energy cost savings from more-efficient equipment would likely not be high enough to induce a commercial consumer to increase the use of the equipment, either in a previously-cooled space or another previously-uncooled space. Therefore, DOE did not assume a rebound effect in the January 2015 NOPR analysis. DOE sought input from interested parties on whether there will be a rebound effect for improvements in the efficiency of small commercial air conditioners and heat pumps, but did not receive any comment. As a result, DOE has maintained its assumption in this final rule.

To estimate NPV, DOE calculated the net impact as the difference between net operating cost savings (including electricity cost savings and increased repair costs) and increases in total installed costs (including customer prices). 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

[21] An overview of the NEMS model and documentation is found at *http://www.eia.doe.gov/oiaf/aeo/overview/index.html.*

section V.E.1, DOE used a constant price assumption as the default price forecast. 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. 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 air conditioners and heat pumps bought on or after 2017 (or 2019) and summed the discounted values to provide the NPV of an efficiency level. An NPV greater than zero shows net savings (*i.e.,* the efficiency level would reduce commercial consumer expenditures relative to the base case in present value terms). An NPV that is less than zero indicates that the efficiency level would result in a net increase in commercial consumer expenditures in present value terms.

To make the analysis more transparent to all interested parties, DOE used a commercially-available spreadsheet tool 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 first 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. DOE projected the energy savings, energy cost savings, equipment costs, and NPV of benefits for equipment sold in each small commercial air-cooled air conditioner and heat pump class from 2017 through 2046. The projections provided annual and cumulative values for all four output parameters described previously.

2. Shipments Analysis

Equipment shipments are an important element in the estimate of the future impact of a potential energy conservation standard. DOE developed shipment projections for small commercial air-cooled air conditioners and heat pumps less than 65,000 Btu/h and, in turn, calculated equipment stock over the course of the analysis period by assuming a Weibull distribution with an average 19-year equipment life for air conditioners and a 16-year life for heat pumps. (See section V.E.7 for more information on lifetime.) DOE used the shipments projection and the equipment stock to determine the NES. The shipments portion of the spreadsheet model projects small commercial air-cooled air conditioner and heat pump shipments through 2046.

DOE relied on 1999 shipment estimates along with trends from the U.S. Census and *AEO 2014* to estimate shipments for this equipment. Table V.99 shows the 1999 shipments estimates from the 2000 Screening Analysis for EPACT-Covered Commercial HVAC and Water-Heating Equipment (EERE–2006–STD–0098–0015). While the U.S. Census provides shipments data for air-cooled equipment less than 65,000 Btu/h, it does not disaggregate the shipments into single-phase and three-phase. Therefore, DOE used the Census data from 1999 to 2010 [22] as a trend from which to extrapolate DOE's 1999 estimated shipments data (which is divided by equipment class) for three-phase equipment shipments between 2000 to 2010.

TABLE V.9—DOE ESTIMATED SHIPMENTS OF SMALL THREE-PHASE COMMERCIAL AIR CONDITIONERS AND HEAT PUMPS <65,000 Btu/h

Equipment class	1999
Three-Phase Air-Cooled Split-System Air Conditioners <65,000 Btu/h	91,598
Three-Phase Air-Cooled Single-Package Air Conditioners <65,000 Btu/h	213,728
Three-Phase Air-Cooled Split-System Heat Pumps <65,000 Btu/h	11,903
Three-Phase Air-Cooled Single-Package Heat Pumps <65,000 Btu/h	27,773

Because the Census data end in 2010, DOE cannot use those data to determine whether shipments continue to decline past 2010. Therefore, DOE reviewed AHRI's monthly shipments data for the broader category of central air conditioners and heat pumps to determine more recent trends.[23] DOE found that the average annual growth rate from 2005 to 2010 was −12 percent for air conditioners and −4 percent for heat pumps. However, the average annual growth rate from 2010 to 2014 was 7 percent for air conditioners and 8 percent for heat pumps. These data indicate that the decline in shipments through 2010 has stopped and has in fact begun to reverse. Therefore, DOE used the AHRI-reported growth rates from 2010 to 2011 (10 percent for air conditioners and 1 percent for heat pumps) to scale its projected 2010 shipments to 2011, at which time it could begin projecting shipments using *AEO 2014* forecasts (2011 through 2040) for commercial floor space. DOE assumed that shipments of small commercial air-cooled air conditioners and heat pumps would be related to the growth of commercial floor space. DOE used this projection, with an average annual growth rate of 1 percent, to project shipments for each of the four equipment classes through 2040. For years beyond 2040, DOE also applied an average annual growth rate of 1 percent.

Table V.10 shows the projected shipments for the different equipment classes of small commercial air-cooled air conditioners and heat pumps less than 65,000 Btu/h for selected years from 2017 to 2046, as well as the cumulative shipments. As equipment purchase price and repair costs increase with efficiency, DOE recognizes that higher first costs and repair costs can result in a drop in shipments. However, in the January 2015 NOPR, DOE had no basis for estimating the elasticity of shipments for small commercial air-cooled air conditioners and heat pumps less than 65,000 Btu/h as a function of first costs, repair costs, or operating costs. In addition, because air-cooled air conditioners are likely the lowest-cost option for air conditioning small office and retail applications, DOE tentatively concluded in the NOPR that it is unlikely that shipments would change as a result of higher first costs and repair costs. Therefore, DOE presumed that the shipments projection would not change with higher standard levels. 80 FR 1171, 1196 (Jan. 8, 2015).

DOE sought input on this assumption. In response, Lennox International commented that more stringent efficiency levels increase equipment costs and reduce demand, citing the decline in residential central air conditioner shipments when SEER requirements were raised from 10 to 13.

[22] U.S. Census Bureau, Current Industrial Reports for Refrigeration, Air Conditioning, and Warm Air Heating Equipment, MA333M. Note that the current industrial reports were discontinued in 2010, so more recent data are not available. (Available at: *http://www.census.gov/manufacturing/cir/historical_data/ma333m/index.html*).

[23] AHRI, *HVACR & Water Heating Industry Statistical Profile* (2012) (Available at: *http://www.ari.org/site/883/Resources/Statistics/AHRI-Industry-Statistical-Profile*). See also AHRI Monthly Shipments: *http://www.ari.org/site/498/Resources/Statistics/Monthly-Shipments*; especially December 2013 release: *http://www.ari.org/App_Content/ahri/files/Statistics/Monthly%20Shipments/2013/December2013.pdf;* May 2014 release: *http://www.ari.org/App_Content/ahri/files/Statistics/Monthly%20Shipments/2014/May2014.pdf.*

Lennox also noted that higher prices also lead to more repairs, which reduces energy savings benefits. (Lennox International, No. 36 at p. 2–3)

DOE acknowledges Lennox's concerns. However, DOE does not have data available to estimate the price elasticity for this equipment. Furthermore, DOE does not believe that the commercial market would necessarily respond in a similar manner to an increased standard as would the residential market. Given that even without a drop in shipments, none of the efficiency levels in the NOPR were determined to be economically justified, DOE has not revised its shipments estimates for the final rule.

Chapter 7 of the final rule TSD provides additional details on the shipments projections.

TABLE V.10—SHIPMENTS PROJECTION FOR SMALL COMMERCIAL AIR-COOLED AIR CONDITIONERS AND HEAT PUMPS <65,000 Btu/h

Equipment	Units shipped by year and equipment class							
	2017	2020	2025	2030	2035	2040	2046	Cumulative shipments (2017–2046) *
Three-Phase Air-Cooled Split-System Air Conditioners <65,000 Btu/h	80,210	83,175	87,651	91,610	96,170	101,593	107,802	2,806,115
Three-Phase Air-Cooled Single-Package Air Conditioners <65,000 Btu/h	122,271	126,790	133,613	139,649	146,600	154,867	164,332	4,277,584
Three-Phase Air-Cooled Split-System Heat Pumps <65,000 Btu/h	19,634	20,360	21,455	22,424	23,541	24,868	26,388	686,883
Three-Phase Air-Cooled Single-Package Heat Pumps <65,000 Btu/h	25,157	26,086	27,490	28,732	30,162	31,863	33,810	880,091
Total	247,272	256,411	270,210	282,415	296,473	313,191	332,333	8,650,673

* Note that the analysis period for split-system air conditioners is 2019–2048, but for comparison purposes, the same time period for cumulative shipments is shown for each equipment class.

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

DOE developed base-case efficiency distributions based on model availability in the AHRI Certified Directory. DOE bundled the efficiency levels into ''efficiency ranges'' and determined the percentage of models within each range. 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 within the base case.

In the January 2015 NOPR, DOE estimated a base-case efficiency trend of an increase of approximately 1 SEER every 35 years, based on the EER trend from 2012 to 2035 found in the Commercial Unitary Air Conditioner Advance Notice of Proposed Rulemaking (ANOPR).[24] DOE used this same trend in the standards-case scenarios. 80 FR 1171, 1197 (Jan. 8, 2015). DOE requested comment on the estimated efficiency trend but did not receive any comments. As a result, DOE used this same trend in its final rule analysis.

In addition, 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.,* 2017 for adoption of efficiency levels in ASHRAE Standard 90.1–2013). Table V.8 presents the estimated base-case efficiency market shares for each small commercial air-cooled air conditioner and heat pump equipment class.

TABLE V.11—BASE-CASE EFFICIENCY MARKET SHARES FOR SMALL COMMERCIAL AIR-COOLED AIR CONDITIONERS AND HEAT PUMPS <65,000 Btu/h

Three-phase air-cooled split-system air conditioners <65,000 Btu/h (2019)		Three-phase air-cooled single-package air conditioners <65,000 Btu/h (2020)		Three-phase air-cooled split-system heat pumps 65,000 Btu/h (2020)		Three-phase air-cooled single-package heat pumps <65,000 Btu/h (2020)	
SEER	Market share (%)	SEER	Market share (%)	SEER	Market share (%)	SEER	Market share (%)
13	26	13	0	13	0	13	0
14	50	14	52	14	80	14	69
15	22	15	30	15	19	15	21
16	2	16	7	16	1	16	9
17	0	17	4	17	0	17	1
18	0	18	7	18	0	18	1
19	0	19	0				

Note: The 0% market share at 13.0 SEER for three equipment classes is accounting for the default adoption of ASHRAE Standard 90.1–2013 levels in 2017.

4. National Energy Savings and Net Present Value

The stock of small commercial air-cooled air conditioner and heat pump equipment less than 65,000 Btu/h is the total number of units in each equipment class purchased or shipped from previous years that have survived until

[24] See DOE's technical support document underlying DOE's July 29, 2004 ANOPR. 69 FR 45460 (Available at: *http://www.regulations.gov/#!documentDetail;D=EERE-2006-STD-0103-0078*). DOE assumed that the EER trend would reasonably represent a SEER trend.

a given point. The NES spreadsheet,[25] through use of the shipments model, keeps track of the total number of units shipped each year. For purposes of the NES and NPV analyses, DOE assumes that shipments of air conditioner and heat pump units survive for an average of 19 years and 16 years, respectively, following a Weibull distribution, at the end of which time they are removed from service.

The national annual energy consumption is the product of the annual unit energy consumption and the number of units of each vintage in the stock, summed over all vintages. This approach accounts for differences in unit energy consumption from year to year. In determining national annual energy consumption, DOE estimated energy consumption and savings based on site energy and converted the electricity consumption and savings to primary energy using annual conversion factors derived from the *AEO 2014* version of NEMS. Cumulative energy savings are the sum of the NES for each year over the timeframe of the analysis.

In response to the recommendations of a committee on ''Point-of-Use and Full-Fuel-Cycle Measurement Approaches to Energy Efficiency Standards'' appointed by the National Academy of Sciences, DOE announced its intention to use FFC measures of energy use and greenhouse gas and other emissions in the national impact analyses and emissions analyses included in future energy conservation standards rulemakings. 76 FR 51281 (Aug. 18, 2011). After evaluating the approaches discussed in the August 18, 2011 notice, DOE published a statement of amended policy in the **Federal Register** in which DOE explained its determination that NEMS is the most appropriate tool for its FFC analysis and its intention to use NEMS for that purpose. 77 FR 49701 (Aug. 17, 2012). The approach used for this final rule is described in Appendix 8A of the final rule TSD.

In accordance with the OMB's guidelines on regulatory analysis, 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.

Table V.12 summarizes the inputs to the NES spreadsheet model along with a brief description of the data sources. The results of DOE's NES and NPV analysis are summarized in section VIII.B.1.b and described in detail in chapter 8 of the final rule TSD.

TABLE V.12—SUMMARY OF SMALL COMMERCIAL AIR-COOLED AIR CONDITIONER AND HEAT PUMPS <65,000 Btu/h NES AND NPV MODEL INPUTS

Inputs	Description
Shipments	Annual shipments based on U.S. Census, AHRI monthly shipment reports, and *AEO2014* forecasts of commercial floor space. (See chapter 7 of the final rule TSD.)
Compliance Date of Standard	2020 for adoption of a more-stringent efficiency level than those specified by ASHRAE Standard 90.1–2013 for the three equipment classes triggered by ASHRAE. 2017 for adoption of the efficiency levels specified by ASHRAE Standard 90.1–2013. 2019 for split-system air conditioners.
Base-Case Efficiencies	Distribution of base-case shipments by efficiency level, with efficiency trend of an increase of 1 EER every 35 years.
Standards-Case Efficiencies	Distribution of shipments by efficiency level for each standards case. In compliance year, units below the standard level ''roll-up'' to meet the standard. Efficiency trend of an increase of 1 EER every 35 years.
Annual Energy Use per Unit	Annual national weighted-average values are a function of efficiency level. (See chapter 4 of the final rule TSD.)
Total Installed Cost per Unit	Annual weighted-average values are a function of efficiency level. (See chapter 5 of the final rule TSD.)
Annualized Maintenance and Repair Costs per Unit.	Annual weighted-average values are a function of efficiency level. (See chapter 5 of the final rule TSD.)
Escalation of Fuel Prices	*AEO2014* forecasts (to 2040) and extrapolation for beyond 2040. (See chapter 8 of the final rule TSD.)
Site to Primary and FFC Conversion.	Based on *AEO2014* forecasts (to 2040) and extrapolation for beyond 2040. (See chapter 8 of the final rule TSD.)
Discount Rate	3 percent and 7 percent real.
Present Year	Future costs are discounted to 2015.

VI. Methodology for Water-Source Heat Pumps

This section addresses the analyses DOE has performed for this rulemaking with respect to water-source heat pumps. A separate subsection addresses each analysis. In overview, DOE used a spreadsheet to calculate the LCC and PBPs of potential energy conservation standards. DOE used another spreadsheet to provide shipments projections and then calculate national energy savings and net present value impacts of potential amended energy conservation standards.

A. Market Assessment

To begin its review of the ASHRAE Standard 90.1–2013 efficiency levels, DOE developed information that provides an overall picture of the market for the equipment concerned, including the purpose of the equipment, the industry structure, and market characteristics. This activity included both quantitative and qualitative assessments based primarily on publicly-available information. The subjects addressed in the market assessment for this rulemaking include

[25] The NES spreadsheet can be found in the docket for the ASHRAE rulemaking at: *www.regulations.gov/#!docketDetail;D=EERE-2014-BT-STD-0015.*

equipment classes, manufacturers, quantities, and types of equipment sold and offered for sale. The key findings of DOE's market assessment are summarized subsequently. For additional detail, see chapter 2 of the final rule TSD.

As proposed in the January 2015 NOPR, DOE is adopting the following definition for water-source heat pumps, adapted from the ASHRAE Handbook [26] and specifically referencing the new nomenclature included in ASHRAE 90.1–2013: ''*Water-source heat pump* means a single-phase or three-phase reverse-cycle heat pump of all capacities (up to 760,000 Btu/h) that uses a circulating water loop as the heat source for heating and as the heat sink for cooling. The main components are a compressor, refrigerant-to-water heat exchanger, refrigerant-to-air heat exchanger, refrigerant expansion devices, refrigerant reversing valve, and indoor fan. Such equipment includes, but is not limited to, water-to-air water-loop heat pumps.'' 80 FR 1171, 1182–1183 (Jan. 8, 2015).

1. Equipment Classes

EPCA and ASHRAE Standard 90.1–2013 both divide water-source heat pumps into three categories based on the following cooling capacity ranges: (1) <17,000 Btu/h; (2) ≥17,000 and <65,000 Btu/h; and (3) ≥65,000 and <135,000 Btu/h. ASHRAE 90.1–2013 revised the nomenclature for these equipment classes to refer to ''water-to-air, water-loop.'' In this document, DOE is revising the nomenclature for these equipment classes (but not the broader category) to match that used by ASHRAE. Specifically, DOE revises Table 1 to 10 CFR 431.96 and Tables 1 and 2 to 10 CFR 431.97 to refer to ''water-source (water-to-air, water-loop)'' heat pumps rather than simply ''water-source'' heat pumps. Throughout this final rule, any reference to water-source heat pump equipment classes should be considered as referring to water-to-air, water-loop heat pumps.

2. Review of Current Market

In order to obtain the information needed for the market assessment for this rulemaking, DOE consulted a variety of sources, including manufacturer literature, manufacturer Web sites, and the AHRI certified directory.[27] The information DOE gathered serves as resource material throughout the rulemaking. The sections that follow provide an overview of the market assessment, and chapter 2 of the final rule TSD provides additional detail on the market assessment, including citations to relevant sources.

a. Trade Association Information

DOE identified the same trade groups relevant to water-source heat pumps as to those listed in section V.A.2.a for small air-cooled air conditioners and heat pumps, namely AHRI, HARDI, and ACCA. DOE used data available from AHRI in its analysis, as described in the next section.

b. Manufacturer Information

DOE reviewed data for water-source (water-to-air, water-loop) heat pumps currently on the market by examining the AHRI Directory of Certified Product Performance. DOE identified 18 parent companies (comprising 21 manufacturers) of water-source (water-to-air, water-loop) heat pumps, which are listed in chapter 2 of the final rule TSD. Of these manufacturers, seven were identified as small businesses based upon number of employees and the employee thresholds set by the Small Business Administration. More details on this analysis can be found below in section IX.B.

c. Market Data

DOE reviewed the AHRI database to characterize the efficiency and performance of water-source (water-to-air, water-loop) heat pump models currently on the market. The full results of this market characterization are found in chapter 2 of the final rule TSD. For water-source heat pumps less than 17,000 Btu/h, the average EER was 13.8, and the average coefficient of performance (COP) was 4.7. Of the models identified by DOE, 34 (six percent of the total models) have EERs rated below the ASHRAE Standard 90.1–2013 levels, and 30 (five percent of the total models) have COPs rated below the ASHRAE Standard 90.1–2013 levels. For water-source heat pumps greater than or equal to 17,000 Btu/h and less than 65,000 Btu/h, the average EER was 15.2, and the average COP was 4.9. Of the models identified by DOE, 72 (two percent of the total models) have EERs rated below the ASHRAE Standard 90.1–2013 levels, and 133 (four percent of the total models) have COPs rated below the ASHRAE Standard 90.1–2013 levels. For water-source heat pumps greater than or equal to 65,000 Btu/h and less than 135,000 Btu/h, the average EER was 14.7, and the average COP was 4.8. Of the models identified by DOE, five (one percent of the total models) have EERs rated below the ASHRAE Standard 90.1–2013 levels, and two (0.5 percent of the total models) have COPs rated below the ASHRAE Standard 90.1–2013 levels.

B. Engineering Analysis

The engineering analysis establishes the relationship between an increase in energy efficiency and the increase in cost (manufacturer selling price (MSP)) of a piece of equipment DOE is evaluating for potential amended energy conservation standards. This relationship serves as the basis for cost-benefit calculations for individual consumers, manufacturers, and the Nation. The engineering analysis identifies representative baseline equipment, which is the starting point for analyzing possible energy efficiency improvements. For covered ASHRAE equipment, DOE sets the baseline for analysis at the ASHRAE Standard 90.1 efficiency level, because by statute, DOE cannot adopt any level below the revised ASHRAE level. The engineering analysis then identifies higher efficiency levels and the incremental increase in product cost associated with achieving the higher efficiency levels. After identifying the baseline models and cost of achieving increased efficiency, DOE estimates the additional costs to the commercial consumer through an analysis of contractor costs and markups, and uses that information in the downstream analyses to examine the costs and benefits associated with increased equipment efficiency.

DOE typically structures its engineering analysis around one of three methodologies: (1) The design-option approach, which calculates the incremental costs of adding specific design options to a baseline model; (2) the efficiency-level approach, which calculates the relative costs of achieving increases in energy efficiency levels without regard to the particular design options used to achieve such increases; and/or (3) the reverse-engineering or cost-assessment approach, which involves a ''bottom-up'' manufacturing cost assessment based on a detailed bill of materials derived from teardowns of the equipment being analyzed. A supplementary method called a catalog teardown uses published manufacturer catalogs and supplementary component data to estimate the major physical differences between a piece of equipment that has been physically

[26] 2012 ASHRAE Handbook, Heating, Ventilating, and Air-Conditioning Systems and Equipment. ASHRAE, Chapter 9 (Available at: *https://www.ashrae.org/resources__publications/description-of-the-2012-ashrae-handbook-hvac-systems-and-equipment*).

[27] AHRI Directory of Certified Product Performance (2013) (Available at: *www.ahridirectory.org*) (Last accessed November 11, 2013).

disassembled and another piece of similar equipment for which catalog data are available to determine the cost of the latter equipment. Deciding which methodology to use for the engineering analysis depends on the equipment, the design options under study, and any historical data upon which DOE may draw.

1. Approach

As discussed in the January 2015 NOPR, DOE used a combination of the efficiency-level approach and the cost-assessment approach. 80 FR 1171, 1200 (Jan. 8, 2015). DOE used the efficiency-level approach to identify incremental improvements in efficiency for each equipment class and the cost-assessment approach to develop a cost for each efficiency level. The efficiency levels that DOE considered in the engineering analysis were representative of commercial water-source heat pumps currently produced by manufacturers at the time the engineering analysis was developed. DOE relied on data reported in the AHRI Directory of Certified Product Performance to select representative efficiency levels. This directory reported EER, COP, heating and cooling capacities, and other data for all three application types (water-loop, ground-water, ground-loop) for all AHRI-certified units. After identifying representative efficiency levels, DOE used a catalog teardown or ''virtual teardown'' approach to estimate equipment costs at each level. DOE obtained general descriptions of key water-source heat pump components in product literature and used data collected for dozens of HVAC products to characterize the components' design details. This approach was used instead of the physical teardown approach due to time constraints.

In the January 2015 NOPR, DOE noted the drawbacks to using a catalog teardown approach. 80 FR 1171, 1200 (Jan. 8, 2015). However, DOE tentatively concluded the approach provided a reasonable approximation of all cost increases associated with efficiency increases. DOE did not receive any comments that rejected this conclusion, and therefore, adopts it in this Final Rule.

After selecting efficiency levels for each capacity class, as described in the sections that follow, DOE selected products for the catalog teardown analysis that corresponded to the representative efficiencies and cooling capacities. The engineering analysis included data for over 60 water-source heat pumps. DOE calculated the MPC for products spanning the full range of efficiencies from the baseline to the max-tech level for each analyzed equipment class. In some cases, catalog data providing sufficient information for cost analysis were not available at each efficiency level under consideration. Hence, DOE calculated the costs for some of the efficiency levels based on the cost/efficiency trends observed for other efficiency levels for which such catalog data were available. The engineering analysis is described in more detail in chapter 3 of the final rule TSD.

2. Baseline Equipment

DOE selected baseline efficiency levels as reference points for each equipment class, against which it measured changes resulting from potential amended energy conservation standards. DOE defined the baseline efficiency levels as reference points to compare the technology, energy savings, and cost of equipment with higher energy efficiency levels. Typically, units at the baseline efficiency level just meet Federal energy conservation standards and provide basic consumer utility. However, EPCA requires that DOE must adopt either the ASHRAE Standard 90.1–2013 levels or more-stringent levels. Therefore, because the ASHRAE Standard 90.1–2013 levels were the lowest levels that DOE could adopt, DOE used those levels as the reference points against which more-stringent levels could be evaluated. Table VI.1 shows the current baseline and ASHRAE efficiency levels for each water-source heat pump equipment class. In Table VI.2 below, the ASHRAE levels are designated ''0'' and more-stringent levels are designated 1, 2, and so on.

TABLE VI.1—BASELINE EFFICIENCY LEVELS FOR WATER-SOURCE HEAT PUMPS

	Water-source (water-to-air, water-loop) heat pumps <17,000 Btu/h	Water-source (water-to-air, water-loop) heat pumps ≥17,000 and <65,000 Btu/h	Water-source (water-to-air, water-loop) heat pumps ≥65,000 and <135,000 Btu/h
Efficiency Level (EER)			
Baseline—Federal Standard	11.2	12.0	12.0
Baseline—ASHRAE Standard	12.2	13.0	13.0

3. Identification of Increased Efficiency Levels for Analysis

DOE developed and considered potential increased energy efficiency levels for each equipment class. These more-stringent efficiency levels are representative of efficiency levels along the technology paths that manufacturers of residential heating products commonly use to maintain cost-effective designs while increasing energy efficiency. DOE developed more-stringent energy efficiency levels for each of the equipment classes, based on a review of AHRI's Directory of Certified Product Performance, manufacturer catalogs, and other publicly-available literature. The efficiency levels selected for analysis for each water-source heat pump equipment class are shown in Table VI.2. Chapter 3 of the final rule TSD shows additional details on the efficiency levels selected for analysis.

TABLE VI.2—EFFICIENCY LEVELS FOR ANALYSIS OF WATER-SOURCE HEAT PUMPS

	Water-source (water-to-air, water-loop) heat pumps <17,000 Btu/h	Water-source (water-to-air, water-loop) heat pumps ≥17,000 and <65,000 Btu/h	Water-source (water-to-air, water-loop) heat pumps ≥65,000 and <135,000 Btu/h
Efficiency Level (EER, Btu/W-h)			
Baseline—Federal Standard	11.2	12.0	12.0
Baseline—ASHRAE Level (0)	12.2	13.0	13.0
Efficiency Level 1	13.0	14.6	14.0
Efficiency Level 2	14.0	16.6	15.0
Efficiency Level 3	15.7	18.0	16.0
Efficiency Level 4*	16.5	19.2	17.2
Efficiency Level 5**	18.1	21.6	-

* Efficiency Level 4 is ''Max-Tech'' for the largest equipment classes.
** Efficiency Level 5 is ''Max-Tech'' for the two smaller equipment classes.

4. Engineering Analysis Results

The results of the engineering analysis are cost-efficiency curves based on results from the cost models for analyzed units. DOE's calculated MPCs for the three analyzed classes of water-source heat pumps are shown in Table VI.3. DOE used the cost-efficiency curves from the engineering analysis as an input for the life-cycle cost and PBP analysis. Further details regarding MPCs for water-source heat pumps may be found in chapter 3 of the final rule TSD.

TABLE VI.3—MANUFACTURER PRODUCTION COSTS FOR WATER-SOURCE HEAT PUMPS

	Water-source (water-to-air, water-loop) heat pumps <17,000 Btu/h		Water-source (water-to-air, water-loop) heat pumps ≥17,000 and <65,000 Btu/h		Water-source (water-to-air, water-loop) heat pumps ≥65,000 and <135,000 Btu/h	
	EER	MPC (2014$)	EER	MPC (2014$)	EER	MPC (2014$)
ASHRAE—Level 0	12.2	860	13.0	1,346	13.0	3,274
Efficiency Level 1	13.0	904	14.6	1,463	14.0	3,660
Efficiency Level 2	14.0	960	16.6	1,609	15.0	4,045
Efficiency Level 3	15.7	1,053	18.0	1,711	16.0	4,431
Efficiency Level 4	16.5	1,097	19.2	1,798	17.2	4,893
Efficiency Level 5	18.1	1,185	21.6	1,974	....	....

a. Manufacturer Markups

As discussed in detail in section V.B.4.a, DOE applies a non-production cost multiplier (the manufacturer markup) to the full MPC to account for corporate non-production costs and profit. The resulting manufacturer selling price (MSP) is the price at which the manufacturer can recover all production and nonproduction costs and earn a profit. Because water-source heat pumps and commercial air-cooled equipment are sold by similar heating and cooling product manufacturers, DOE used the same manufacturer markup of 1.3 that was developed for small commercial air-cooled air-conditioners and heat pumps, as described in chapter 3 of the final rule TSD.

b. Shipping Costs

Manufacturers of commercial HVAC equipment typically pay for freight (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 accounts for shipping costs separately from other non-production costs that comprise the manufacturer markup. DOE calculated the MSP for water-source heat pumps by multiplying the MPC at each efficiency level (determined from the cost model) by the manufacturer markup and adding shipping costs. Shipping costs for water-source heat pumps were calculated similarly to those for small commercial air-cooled air-conditioners and heat pumps described in section V.B.4.b. See chapter 3 of the final rule TSD for more details about DOE's shipping cost assumptions and the shipping costs per unit for each water-source heat pump product class.

C. Markups Analysis

The markups analysis develops appropriate markups in the distribution chain to convert the estimates of manufacturer selling price derived in the engineering analysis to commercial consumer prices.[28] 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 commercial consumer price.

For water-source heat pumps, DOE used the same markups that DOE developed for small commercial air-cooled air-conditioners and heat pumps, as discussed in section V.C. DOE understands that all the types of equipment move through the same distribution channels and that, therefore, using the same markups is reasonable. In addition, DOE's development of markups within those channels is at the broader equipment category level, in this case heating, ventilation, and air-conditioning equipment. As with small commercial air-cooled equipment, in the January 2015 NOPR, DOE did not use national accounts in its markups analysis for water-source heat pumps, because DOE does not believe that the commercial consumers of water-source heat pump

[28] ''Commercial consumer'' refers to purchasers of the equipment being regulated.

equipment less than 135,000 Btu/h would typically be national retail chains that negotiate directly with manufacturers. 80 FR 1171, 1202. DOE sought comment on whether the use of national accounts would be appropriate in this analysis. DOE did not receive any comments, and as such has retained its approach in this final rule.

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

D. Energy Use Analysis

The energy use analysis provides estimates of the annual energy consumption of water-source heat pumps at the considered efficiency levels. DOE uses these values in the LCC and PBP analyses and in the NIA.

The cooling unit energy consumption (UEC) by equipment type and efficiency level used in the January 2015 NOPR came from Appendix D of the 2000 Screening Analysis for EPACT-Covered Commercial HVAC and Water-Heating Equipment. (EERE–2006–STD–0098–0015). 80 FR 1171, 1202. Where identical efficiency levels were available, DOE used the UEC directly from the screening analysis. For additional efficiency levels, DOE scaled the UECs based on the ratio of EER, as was done in the original analysis. DOE also adjusted the cooling energy use from the 2000 Screening Analysis using factors from the NEMS commercial demand module that account for improvements in building shell characteristics and changes in internal load as a function of region and building activity.

In response to the January 2015 NOPR, NEEA commented that DOE should revise its energy analysis for water-source heat pumps by factoring in the oversizing of equipment, which leads to additional energy use. In addition, NEEA also noted that in the field, FLEOH does not scale proportionally with EER at higher EER levels, instead decreasing at a higher rate as a result of better part load performance. (NEEA, No. 41 at p. 2) DOE acknowledges that the original 2000 Screening Analysis sized equipment based on design-day peak load and did not explicitly account for oversizing, and as such may be a conservative estimate of energy usage. However, the uncertainty in the energy use analysis that was cited in the January 2015 NOPR extends well beyond the sizing factors. 80 FR 1171, 1225 – 1226 (Jan. 8, 2015). For example, DOE has no data on distribution by building type or field data to corroborate UEC estimates or simulations results. Furthermore, DOE has no data with which to modify the scaling of UEC with EER. While altering its assumptions on sizing and UEC scaling could impact the analytical results, it would not change DOE's fundamental determination that there is too much uncertainty in the energy use and other analyses to justify a standard level more stringent than those in ASHRAE 90.1–2013. Therefore, given the lack of available data and lack of potential impact on the policy decision, DOE has not modified the cooling side energy use for the final rule.

In the January 2015 NOPR, to characterize the heating-side performance, DOE analyzed CBECS 2003 data to develop a national-average annual energy use per square foot for buildings that use heat pumps. 80 FR 1171, 1202 (Jan. 8, 2015). DOE assumed that the average COP of the commercial unitary heat pump (CUHP) was 2.9.[29] DOE converted the energy use per square foot value to annual energy use per ton using a ton-per-square-foot relationship derived from the energy use analysis in the 2014 CUAC NOPR. (EERE–2013–BT–STD–0007–0027) Although this analysis in the NOPR related to equipment larger than some of the equipment that is the subject of this final rule and is directly applicable only to air-source heat pumps rather than water-source heat pumps, DOE assumed that this estimate was sufficiently representative of the heating energy use for all three classes of water-source heat pumps. DOE sought comment on this issue but did not receive any. As a result, DOE has retained this approach for the final rule.

Because equipment energy use is a function of efficiency, DOE assumed that the annual heating energy consumption of a unit scales proportionally with its heating COP efficiency level. Finally, to determine the COPs of units with given EERs, DOE correlated COP to EER based on the AHRI Certified Equipment Database.[30] Thus, for any given cooling efficiency of a water-source heat pump, DOE was able to use this method to establish the corresponding heating efficiency, and, in turn, the associated annual heating energy consumption.

In order to create variability in the cooling and heating UECs by region and building type, in the January 2015 NOPR, DOE used a Pacific Northwest National Laboratory report[31] that estimated the annual energy usage of space cooling and heating products using a Full Load Equivalent Operating Hour (FLEOH) approach. 80 FR 1171, 1202–1203 (Jan. 8, 2015). DOE normalized the provided FLEOHs to the UECs taken from the 2011 DFR for central air conditioners and heat pumps to vary the average UEC across region and building type. DOE used the following building types: office, education, lodging, multi-family apartments, and healthcare. 80 FR at 1203. DOE sought comment on whether these building types are appropriate or whether there are other building types that should be considered for the water-source heat pump analysis. DOE did not receive any comments on this issue and retained the same building types for this final rule analysis.

E. Life-Cycle Cost and Payback Period Analysis

The purpose of the LCC and PBP analysis is to analyze the effects of potential amended energy conservation standards on commercial consumers of water-source heat pumps by determining how a potential amended standard affects their operating expenses (usually decreased) and their total installed costs (usually increased).

The LCC is the total consumer expense over the life of the equipment, consisting of equipment and installation costs plus operating costs (*i.e.,* expenses for energy use, maintenance, and repair). DOE discounts future operating costs to the time of purchase using commercial consumer discount rates. The PBP is the estimated amount of time (in years) it takes commercial consumers to recover the increased total installed cost (including equipment and installation costs) of a more-efficient type of equipment through lower operating costs. DOE calculates the PBP by dividing the change in total installed cost (normally higher) due to a standard by the change in annual operating cost (normally lower) that results from the potential standard. However, unlike the LCC, DOE only considers the first year's operating expenses in the PBP calculation. Because the PBP does not account for changes in operating expense over time or the time value of money, it is also referred to as a simple PBP.

For any given efficiency level, DOE measures the PBP and the change in LCC relative to an estimate of the base-case efficiency level. For water-source

[29] A heating efficiency of 2.9 COP corresponds to the existing minimum heating efficiency standard for commercial unitary heat pumps, a value which DOE believes is representative of the heat pump stock characterized by CBECS.

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

[31] See Appendix D of the 2000 Screening Analysis for EPACT-Covered Commercial HVAC and Water-Heating Equipment. (EERE–2006–STD–0098–0015)

heat pumps, the base-case estimate reflects the market in the case where the ASHRAE level becomes the Federal minimum, and the LCC calculates the LCC savings likely to result from higher efficiency levels compared with the ASHRAE base case.

DOE conducted an LCC and PBP analysis for water-source heat pumps using a computer spreadsheet model. When combined with Crystal Ball (a commercially-available software program), the LCC and PBP model generates a Monte Carlo simulation to perform the analyses by incorporating uncertainty and variability considerations in certain of the key parameters as discussed below. Inputs to the LCC and PBP analysis are categorized as: (1) Inputs for establishing the total installed cost and (2) inputs for calculating the operating expense. The following sections contain brief discussions of comments on the inputs and key assumptions of DOE's LCC and PBP analysis and explain how DOE took these comments into consideration. They are also described in detail in chapter 6 of the final rule TSD.

1. Equipment Costs

In the LCC and PBP analysis, the equipment costs faced by purchasers of water-source heat pumps are derived from the MSPs estimated in the engineering analysis, the overall markups estimated in the markups analysis, and sales tax.

To develop an equipment price trend, DOE derived an inflation-adjusted index of the PPI for ''all other miscellaneous refrigeration and air-conditioning equipment'' from 1990–2013, which is the PPI series most relevant to water-source heat pumps. Although the inflation-adjusted index shows a declining trend from 1990 to 2004, data since 2008 have shown a flat-to-slightly rising trend. Given the uncertainty as to which of the trends will prevail in coming years, DOE chose to apply a constant price trend (at 2013 levels) for each efficiency level in each equipment class for the final rule. See chapter 6 of the final rule TSD for more information on the price trends.

2. Installation Costs

DOE derived installation costs for water-source heat pump equipment from current RS Means data (2013).[32] RS Means provides estimates for installation costs for the subject equipment by equipment capacity, as well as cost indices that reflect the variation in installation costs for 656 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.

Based on these data, DOE concluded that data for 1-ton, 3-ton, and 7.5-ton water-source heat pumps would be sufficiently representative of the installation costs for of water-source heat pumps with capacities of less than 17,000 btu/h, greater than or equal to 17,000 and less than 65,000 btu/h, and greater than or equal to 65,000 and less than 135,000 btu/h, respectively.

DOE also varied installation cost as a function of equipment weight. Because weight tends to increase with equipment efficiency, installation cost increased with equipment efficiency. The weight of the equipment in each class and efficiency level was determined through the engineering analysis.

3. Unit Energy Consumption

The calculation of annual per-unit energy consumption by each class of the subject water-source heat pumps at each considered efficiency level based on the energy use analysis is described above in section VI.D and in chapter 4 of the final rule TSD.

4. Electricity Prices and Electricity Price Trends

DOE used the same average and marginal electricity prices and electricity price trends as discussed in the methodology for small commercial air-cooled air conditioners and heat pumps (see section V.E.4). These data were developed for the broader commercial air-conditioning category and, thus, are also relevant to water-source heat pumps.

5. Maintenance Costs

Maintenance costs are costs to the commercial consumer of ensuring continued operation of the equipment (*e.g.,* checking and maintaining refrigerant charge levels and cleaning heat-exchanger coils). Because RS Means does not provide maintenance costs for water-source heat pumps, DOE used annualized maintenance costs for air-source heat pumps, the closest related equipment category, derived from RS Means data.[33] 80 FR 1171, 1203–1204 (Jan. 8, 2015). DOE does not expect the maintenance costs for water-source heat pumps to differ significantly from those for air-source heat pumps. These data provided estimates of person-hours, labor rates, and materials required to maintain commercial air-source heat pumps. The estimated annualized maintenance cost, in 2014 dollars, is $334 for a heat pump rated up to 60,000 btu/h and $404 for a heat pump rated greater than 60,000 btu/h. DOE applied the former cost to water-source heat pumps less than 17,000 Btu/h and heat pumps greater than or equal to 17,000 and less than 65,000 Btu/h. DOE applied the latter cost to water-source heat pumps greater than or equal to 65,000 Btu/h and less than 135,000 Btu/h. DOE requested comment on how maintenance costs for water-source heat pumps might be expected to differ from that for air-source heat pumps. DOE did not receive any comments, and as such has retained the same approach in the final rule.

6. Repair Costs

Repair costs are costs to the commercial consumer associated with repairing or replacing components that have failed. As with maintenance costs, RS Means does not provide repair costs for water-source heat pumps. Therefore, DOE assumed the repair costs for water-source heat pumps would be similar to air-source units and utilized RS Means[34] to find the repair costs for air-source heat pumps. 80 FR 1171, 1204 (Jan. 8, 2015). DOE does not expect the repair costs for water-source heat pumps to differ significantly from those for air-source heat pumps. DOE took the repair costs for 1.5-ton, 5-ton, and 10-ton air to air heat pumps and linearly scaled the repair costs to derive repair costs for 1-ton, 3-ton, and 7.5-ton equipment. DOE assumed that the repair would be a one-time event in year 10 of the equipment life. DOE then annualized the present value of the cost over the average equipment life (see next section) to obtain an annualized equivalent repair cost. This value, in 2014 dollars, ranged from $93 to $240 for the ASHRAE baseline, depending on equipment class. The materials portion of the repair cost was scaled with the percentage increase in manufacturers' production cost by efficiency level. The labor cost was held constant across efficiency levels. This annualized repair cost was then added to the maintenance cost to create an annual ''maintenance and repair cost'' for the lifetime of the equipment. In the January 2015 NOPR, DOE requested comment on how repair costs for water-source heat pumps might be expected to differ from that for air-source heat

[32] RS Means Mechanical Cost Data 2013. *Reed Construction Data, LLC. (2012).*

[33] RS Means Facilities Maintenance & Repair Cost Data 2013. *Reed Construction Data, LLC. (2012).*

[34] *Id.*

pumps. 80 FR 1171, 1204 (Jan. 8, 2015). DOE did not receive comment and as such, retained the same approach for the final rule. For further discussion of how DOE derived and implemented repair costs, see chapter 8 of the final rule TSD.

7. Equipment Lifetime

Equipment lifetime is the age at which the subject water-source heat pumps are retired from service. In the January 2015 NOPR, DOE based equipment lifetime on a retirement function in the form of a Weibull probability distribution, with a mean of 19 years. 80 FR 1171, 1204 (Jan. 8, 2015). Because a function specific to water-source heat pumps was not available, DOE used the function for air-cooled air conditioners presented in the 2011 DFR (EERE–2011–BT–STD–0011–0012), as it is for similar equipment and represented the desired mean lifetime of 19 years. In the NOPR, DOE requested data and information that would help it develop a retirement function specific to water-source heat pumps. DOE did not receive any comments, and as such retained the same Weibull distribution in the final rule.

8. Discount Rate

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

DOE derived the discount rates by estimating the cost of capital of companies that purchase water-source heat pump equipment. More details regarding DOE's estimates of commercial consumer discount rates are provided in chapter 6 of the final rule TSD.

9. Base-Case Market Efficiency Distribution

For the LCC analysis, DOE analyzes the considered efficiency levels relative to a base case (*i.e.,* the case without amended energy efficiency standards, in this case the default scenario in which DOE is statutorily required to adopt the efficiency levels in ASHRAE 90.1–2013). This analysis requires an estimate of the distribution of equipment efficiencies in the base case (*i.e.,* what consumers would have purchased in the compliance year in the absence of amended standards more stringent than those in ASHRAE 90.1–2013). DOE refers to this distribution of equipment energy efficiencies as the base-case efficiency distribution. For more information on the development of the base-case distribution, see section VI.F.3 and chapter 6 of the final rule TSD.

10. Compliance Date

DOE calculated the LCC and PBP for all commercial consumers as if each were to purchase new equipment in the year that compliance with amended standards is required. Generally, covered equipment to which a new or amended energy conservation standard applies must comply with the standard if such equipment is manufactured or imported on or after a specified date. In this final rule, DOE has evaluated whether more-stringent efficiency levels than those in ASHRAE Standard 90.1–2013 would be technologically feasible, economically justified, and result in a significant additional amount of energy savings and has declined to implement more stringent efficiency levels. EPCA states that compliance with any such standards shall be required on or after a date which is two or three years (depending on equipment size) after the compliance date of the applicable minimum energy efficiency requirement in the amended ASHRAE/IES standard. (42 U.S.C. 6313(a)(6)(D)) Given the equipment size at issue here, DOE has applied the two-year implementation period to water-source heat pumps manufactured on or after October 9, 2015, which is two years after the publication date of ASHRAE Standard 90.1–2013.

Economic justification is not required for DOE to adopt the efficiency levels in ASHRAE 90.1–2013, as DOE is statutorily required to, at a minimum, adopt those levels. Therefore, DOE did not perform an LCC analysis on the ASHRAE Standard 90.1–2013 levels, and, for purposes of the LCC analysis, DOE used 2020 as the first year of compliance with amended standards.

11. Payback Period Inputs

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

Similar to the LCC, the inputs to the PBP calculation are the total installed cost of the equipment to the commercial consumer for each efficiency level and the average annual operating expenditures for each efficiency level for each building type and Census Division, weighted by the probability of shipment to each market. The PBP calculation uses the same inputs as the LCC analysis, except that discount rates are not needed. Because the simple PBP does not take into account changes in operating expenses 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 6 of the final rule TSD provides additional detail about the PBP.

F. National Impact Analysis—National Energy Savings and Net Present Value Analysis

The NIA evaluates the effects of a considered energy conservation standard from a national perspective rather than from the consumer 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, which are expected to result from amended standards at specific efficiency levels. For each efficiency level analyzed, DOE calculated the NPV and NES for adopting more-stringent standards than the efficiency levels specified in ASHRAE Standard 90.1–2013.

The NES refers to cumulative energy savings from 2016 through 2045;[35] however, when evaluating more-stringent standards, energy savings do not begin accruing until the later compliance date of 2020. DOE calculated new 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).

The NPV refers to cumulative monetary savings. DOE calculated net monetary savings in each year relative to the base case (ASHRAE Standard 90.1–2013) as the difference between total operating cost savings and increases in total installed cost.

[35] Although the expected compliance date for adoption of the efficiency levels in ASHRAE Standard 90.1–2013 is October 9, 2015, DOE began its analysis period in 2016 to avoid ascribing savings to the three-quarters of 2015 prior to the compliance date.

Cumulative savings are the sum of the annual NPV over the specified period. DOE accounted for operating cost savings until past 2100, when the equipment installed in the thirtieth year after the compliance date of the amended standards should be retired.

1. Approach

The NES and NPV are a function of the total number of units and their efficiencies. Both the NES and NPV depend on annual shipments and equipment lifetime. Both calculations start by using the shipments estimate and the quantity of units in service derived from the shipments model. DOE used the same approach to determine NES and NPV for water-source heat pumps which was used for small commercial air-cooled air-conditioning and heating equipment, as described in section V.F.1. In this case, the analysis period runs from 2016 through 2045.

In the January 2015 NOPR, DOE considered whether a rebound effect is applicable in its NES analysis, a concept explained in detail in section V.F. 1. 80 FR 1171, 1205 (Jan. 8, 2015). DOE did not expect commercial consumers with water-source heat pump equipment to increase their use of the equipment, either in a previously cooled space or another previously uncooled space. Water-source heat pumps are part of engineered water-loop systems designed for specific applications. It is highly unlikely that the operation or installation of these systems would be changed simply as a result of energy cost savings. Therefore, DOE did not assume a rebound effect in the NOPR analysis. DOE sought input from interested parties on whether there will be a rebound effect for improvements in the efficiency of water-source heat pumps, but did not receive any comment. As a result, DOE retained its assumptions in this final rule.

2. Shipments Analysis

Equipment shipments are an important element in the estimate of the future impact of a potential energy conservation standard. DOE developed shipment projections for water-source heat pumps and, in turn, calculated equipment stock over the course of the analysis period by assuming a Weibull distribution with an average 19-year equipment life. (See section V.E.7 for more information on equipment lifetime.) DOE used the shipments projection and the equipment stock to determine the NES. The shipments portion of the spreadsheet model projects water-source heat pump shipments through 2045.

DOE based its shipments analysis for water-source heat pumps on data from the U.S. Census. The U.S. Census published historical (1980, 1983–1994, 1997–2006, and 2008–2010) water-source heat pump shipment data.[36] Table VI.4 exhibits the shipment data provided for a selection of years. DOE analyzed data from the years 1990–2010 to establish a trend from which to project shipments beyond 2010. DOE used a linear trend. Because the Census data do not distinguish between equipment capacities, DOE used the shipments data by equipment class provided by AHRI in 1999, and published in the 2000 Screening Analysis for EPACT-Covered Commercial HVAC and Water-Heating Equipment (EERE–2006–STD–0098–0015), to distribute the total water-source heat pump shipments to individual equipment classes. Table VI.5 exhibits the shipment data provided for 1999. DOE assumed that this distribution of shipments across the various equipment classes remained constant and has used this same distribution in its projection of future shipments of water-source heat pumps. The complete historical data set and the projected shipments for each equipment class can be found in the chapter 7 of the final rule TSD.

TABLE VI.4—TOTAL SHIPMENTS OF WATER-SOURCE HEAT PUMPS

[Census product code: 333415E181]

	1989	1999	2009
Total	157,080	120,545	180,101

TABLE VI.5—TOTAL SHIPMENTS OF WATER-SOURCE HEAT PUMPS (AHRI)

Equipment class	1999	Percent
WSHP <17000 Btu/h	41,000	31
WSHP 17000–65000 Btu/h	86,000	65
WSHP 65000–135000 Btu/h	5,000	4

Table VI.6 shows the projected shipments for the different equipment classes of water-source heat pumps for selected years from 2016 to 2045, as well as the cumulative shipments.

TABLE VI.6—SHIPMENTS PROJECTION FOR WATER-SOURCE HEAT PUMPS

Equipment	Units shipped by year and equipment class							
	2016	2020	2025	2030	2035	2040	2045	Cumulative shipments (2016–2045)
WSHP <17000 Btu/h	62,934	68,072	74,495	80,918	87,341	93,764	100,187	2,446,810
WSHP 17000–65000 Btu/h	132,007	142,785	156,258	169,731	183,203	196,676	210,148	5,132,334
WSHP 65000–135000 Btu/h	7,675	8,301	9,085	9,868	10,651	11,435	12,218	7,579,144
Total	202,616	219,159	239,838	260,517	281,195	301,874	322,553	7,877,536

As equipment purchase price and repair costs increase with efficiency, DOE recognizes that higher first costs and repair costs can result in a drop in shipments. However, in the January 2015 NOPR, DOE had no basis for estimating the elasticity of shipments for water-source heat pumps as a function of first costs, repair costs, or operating costs. 80 FR 1171, 1206 (Jan. 8, 2015). In addition, because water-source heat pumps are often installed for their higher efficiency as compared to air-cooled equipment, DOE had tentatively concluded in the January 2015 NOPR that it was unlikely that shipments would change as a result of higher first costs and repair costs. Therefore, DOE presumed that the shipments projection would not change with higher standard levels. DOE sought input on this assumption in the January 2015 NOPR. *Id.* As noted in section V.F.2, in response, Lennox International commented that they with increased costs they expected a drop in shipments

[36] U.S. Census Bureau, Current Industrial Reports for Refrigeration, Air Conditioning, and Warm Air Heating Equipment, MA333M. Note that the current industrial reports were discontinued in 2010, so more recent data are not available (Available at: *http://www.census.gov/manufacturing/cir/historical_data/ma333m/index.html*).

and an increase in repairs. (Lennox International, No. 36 at p. 2–3)

DOE acknowledges Lennox's concerns. However, DOE does not have data available to estimate the price elasticity for this equipment. Given that even without a drop in shipments, none of the efficiency levels in the January 2015 NOPR were determined to be economically justified, DOE has not revised its shipments estimates for this final rule. Chapter 7 of the final rule TSD provides additional details on the shipments forecasts.

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

DOE estimated base-case efficiency distributions based on model availability in the AHRI certified directory. In the January 2015 NOPR, DOE also estimated a base-case efficiency trend of an increase of approximately 1 EER every 35 years, based on the trend from 2012 to 2035 found in the Commercial Unitary Air Conditioner Advance Notice of Proposed Rulemaking (ANOPR).[37] 80 FR 1171, 1207 (Jan. 8, 2015). DOE used this same trend in the standards-case scenarios. DOE requested comment on its estimated efficiency trends, but did not receive any. As a result, DOE used the same trend for this final rule.

For each efficiency level analyzed, DOE used a ''roll-up'' scenario to establish the market shares by efficiency level for the first full year that compliance would be required with amended standards (*i.e.*, 2016 for adoption of efficiency levels in ASHRAE Standard 90.1–2013 or 2020 if DOE adopts more-stringent efficiency levels than those in ASHRAE Standard 90.1–2013). Table VI.7 presents the estimated base-case efficiency market shares for each water-source heat pump equipment class.

TABLE VI.7—BASE-CASE EFFICIENCY MARKET SHARES IN 2020 FOR WATER-SOURCE HEAT PUMPS

Water-source (water-to-air, water-loop) heat pumps <17,000 Btu/h		Water-source (water-to-air, water-loop) heat pumps ≥17,000 and <65,000 Btu/h		Water-source (water-to-air, water-loop) heat pumps ≥65,000 and <135,000 Btu/h	
EER	Market share (percent)	EER	Market share (percent)	EER	Market share (percent)
11.2	0.0	12.0	0.0	12.0	0.0
12.2	0.7	13.0	7.6	13.0	0.0
13.0	49.7	14.6	55.1	14.0	29.8
14.0	22.0	16.6	25.0	15.0	48.5
15.7	20.5	18.0	8.9	16.0	20.1
16.5	4.9	19.2	2.5	17.0	1.7
18.1	2.3	21.6	1.0		

Note: The 0% market share at the first listed EER level is accounting for the default adoption of ASHRAE Standard 90.1–2013 levels in 2016.

4. National Energy Savings and Net Present Value

The stock of water-source heat pump equipment is the total number of units in each equipment class purchased or shipped from previous years that have survived until a given point in time. The NES spreadsheet,[38] through use of the shipments model, keeps track of the total number of units shipped each year. For purposes of the NES and NPV analyses, DOE assumes that shipments of water-source heat pump units survive for an average of 19 years, following a Weibull distribution, at the end of which time they are removed from service.

The national annual energy consumption is the product of the annual unit energy consumption and the number of units of each vintage in the stock, summed over all vintages. This approach accounts for differences in unit energy consumption from year to year. In determining national annual energy consumption, DOE estimated energy consumption and savings based on site energy and converted the electricity consumption and savings to primary energy using annual conversion factors derived from the *AEO 2014* version of NEMS. Cumulative energy savings are the sum of the NES for each year over the timeframe of the analysis.

In response to the recommendations of a committee on ''Point-of-Use and Full-Fuel-Cycle Measurement Approaches to Energy Efficiency Standards'' appointed by the National Academy of Sciences, DOE announced its intention to use FFC measures of energy use and greenhouse gas and other emissions in the national impact analyses and emissions analyses included in future energy conservation standards rulemakings. 76 FR 51281 (Aug. 18, 2011). After evaluating the approaches discussed in the August 18, 2011 notice, DOE published a statement of amended policy in the **Federal Register** in which DOE explained its determination that NEMS is the most appropriate tool for its FFC analysis and its intention to use NEMS for that purpose. 77 FR 49701 (Aug. 17, 2012). The approach used for this final rule is described in Appendix 8A of the final rule TSD.

Table VI.8 summarizes the inputs to the NES spreadsheet model along with a brief description of the data sources. The results of DOE's NES and NPV analysis are summarized in section VIII.B.2.b and described in detail in chapter 7 of the final rule TSD.

TABLE VI.8—SUMMARY OF WATER-SOURCE HEAT PUMP NES AND NPV MODEL INPUTS

Inputs	Description
Shipments	Annual shipments based on U.S. Census data. (See chapter 7 of the final rule TSD.)

[37] *See* DOE's technical support document underlying DOE's July 29, 2004 ANOPR. 69 FR 45460 (Available at: *www.regulations.gov/#!documentDetail;D=EERE-2006-STD-0103-0078*).

[38] The NES spreadsheet can be found in the docket for the ASHRAE rulemaking at: *www.regulations.gov/#!docketDetail;D=EERE-2014-BT-STD-0015*.

TABLE VI.8—SUMMARY OF WATER-SOURCE HEAT PUMP NES AND NPV MODEL INPUTS—Continued

Inputs	Description
Compliance Date of Standard	2020 for adoption of a more-stringent efficiency level than those specified by ASHRAE Standard 90.1–2013. 2016 for adoption of the efficiency levels specified by ASHRAE Standard 90.1–2013.
Base-Case Efficiencies	Distribution of base-case shipments by efficiency level, with efficiency trend of an increase of 1 EER every 35 years.
Standards-Case Efficiencies	Distribution of shipments by efficiency level for each standards case. In compliance year, units below the standard level "roll-up" to meet the standard. Efficiency trend of an increase of 1 EER every 35 years.
Annual Energy Use per Unit	Annual national weighted-average values are a function of efficiency level. (See chapter 4 of the final rule TSD.)
Total Installed Cost per Unit	Annual weighted-average values are a function of efficiency level. (See chapter 5 of the final rule TSD.)
Annualized Maintenance and Repair Costs per Unit.	Annual weighted-average values are a function of efficiency level. (See chapter 5 of the final rule TSD.)
Escalation of Fuel Prices	*AEO2014* forecasts (to 2040) and extrapolation for beyond 2040. (See chapter 8 of the final rule TSD.)
Site to Primary and FFC Conversion.	Based on *AEO2014* forecasts (to 2040) and extrapolation for beyond 2040. (See chapter 8 of the final rule TSD.)
Discount Rate	3 percent and 7 percent real.
Present Year	Future costs are discounted to 2015.

VII. Methodology for Emissions Analysis and Monetizing Carbon Dioxide and Other Emissions Impacts

A. Emissions Analysis

In the emissions analysis, DOE estimates the reduction in power sector emissions of carbon dioxide (CO_2), nitrogen oxides (NO_X), sulfur dioxide (SO_2), and mercury (Hg) from potential amended energy conservation standards for the ASHRAE equipment that is the subject of this document. In addition, DOE estimates emissions impacts in production activities (extracting, processing, and transporting fuels) that provide the energy inputs to power plants. These are referred to as "upstream" emissions. Together, these emissions account for the full-fuel cycle (FFC). In accordance with DOE's FFC Statement of Policy (76 FR 51281 (Aug. 18, 2011) as amended at 77 FR 49701 (August 17, 2012)), the FFC analysis also includes impacts on emissions of methane (CH_4) and nitrous oxide (N_2O), both of which are recognized as greenhouse gases. The combustion emissions factors and the method DOE used to derive upstream emissions factors are described in chapter 9 of the final rule TSD. The cumulative emissions reduction estimated for the subject ASHRAE equipment is presented in section VIII.C.

DOE primarily conducted the emissions analysis using emissions factors for CO_2 and most of the other gases derived from data in *AEO 2014.* Combustion emissions of CH_4 and N_2O were estimated using emissions intensity factors published by the U.S. Environmental Protection Agency (EPA) in its Greenhouse Gas (GHG) Emissions Factors Hub.[39] DOE developed separate emissions factors for power sector emissions and upstream emissions. The method that DOE used to derive emissions factors is described in chapter 9 of the final rule TSD.

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

SO_2 emissions from affected electric generating units (EGUs) are subject to nationwide and regional emissions cap-and-trade programs. Title IV of the Clean Air Act sets an annual emissions cap on SO_2 for affected EGUs in the 48 contiguous States and the District of Columbia (DC). (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, which created an allowance-based trading program that operates along with the Title IV program, was remanded to the EPA by the U.S. Court of Appeals for the District of Columbia Circuit, but it remained in effect.[40] 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 D.C. Circuit issued a decision to vacate CSAPR.[41] The court ordered EPA to continue administering CAIR. The emissions factors used for this final rule, which are based on *AEO 2014,* assume that CAIR remains a binding regulation through 2040.[42]

The attainment of emissions caps is typically flexible among EGUs and is enforced through the use of emissions allowances and tradable permits. Beginning in 2016, however, SO_2 emissions will decline significantly as a result of the Mercury and Air Toxics Standards (MATS) for power plants. 77 FR 9304 (Feb. 16, 2012). In the final MATS rule, EPA established a standard for hydrogen chloride as a surrogate for acid gas hazardous air pollutants (HAP), and also established a standard for SO_2 (a non-HAP acid gas) as an alternative equivalent surrogate standard for acid gas HAP. The same controls are used to reduce HAP and non-HAP acid gas; thus, SO_2 emissions will be reduced as a result of the control technologies installed on coal-fired power plants to comply with the MATS requirements for acid gas. *AEO 2014* assumes that, in order to continue operating, coal plants must have either flue gas

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

[40] 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).

[41] 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).

[42] On April 29, 2014, the U.S. Supreme Court reversed the judgment of the D.C. Circuit and remanded the case for further proceedings consistent with the Supreme Court's opinion. The Supreme Court held in part that EPA's methodology for quantifying emissions that must be eliminated in certain states due to their impacts in other downwind states was based on a permissible, workable, and equitable interpretation of the Clean Air Act provision that provides statutory authority for CSAPR. See *EPA* v. *EME Homer City Generation*, No 12–1182, slip op. at 32 (U.S. April 29, 2014). On October 23, 2014, the D.C. Circuit lifted the stay of CSAPR. Pursuant to this action, CSAPR will go into effect (and the Clean Air Interstate Rule will sunset) as of January 1, 2015. However, because DOE used emissions factors based on *AEO 2014* for this final rule, the analysis assumes that CAIR, not CSAPR, is the regulation in force. The difference between CAIR and CSAPR is not relevant for the purpose of DOE's analysis of SO_2 emissions.

desulfurization or dry sorbent injection systems installed by 2016. Both technologies are used to reduce acid gas emissions, and 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. Therefore, DOE believes that energy efficiency standards will reduce SO_2 emissions in 2016 and beyond.

CAIR established a cap on NO_X emissions in 28 eastern States and the District of Columbia.[43] Energy conservation standards are expected to have little effect on NO_X emissions in those States covered by CAIR, because excess NO_X emissions allowances resulting from the lower electricity demand could be used to permit offsetting increases in NO_X emissions. However, standards would be expected to reduce NO_X emissions in the States not affected by the caps, so DOE estimated NO_X emissions reductions from the standards considered in this final rule for these States.

The MATS limit mercury emissions from power plants, but they do not include emissions caps. DOE estimated mercury emissions using emissions factors based on *AEO 2014*, which incorporates the MATS.

B. Monetizing Carbon Dioxide and Other Emissions Impacts

As part of the development of this final 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 efficiency levels considered. In order to make this calculation analogous to the calculation of the NPV of consumer benefit, DOE considered the reduced emissions expected to result over the lifetime of equipment shipped in the forecast period for each efficiency level. 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 social cost of carbon (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 10 of the final rule TSD.

1. Social Cost of Carbon

The SCC is an estimate of the monetized damages associated with an incremental increase in carbon emissions in a given year. It is intended to include (but is not limited to) changes in net agricultural productivity, human health, property damages from increased flood risk, and the value of ecosystem services. Estimates of the SCC are provided in dollars per metric ton of 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[44] 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,

[43] 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 is slight.

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

$33, $19, $10, and $5 per metric ton of CO_2. These interim values represented the first sustained interagency effort within the U.S. government to develop an SCC for use in regulatory analysis. The results of this preliminary effort were presented in several proposed and final rules.

c. Current Approach and Key Assumptions

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

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

In 2010, the interagency group selected four sets of SCC values for use in regulatory analyses. Three sets of values are based on the average SCC 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,[45] although preference is given to consideration of the global benefits of reducing CO_2 emissions. Table VII.1 presents the values in the 2010 interagency group report,[46] which is reproduced in appendix 10A of the final rule TSD.

TABLE VII.1—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 document were generated using the most recent versions of the three integrated assessment models that have been published in the peer-reviewed literature.[47]

Table VII.2 shows the updated sets of SCC estimates from the 2013 interagency update in 5-year increments from 2010 to 2050. The full set of annual SCC estimates between 2010 and 2050 is reported in appendix 10B 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.

[45] 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.

[46] *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*).

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

TABLE VII.2—ANNUAL SCC VALUES FROM 2013 INTERAGENCY REPORT, 2010–2050

[2007$ per metric ton CO_2]

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

It is important to recognize that a number of key uncertainties remain, and that current SCC estimates should be treated as provisional and revisable because they will evolve with improved scientific and economic understanding. The interagency group also recognizes that the existing models are imperfect and incomplete. The 2009 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 knowledge of the science and economics of climate impacts, as well as improvements in modeling.

In summary, in considering the potential global benefits resulting from reduced CO_2 emissions, DOE used the values from the 2013 interagency report adjusted to 2014$ using the implicit price deflator for gross domestic product (GDP) 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, $41.2, $63.4, and $121 per metric ton avoided (values expressed in 2014$). 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 was used to obtain the SCC values in each case.

In response to the NOPR, the Associations stated that DOE should not use SCC values to establish monetary figures for emissions reductions until the SCC undergoes a more rigorous notice, review, and comment process. (The Associations, No. 37 at p. 4) In conducting the interagency process that developed the SCC values, technical experts from numerous agencies met on a regular basis to consider public comments, explore the technical literature in relevant fields, and discuss key model inputs and assumptions. Key uncertainties and model differences transparently and consistently inform the range of SCC estimates. These uncertainties and model differences are discussed in the interagency working group's reports, which are reproduced in appendix 10A and 10B of the final rule TSD, as are the major assumptions. The 2010 SCC values have been used in a number of Federal rulemakings in which the public had opportunity to comment. In November 2013, the OMB announced a new opportunity for public comment on the TSD underlying the revised SCC estimates. See 78 FR 70586 (Nov. 26, 2013). OMB is currently reviewing comments and considering whether further revisions to the 2013 SCC estimates are warranted. DOE stands ready to work with OMB and the other members of the interagency working group on further review and revision of the SCC estimates as appropriate.

2. Valuation of Other Emissions Reductions

As noted previously, DOE has taken into account how considered energy conservation standards would reduce site NO_X emissions nationwide and increase 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 efficiency levels considered for this final rule based on estimates found in the relevant scientific literature. Estimates of monetary value for reducing NO_X from stationary sources range from $484 to $4,971 per ton in 2014$.[48] DOE calculated monetary benefits using a medium value for NO_X emissions of $2,727 per short ton (in 2014$) and real discount rates of 3 percent and 7 percent.

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

VIII. Analytical Results and Conclusions

A. Efficiency Levels Analyzed

1. Small Commercial Air-Cooled Air Conditioners and Heat Pumps Less Than 65,000 Btu/h

The methodology for small commercial air-cooled air conditioners and heat pumps less than 65,000 Btu/h was presented in section V of this this final rule. Table VIII.1 presents the market baseline efficiency level and the higher efficiency levels analyzed for each equipment class of small commercial air-cooled air conditioners and heat pumps less than 65,000 Btu/h subject to this rule. The EPCA baseline efficiency levels correspond to the lowest efficiency levels currently available on the market. The efficiency levels above the baseline represent efficiency levels specified by ASHRAE

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

Standard 90.1–2013 and efficiency levels more stringent than those specified in ASHRAE Standard 90.1–2013 where equipment is currently available on the market. Note that for the energy savings and economic analysis, efficiency levels above those specified in ASHRAE Standard 90.1–2013 are compared to ASHRAE Standard 90.1–2013 as the baseline rather than the EPCA baseline (*i.e.,* the current Federal standards). For split-system air conditioners, for which ASHRAE 90.1–2013 did not change the efficiency level, all efficiency levels are compared to the Federal or EPCA baseline.

TABLE VIII.1—EFFICIENCY LEVELS ANALYZED FOR SMALL COMMERCIAL AIR-COOLED AIR CONDITIONERS AND HEAT PUMPS <65,000 BTU/H

	Small three-phase air-cooled split-system air conditioners <65,000 Btu/h	Small three-phase air-cooled single-package air conditioners <65,000 Btu/h	Small three-phase air-cooled split-system heat pumps <65,000 Btu/h	Small three-phase air-cooled single-package heat pumps <65,000 Btu/h
Efficiency Level (SEER/HSPF)				
Baseline—Federal Standard	13	13	13/7.7	13/7.7
ASHRAE Level (0)	* 14	14	14/8.2	14/8.0
Efficiency Level 1	15	15	15/8.5	15/8.4
Efficiency Level 2	16	16	16/8.7	16/8.8
Efficiency Level 3	17	17	17/9.0	17/8.9
Efficiency Level 4 **	18	18	18.0/9.2	18.0/9.1
Efficiency Level 5 ***	19	19		

* For split system air conditioners, the ASHRAE level is 13.0 SEER. DOE analyzed the 14.0 SEER level as a level more stringent than ASHRAE, but designated it as efficiency level 0 for consistency in SEER level across equipment classes.
** Efficiency Level 4 is "Max-Tech" for HP equipment classes.
*** Efficiency Level 5 is "Max-Tech" for AC equipment classes.

2. Water-Source Heat Pumps

The methodology for water-source heat pumps was presented in section VI of this final rule. Table VIII.2 presents the baseline efficiency level and the more-stringent efficiency levels analyzed for each equipment class of water-source heat pumps subject to this rule. The baseline efficiency levels correspond to the lowest efficiency levels currently available on the market. The efficiency levels above the baseline represent efficiency levels specified in ASHRAE Standard 90.1–2013 and more-stringent efficiency levels where equipment is currently available on the market.

TABLE VIII.2—EFFICIENCY LEVELS ANALYZED FOR WATER-SOURCE HEAT PUMPS

	Water-source (water-to-air, water-loop) heat pumps <17,000 Btu/h	Water-source (water-to-air, water-loop) heat pumps ≥17,000 and <65,000 Btu/h	Water-source (water-to-air, water-loop) heat pumps ≥65,000 and <135,000 Btu/h
Efficiency Level (EER/COP)			
Baseline—Federal Standard	11.2/4.2	12.0/4.2	12.0/4.2
ASHRAE Level (0)	12.2/4.3	13.0/4.3	13.0/4.3
Efficiency Level 1	13.0/4.6	14.6/4.8	14.0/4.7
Efficiency Level 2	14.0/4.8	16.6/5.3	15.0/4.8
Efficiency Level 3	15.7/5.1	18.0/5.6	16.0/5.0
Efficiency Level 4 *	16.5/5.3	19.2/5.9	17.2/5.1
Efficiency Level 5 **	18.1/5.6	21.6/6.5	

* Efficiency Level 4 is "Max-Tech" for the largest equipment class.
** Efficiency Level 5 is "Max-Tech" for the two smaller equipment classes.

3. Commercial Oil-Fired Storage Water Heaters

Table VIII.3 presents the baseline efficiency level and the more-stringent efficiency levels analyzed for the class of oil-fired storage water heaters subject to this rule. The baseline efficiency levels correspond to the lowest efficiency levels currently available on the market. The efficiency levels above the baseline represent efficiency levels specified in ASHRAE Standard 90.1–2013 and more-stringent efficiency levels where equipment is currently available on the market.

TABLE VIII.3—EFFICIENCY LEVELS ANALYZED FOR COMMERCIAL OIL-FIRED STORAGE WATER-HEATING EQUIPMENT

	Oil-fired storage water-heating equipment (>105,000 Btu/h and <4,000 Btu/h/gal) (%)
Efficiency Level (E_t)	
Baseline—Federal Standard	78

TABLE VIII.3—EFFICIENCY LEVELS ANALYZED FOR COMMERCIAL OIL-FIRED STORAGE WATER-HEATING EQUIPMENT—Continued

	Oil-fired storage water-heating equipment (>105,000 Btu/h and <4,000 Btu/h/gal) (%)
ASHRAE Level (0)	80
Efficiency Level 1	81
Efficiency Level 2—"Max-Tech" –	82

B. Energy Savings and Economic Justification

1. Small Commercial Air-Cooled Air Conditioners and Heat Pumps Less Than 65,000 Btu/h

a. Economic Impacts on Commercial Customers

1. Life-Cycle Cost and Payback Period

To evaluate the net economic impact of potential amended energy conservation standards on commercial consumers of small commercial air-cooled air conditioners and heat pumps, DOE conducted LCC and PBP analyses for each efficiency level. In general, higher-efficiency equipment would affect commercial consumers in two ways: (1) Purchase price would increase, and (2) annual operating costs would decrease. Inputs used for calculating the LCC and PBP include total installed costs (*i.e.,* equipment price plus installation costs), and operating costs (*i.e.,* annual energy usage, energy prices, energy price trends, repair costs, and maintenance costs). The LCC calculation also uses equipment lifetime and a discount rate.

The output of the LCC model is a mean LCC savings (or cost [49]) for each equipment class, relative to the baseline small commercial air-cooled air conditioner and heat pump efficiency level. The LCC analysis also provides information on the percentage of commercial consumers that are negatively affected by an increase in the minimum efficiency standard.

DOE also performed a PBP analysis as part of the LCC analysis. The PBP is the number of years it would take for the commercial 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 6 of the final rule TSD provides detailed information on the LCC and PBP analyses.

DOE's LCC and PBP analyses provided five key outputs for each efficiency level above the baseline (*i.e.,* efficiency levels above the current Federal standard for split-system air conditioners or efficiency levels more stringent than those in ASHRAE Standard 90.1–2013 for the three triggered equipment classes), as reported in Table VIII.4 through Table VIII.11 below. These outputs include the proportion of small commercial air-cooled air conditioner and heat pump purchases in which the purchase of such a unit that is compliant with the amended energy conservation standard creates a net LCC increase, no impact, or a net LCC savings for the commercial consumer. Another output is the average net LCC savings from standard-compliant equipment, as well as the average PBP for the consumer investment in standard-compliant equipment.

Chapter 6 of the final rule TSD provides detailed information on the LCC and PBP analyses.

Table VIII.4 through Table VIII.11 show the LCC and PBP results for all efficiency levels considered for each class of small commercial air-cooled air conditioner and heat pump in this final rule. In the first of each pair of tables, the simple payback is measured relative to the baseline equipment (*i.e.,* equipment at the current Federal standards for split-system air conditioners or equipment with the efficiency levels required in ASHRAE Standard 90.1–2013 for the three triggered equipment classes). In the second tables, the LCC savings are measured relative to the base-case efficiency distribution in the compliance year (*i.e.,* the range of equipment expected to be on the market in the absence of amended standards for split-system air conditioners or the default case where DOE adopts the efficiency levels in ASHRAE Standard 90.1–2013 for the three triggered equipment classes).

TABLE VIII.4—AVERAGE LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR SMALL THREE-PHASE AIR-COOLED SPLIT-SYSTEM AIR CONDITIONERS <65,000 Btu/h

Efficiency level	Average costs *2014$*				Simple payback *years*	Average lifetime *years*
	Installed cost	First year's operating cost	Lifetime operating cost	LCC		
Baseline	$3,901	$776	$7,532	$11,433	N/A	19
0	4,150	773	7,497	11,647	68	19
1	4,401	766	7,433	11,834	49	19
2	4,670	760	7,373	12,043	47	19
3	4,927	763	7,409	12,335	80	19
4	5,194	768	7,449	12,643	148	19
5	5,474	774	7,507	12,981	560	19

Note: The results for each efficiency level are calculated assuming that all commercial consumers use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

[49] An LCC cost is shown as a negative savings in the results presented.

TABLE VIII.5—LCC SAVINGS RELATIVE TO THE BASE-CASE EFFICIENCY DISTRIBUTION FOR SMALL THREE-PHASE AIR-COOLED SPLIT-SYSTEM AIR CONDITIONERS <65,000 BTU/H

Efficiency level	Life-cycle cost savings	
	% of customers that experience	Average savings*
	Net cost	*2014$*
0	26	($56)
1	75	(198)
2	97	(402)
3	100	(695)
4	100	(1,002)
5	100	(1,341)

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

TABLE VIII.6—AVERAGE LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR SMALL THREE-PHASE AIR-COOLED SINGLE-PACKAGE AIR CONDITIONERS <65,000 BTU/H

Efficiency level	Average costs *2014$*				Simple payback *years*	Average lifetime *years*
	Installed cost	First year's operating cost	Lifetime operating cost	LCC		
ASHRAE Baseline	$4,781	$772	$7,516	$12,297	N/A	19
1	5,090	758	7,381	12,471	22	19
2	5,400	753	7,329	12,729	32	19
3	5,702	757	7,368	13,070	61	19
4	6,007	761	7,407	13,414	110	19
5	6,375	766	7,457	13,833	270	19

Note: The results for each efficiency level are calculated assuming that all commercial consumers use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE VIII.7—LCC SAVINGS RELATIVE TO THE BASE-CASE EFFICIENCY DISTRIBUTION FOR SMALL THREE-PHASE AIR-COOLED SINGLE-PACKAGE AIR CONDITIONERS <65,000 BTU/H

Efficiency level	Life-cycle cost savings	
	% of customers that experience	Average savings*
	Net cost	*2014$*
1	49	($89)
2	81	(299)
3	89	(602)
4	93	(922)
5	100	(1,340)

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

TABLE VIII.8—AVERAGE LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR SMALL THREE-PHASE AIR-COOLED SPLIT-SYSTEM HEAT PUMPS <65,000 BTU/H

Efficiency level	Average costs *2014$*				Simple payback *years*	Average lifetime *years*
	Installed cost	First year's operating cost	Lifetime operating cost	LCC		
ASHRAE Baseline	$4,513	$796	$7,070	$11,584	N/A	16
1	4,774	783	6,957	11,731	20	16
2	5,118	777	6,906	12,024	33	16
3	5,401	778	6,911	12,312	49	16
4	5,694	778	6,918	12,612	69	16

Note: The results for each efficiency level are calculated assuming that all commercial consumers use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE VIII.9—LCC SAVINGS RELATIVE TO THE BASE-CASE EFFICIENCY DISTRIBUTION FOR SMALL THREE-PHASE AIR-COOLED SPLIT-SYSTEM HEAT PUMPS <65,000 BTU/H

Efficiency level	Life-cycle cost savings	
	% of customers that experience	Average savings*
	Net cost	*2014$*
1	75	($118)
2	99	(410)
3	100	(697)
4	100	(997)

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

TABLE VIII.10—AVERAGE LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR SMALL THREE-PHASE AIR-COOLED SINGLE-PACKAGE HEAT PUMPS <65,000 BTU/H

Efficiency level	Average costs *2014$*				Simple payback *years*	Average lifetime *years*
	Installed cost	First year's operating cost	Lifetime operating cost	LCC		
ASHRAE Baseline	$5,155	$797	$7,084	$12,239	N/A	16
1	5,499	784	6,969	12,468	27	16
2	5,830	777	6,909	12,739	34	16
3	6,161	778	6,916	13,077	53	16
4	6,550	779	6,923	13,473	77	16

Note: The results for each efficiency level are calculated assuming that all commercial consumers use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE VIII.11—LCC SAVINGS RELATIVE TO THE BASE-CASE EFFICIENCY DISTRIBUTION FOR SMALL THREE-PHASE AIR-COOLED SINGLE-PACKAGE HEAT PUMPS <65,000 BTU/H

Efficiency level	Life-cycle cost savings	
	% of customers that experience	Average savings*
	Net cost	*2014$*
1	68	($158)
2	90	(402)
3	99	(735)
4	99	(1,128)

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

b. National Impact Analysis

1. Amount and Significance of Energy Savings

To estimate the lifetime energy savings for equipment shipped through 2046 (or 2048) due to amended energy conservation standards, DOE compared the energy consumption of small commercial air-cooled air conditioners and heat pumps less than 65,000 Btu/h under the ASHRAE Standard 90.1–2013 efficiency levels (or current Federal levels for split-system air conditioners) to energy consumption of the same small commercial air-cooled air conditioners and heat pumps under more-stringent efficiency standards. For the three equipment classes triggered by ASHRAE, DOE also compared the energy consumption of those small commercial air-cooled air conditioners and heat pumps under the ASHRAE Standard 90.1–2013 efficiency levels to energy consumption of small commercial air-cooled air conditioners and heat pumps under the current EPCA base case (*i.e.,* under current Federal standards). DOE examined up to five efficiency levels higher than those of ASHRAE Standard 90.1–2013. Table VIII.12 through Table VIII.15 show the projected national energy savings at each of the considered standard levels. (See chapter 8 of the final rule TSD.)

TABLE VIII.12—POTENTIAL ENERGY SAVINGS FOR SMALL THREE-PHASE AIR-COOLED SPLIT-SYSTEM AIR CONDITIONERS <65,000 BTU/H

Efficiency level	Primary energy savings estimate (quads)	FFC Energy savings estimate (quads)
Level 0–14 SEER	0.02	0.02
Level 1–15 SEER	0.08	0.08
Level 2–16 SEER	0.13	0.14
Level 3–17 SEER	0.16	0.17
Level 4–18 SEER	0.18	0.19
Level 5–"Max-Tech"–19 SEER	0.19	0.20

TABLE VIII.13—POTENTIAL ENERGY SAVINGS FOR SMALL THREE-PHASE AIR-COOLED SINGLE-PACKAGE AIR CONDITIONERS <65,000 BTU/H

Efficiency level	Primary energy savings estimate* (quads)	FFC Energy savings estimate* (quads)
Level 0–ASHRAE–14 SEER	0.04	0.04
Level 1–15 SEER	0.05	0.06
Level 2–16 SEER	0.11	0.12
Level 3–17 SEER	0.15	0.15
Level 4–18 SEER	0.18	0.18
Level 5–"Max-Tech"–19 SEER	0.19	0.20

* The potential energy savings for efficiency levels more stringent than those specified by ASHRAE Standard 90.1–2013 were calculated relative to the efficiency levels that would result if ASHRAE Standard 90.1–2013 standards were adopted.

TABLE VIII.14—POTENTIAL ENERGY SAVINGS FOR SMALL THREE-PHASE AIR-COOLED SPLIT-SYSTEM HEAT PUMPS <65,000 BTU/H

Efficiency level	Primary energy savings estimate* (quads)	FFC Energy savings estimate* (quads)
Level 0–ASHRAE–14 SEER	0.01	0.01
Level 1–15 SEER	0.01	0.01
Level 2–16 SEER	0.02	0.02
Level 3–17 SEER	0.03	0.03
Level 4–"Max-Tech"–18 SEER	0.03	0.03

* The potential energy savings for efficiency levels more stringent than those specified by ASHRAE Standard 90.1–2013 were calculated relative to the efficiency levels that would result if ASHRAE Standard 90.1–2013 standards were adopted.

TABLE VIII.15—POTENTIAL ENERGY SAVINGS FOR SMALL THREE-PHASE AIR-COOLED SINGLE-PACKAGE HEAT PUMPS <65,000 BTU/H

Efficiency level	Primary energy savings estimate* (quads)	FFC Energy savings estimate* (quads)
Level 0–ASHRAE–14 SEER	0.01	0.01
Level 1–15 SEER	0.01	0.01
Level 2–16 SEER	0.02	0.02
Level 3–17 SEER	0.03	0.03
Level 4–"Max-Tech"–18 SEER	0.04	0.04

* The potential energy savings for efficiency levels more stringent than those specified by ASHRAE Standard 90.1–2013 were calculated relative to the efficiency levels that would result if ASHRAE Standard 90.1–2013 standards were adopted.

2. Net Present Value of Customer Costs and Benefits

The NPV analysis is a measure of the cumulative commercial consumer benefit or cost of standards to the Nation. In accordance with OMB's guidelines on regulatory analysis (OMB Circular A–4, section E (Sept. 17, 2003)), DOE calculated NPV using both a 7-percent and a 3-percent real discount rate. Table VIII.16 and Table VIII.17 provide an overview of the NPV results. (See chapter 8 of the final rule TSD for further detail.)

TABLE VIII.16—SUMMARY OF CUMULATIVE NET PRESENT VALUE FOR SMALL THREE-PHASE AIR-COOLED AIR CONDITIONERS AND HEAT PUMPS <65,000 BTU/H

(Discounted at Seven Percent)

Equipment class	Efficiency level 0	Efficiency level 1	Efficiency level 2	Efficiency level 3	Efficiency level 4	Efficiency level 5
Net Present Value (Billion 2014$)						
Three-Phase Air-Cooled Split-System Air Conditioners <65,000 Btu/h	(0.05)	(0.18)	(0.38)	(0.66)	(0.95)	(1.17)
Three-Phase Air-Cooled Single-Package Air Conditioners <65,000 Btu/h	N/A*	(0.14)	(0.43)	(0.82)	(1.25)	(1.63)
Three-Phase Air-Cooled Split-System Heat Pumps <65,000 Btu/h	N/A*	(0.03)	(0.09)	(0.15)	(0.19)	N/A**

TABLE VIII.16—SUMMARY OF CUMULATIVE NET PRESENT VALUE FOR SMALL THREE-PHASE AIR-COOLED AIR CONDITIONERS AND HEAT PUMPS <65,000 BTU/H—Continued

(Discounted at Seven Percent)

Equipment class	Efficiency level 0	Efficiency level 1	Efficiency level 2	Efficiency level 3	Efficiency level 4	Efficiency level 5
Three-Phase Air-Cooled Single-Package Heat Pumps <65,000 Btu/h	N/A*	(0.04)	(0.11)	(0.20)	(0.28)	N/A**

Notes: Numbers in parentheses indicate negative NPV.
The net present value for efficiency levels more stringent than those specified by ASHRAE Standard 90.1–2013 were calculated relative to the efficiency levels that would result if ASHRAE Standard 90.1–2013 standards were adopted.
* Economic analysis was not conducted for the ASHRAE levels (EL 0).
** The max-tech level for this equipment class is EL 4.

TABLE VIII.17—SUMMARY OF CUMULATIVE NET PRESENT VALUE FOR SMALL THREE-PHASE AIR-COOLED AIR CONDITIONERS AND HEAT PUMPS <65,000 BTU/H (DISCOUNTED AT THREE PERCENT)

Equipment class	Efficiency level 0	Efficiency level 1	Efficiency level 2	Efficiency level 3	Efficiency level 4	Efficiency level 5
Net Present Value (Billion 2014$)						
Three-Phase Air-Cooled Split-System Air Conditioners <65,000 Btu/h	(0.07)	(0.27)	(0.64)	(1.15)	(1.71)	(2.09)
Three-Phase Air-Cooled Single-Package Air Conditioners <65,000 Btu/h	N/A*	(0.21)	(0.74)	(1.47)	(2.30)	(2.96)
Three-Phase Air-Cooled Split-System Heat Pumps <65,000 Btu/h	N/A*	(0.05)	(0.15)	(0.26)	(0.33)	N/A**
Three-Phase Air-Cooled Single-Package Heat Pumps <65,000 Btu/h	N/A*	(0.07)	(0.19)	(0.35)	(0.48)	N/A**

Notes: Numbers in parentheses indicate negative NPV. The net present value for efficiency levels more stringent than those specified by ASHRAE Standard 90.1–2013 were calculated relative to the efficiency levels that would result if ASHRAE Standard 90.1–2013 standards were adopted.
* Economic analysis was not conducted for the ASHRAE levels (EL 0).
** The max-tech level for this equipment class is EL 4.

2. Water-Source Heat Pumps

a. Economic Impacts on Commercial Customers

1. Life-Cycle Cost and Payback Period

Table VIII.18 through Table VIII.23 show the LCC and PBP results for all efficiency levels considered for each class of water-source heat pump in this final rule. In the first of each pair of tables, the simple payback is measured relative to the baseline equipment (*i.e.,* equipment with the efficiency level specified in ASHRAE Standard 90.1–2013). In the second tables, the LCC savings are measured relative to the base-case efficiency distribution in the compliance year (*i.e.,* the range of equipment expected to be on the market in the default case where DOE adopts the efficiency levels in ASHRAE Standard 90.1–2013).

TABLE VIII.18—AVERAGE LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR WATER-SOURCE HEAT PUMPS (WATER-TO-AIR, WATER-LOOP) <17,000 BTU/H

Efficiency level	Average costs *2014$*				Simple payback *years*	Average lifetime *years*
	Installed cost	First year's operating cost	Lifetime operating cost	LCC		
ASHRAE Baseline	$3,216	$654	$7,692	$10,908	—	19
1	3,354	645	7,578	10,932	14	19
2	3,530	638	7,492	11,022	19	19
3	3,822	628	7,377	11,199	23	19
4	3,958	624	7,334	11,292	25	19
5	4,233	618	7,263	11,496	28	19

Note: The results for each efficiency level are calculated assuming that all commercial consumers use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE VIII.19—LCC SAVINGS RELATIVE TO THE BASE-CASE EFFICIENCY DISTRIBUTION FOR WATER-SOURCE (WATER-TO-AIR, WATER-LOOP) HEAT PUMPS <17,000 BTU//H

Efficiency level	Life-cycle cost savings	
	% of customers that experience	Average savings*
	Net cost	2014$
1	0	($0)
2	46	(46)
3	68	(175)
4	89	(262)
5	95	(462)

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

TABLE VIII.20—AVERAGE LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR WATER-SOURCE (WATER-TO-AIR, WATER-LOOP) HEAT PUMPS ≥17,000 BTU/H AND <65,000 BTU/H

Efficiency level	Average costs 2014$				Simple payback *years*	Average lifetime *years*
	Installed cost	First year's operating cost	Lifetime operating cost	LCC		
ASHRAE Baseline	$4,882	$1,118	$13,169	$18,052	—	19
1	5,162	1,075	12,655	17,817	6.4	19
2	5,513	1,039	12,232	17,745	8.0	19
3	5,758	1,023	12,041	17,799	9.2	19
4	5,968	1,013	11,930	17,898	10	19
5	6,392	997	11,732	18,124	12	19

Note: The results for each efficiency level are calculated assuming that all commercial consumers use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE VIII.21—LCC SAVINGS RELATIVE TO THE BASE-CASE EFFICIENCY DISTRIBUTION FOR WATER-SOURCE (WATER-TO-AIR, WATER-LOOP) HEAT PUMPS ≥17,000 BTU/H AND <65,000 BTU/H

Efficiency level	Life-cycle cost savings	
	% of customers that experience	Average savings*
	Net cost	2014$
1	2	19
2	29	64
3	52	17
4	66	(78)
5	76	(303)

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

TABLE VIII.22—AVERAGE LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR WATER-SOURCE (WATER-TO-AIR, WATER-LOOP) HEAT PUMPS ≥65,000 BTU/H AND <135,000 BTU/H

Efficiency level	Average costs 2014$				Simple payback *years*	Average lifetime *years*
	Installed cost	First year's operating cost	Lifetime operating cost	LCC		
ASHRAE Baseline	$12,005	$2,202	$25,958	$37,963	—	19
1	12,961	2,126	25,065	38,026	13	19
2	13,919	2,087	24,599	38,518	17	19
3	14,830	2,054	24,213	39,042	19	19

TABLE VIII.22—AVERAGE LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR WATER-SOURCE (WATER-TO-AIR, WATER-LOOP) HEAT PUMPS ≥65,000 BTU/H AND <135,000 BTU/H—Continued

Efficiency level	Average costs 2014$				Simple payback *years*	Average lifetime *years*
	Installed cost	First year's operating cost	Lifetime operating cost	LCC		
4	15,977	2,022	23,834	39,811	22	19

Note: The results for each efficiency level are calculated assuming that all commercial consumers use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE VIII.23—LCC SAVINGS RELATIVE TO THE BASE-CASE EFFICIENCY DISTRIBUTION FOR WATER-SOURCE (WATER-TO-AIR, WATER-LOOP) HEAT PUMPS ≥65,000 BTU/H AND <135,000 BTU/H

Efficiency level	Life-cycle cost savings	
	% of customers that experience	Average savings *
	Net cost	2014$
1	** 0	** $0
2	27	(148)
3	72	(560)
4	93	(1,315)

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

** The base-case efficiency distribution has 0-percent market share at the ASHRAE baseline; therefore, there are no savings for EL1.

b. National Impact Analysis

1. Amount and Significance of Energy Savings

To estimate the lifetime energy savings for equipment shipped through 2045 due to amended energy conservation standards, DOE compared the energy consumption of commercial water-source heat pumps under the ASHRAE Standard 90.1–2013 efficiency levels to energy consumption of the same water-source heat pumps under more-stringent efficiency standards. DOE also compared the energy consumption of those commercial water-source heat pumps under the ASHRAE Standard 90.1–2013 efficiency levels to energy consumption of commercial water-source heat pumps under the current EPCA base case (*i.e.,* under current Federal standards). DOE examined up to five efficiency levels higher than those of ASHRAE Standard 90.1–2013. Table VIII.24 through Table VIII.26 show the projected national energy savings at each of the considered standard levels. (See chapter 8 of the final rule TSD.)

TABLE VIII.24—POTENTIAL ENERGY SAVINGS FOR WATER-SOURCE (WATER-TO-AIR, WATER-LOOP) HEAT PUMPS <17,000 BTU/H

Efficiency level	Primary energy savings estimate * (quads)	FFC Energy savings estimate * (quads)
Level 0—ASHRAE—12.2 EER **		
Level 1—13.0 EER	0.0002	0.0002
Level 2—14.0 EER	0.02	0.02
Level 3—15.7 EER	0.06	0.06
Level 4—16.5 EER	0.08	0.08
Level 5—"Max-Tech"—18.1 EER	0.11	0.11

* The potential energy savings for efficiency levels more stringent than those specified by ASHRAE Standard 90.1–2013 were calculated relative to the efficiency levels that would result if ASHRAE Standard 90.1–2013 standards were adopted.

** The base-case efficiency distribution has 0-percent market share at the Federal baseline; therefore, there are no savings for the ASHRAE level.

TABLE VIII.25—POTENTIAL ENERGY SAVINGS FOR WATER-SOURCE (WATER-TO-AIR, WATER-LOOP) HEAT PUMPS ≥17,000 AND <65,000 BTU/H

Efficiency level	Primary energy savings estimate * (quads)	FFC Energy savings estimate * (quads)
Level 0—ASHRAE—13.0 EER **		
Level 1—14.6 EER	0.02	0.03
Level 2—16.6 EER	0.26	0.27
Level 3—18.0 EER	0.45	0.47
Level 4—19.2 EER	0.60	0.63
Level 5—"Max-Tech"—21.6 EER	0.83	0.87

* The potential energy savings for efficiency levels more stringent than those specified by ASHRAE Standard 90.1–2013 were calculated relative to the efficiency levels that would result if ASHRAE Standard 90.1–2013 standards were adopted.

** The base-case efficiency distribution has 0-percent market share at the Federal baseline; therefore, there are no savings for the ASHRAE level.

TABLE VIII.26—POTENTIAL ENERGY SAVINGS FOR WATER-SOURCE (WATER-TO-AIR, WATER-LOOP) HEAT PUMPS ≥65,000 AND <135,000 BTU/H

Efficiency level	Primary energy savings estimate * (quads)	FFC Energy savings estimate * (quads)
Level 0—ASHRAE—13.0 EER **		
Level 1—14.0 EER **		
Level 2—15.0 EER	0.01	0.01
Level 3—16.0 EER	0.03	0.03
Level 4—"Max-Tech"—17.2 EER	0.05	0.05

* The potential energy savings for efficiency levels more stringent than those specified by ASHRAE Standard 90.1–2013 were calculated relative to the efficiency levels that would result if ASHRAE Standard 90.1–2013 standards were adopted.
** The base-case efficiency distribution has 0-percent market share at the Federal baseline and the ASHRAE baseline; therefore, there are no savings for the ASHRAE level or EL1.

2. Net Present Value of Customer Costs and Benefits

Table VIII.27 and Table VIII.28 provide an overview of the NPV results. (See chapter 8 of the final rule TSD for further detail.)

TABLE VIII.27—SUMMARY OF CUMULATIVE NET PRESENT VALUE FOR WATER-SOURCE (WATER-TO-AIR, WATER-LOOP) HEAT PUMPS (DISCOUNTED AT SEVEN PERCENT)

Equipment class	Net present value (billion 2014$)				
	Efficiency level 1	Efficiency level 2	Efficiency level 3	Efficiency level 4	Efficiency level 5
Water-Source (Water-to-Air, Water-Loop) HP <17,000 Btu/h	(0.00)	(0.04)	(0.14)	(0.21)	(0.33)
Water-Source (Water-to-Air, Water-Loop) HP ≥17,000 to <65,000 Btu/h	0.01	0.00	(0.11)	(0.27)	(0.59)
Water-Source (Water-to-Air, Water-Loop) HP ≥65,000 to 135,000 Btu/h	(*)	(0.01)	(0.06)	(0.11)	N/A **

Notes: Numbers in parentheses indicate negative NPV.
The net present value for efficiency levels more stringent than those specified by ASHRAE Standard 90.1–2013 were calculated relative to the efficiency levels that would result if ASHRAE Standard 90.1–2013 standards were adopted. Economic analysis was not conducted for the ASHRAE levels (EL 0).
* The base-case efficiency distribution has 0-percent market share at the ASHRAE baseline; therefore, there are no savings for EL1.
** The max-tech level for this equipment class is EL 4.

TABLE VIII.28—SUMMARY OF CUMULATIVE NET PRESENT VALUE FOR WATER-SOURCE (WATER-TO-AIR, WATER-LOOP) HEAT PUMPS (DISCOUNTED AT THREE PERCENT)

Equipment class	Net present value (billion 2014$)				
	Efficiency level 1	Efficiency level 2	Efficiency level 3	Efficiency level 4	Efficiency level 5
Water-Source (Water-to-Air, Water-Loop) HP <17,000 Btu/h	(0.00)	(0.05)	(0.20)	(0.30)	(0.49)
Water-Source (Water-to-Air, Water-Loop) HP ≥17,000 to <65,000 Btu/h	0.03	0.26	0.21	0.03	(0.37)
Water-Source (Water-to-Air, Water-Loop) HP ≥65,000 to 135,000 Btu/h	(*)	(0.02)	(0.08)	(0.15)	** N/A

Notes: Numbers in parentheses indicate negative NPV.
The net present value for efficiency levels more stringent than those specified by ASHRAE Standard 90.1–2013 were calculated relative to the efficiency levels that would result if ASHRAE Standard 90.1–2013 standards were adopted. Economic analysis was not conducted for the ASHRAE levels (EL 0).
* The base-case efficiency distribution has 0-percent market share at the ASHRAE baseline; therefore, there are no savings for EL1.
** The max-tech level for this equipment class is EL 4.

3. Commercial Oil-Fired Storage Water Heaters

DOE estimated the potential primary energy savings in quads (*i.e.,* 10^{15} Btu) for each efficiency level considered within each equipment class analyzed. Table VIII.29 shows the potential energy savings resulting from the analyses conducted as part of the April 2014 NODA. 79 FR 20114, 20136 (April 11, 2014).

TABLE VIII.29—POTENTIAL ENERGY SAVINGS ESTIMATES FOR COMMERCIAL OIL-FIRED STORAGE WATER HEATERS >105,000 BTU/H AND <4,000 BTU/H/GAL

Efficiency level	Primary energy savings estimate * (Quads)	FFC Energy savings estimate * (Quads)
Level 0—ASHRAE—80% E_t	0.002	0.002
Level 1—81% E_t	0.001	0.001
Level 2—"Max-Tech"—82% E_t	0.002	0.002

* The potential energy savings for efficiency levels more stringent than those specified by ASHRAE Standard 90.1–2013 were calculated relative to the efficiency levels that would result if ASHRAE Standard 90.1–2013 standards were adopted.

DOE did not conduct an economic analysis for this oil-fired storage water heater equipment category because of the minimal energy savings.

C. Need of the Nation To Conserve Energy

An improvement in the energy efficiency of the equipment subject to this rule, where economically justified, is likely to improve the security of the nation's energy system by reducing overall demand for energy, to strengthen the economy, and to reduce the environmental impacts or costs of energy production. Reduced electricity demand may also improve the reliability of the electricity system, particularly during peak-load periods. Reductions in national electric generating capacity estimated for each efficiency level considered in this rulemaking, throughout the same analysis period as the NIA, are reported in chapter 11 of the final rule TSD.

Energy savings from amended standards for the small air-cooled air conditioners and heat pumps less than 65,000 Btu/h, water-source heat pumps, and oil-fired storage water heaters covered in this final rule could also produce environmental benefits in the form of reduced emissions of air pollutants and greenhouse gases.

Table VIII.30 and Table VIII.31 provide DOE's estimate of cumulative emissions reductions projected to result from the efficiency levels analyzed in this rulemaking.[50] The tables include both power sector emissions and upstream emissions. The upstream emissions were calculated using the multipliers discussed in section VII.A. DOE reports annual CO_2, NO_X, and Hg emissions reductions for each efficiency level in chapter 9 of the final rule TSD. As discussed in section VII.A, DOE did not include NO_X emissions reduction from power plants in States subject to CAIR, because an energy conservation standard would not affect the overall level of NO_X emissions in those States due to the emissions caps mandated by CAIR.

TABLE VIII.30—CUMULATIVE EMISSIONS REDUCTION FOR POTENTIAL STANDARDS FOR SMALL THREE-PHASE AIR-COOLED AIR CONDITIONERS AND HEAT PUMPS <65,000 BTU/H (2017–2046 FOR ASHRAE LEVEL; 2020–2046 FOR MORE-STRINGENT LEVELS; 2019–2048 FOR SPLIT-SYSTEM AIR CONDITIONERS)

	Efficiency level					
	ASHRAE/0	1	2	3	4	5
Power Sector Emissions						
CO_2 *(million metric tons)*	3.7	8.9	16.8	20.8	24.3	25.9
SO_2 *(thousand tons)*	2.9	6.9	13.0	16.1	18.8	20.1
NO_X *(thousand tons)*	2.8	6.7	12.6	15.6	18.2	19.4
Hg *(tons)*	0.01	0.02	0.04	0.05	0.06	0.06
N_2O *(thousand tons)*	0.05	0.13	0.24	0.30	0.35	0.37
CH_4 *(thousand tons)*	0.38	0.90	1.69	2.10	2.45	2.61
Upstream Emissions						
CO_2 *(million metric tons)*	0.22	0.54	1.00	1.24	1.45	1.54
SO_2 *(thousand tons)*	0.04	0.09	0.17	0.22	0.25	0.27
NO_X *(thousand tons)*	3.2	7.6	14.3	17.7	20.7	22.0
Hg *(tons)*	0.0001	0.0002	0.0004	0.0005	0.0006	0.0006
N_2O *(thousand tons)*	0.002	0.005	0.009	0.011	0.012	0.013
CH_4 *(thousand tons)*	19	45	83	103	121	128
Total FFC Emissions						
CO_2 *(million metric tons)*	4.0	9.5	17.8	22.1	25.8	27.4
SO_2 *(thousand tons)*	2.9	7.0	13.2	16.4	19.1	20.3
NO_X *(thousand tons)*	6.0	14.3	26.8	33.4	38.9	41.4
Hg *(tons)*	0.01	0.02	0.04	0.05	0.06	0.06
N_2O *(thousand tons)*	0.06	0.13	0.25	0.31	0.36	0.39
CH_4 *(thousand tons)*	19	45	85	105	123	131

Note: The potential emissions reduction for efficiency levels more stringent than those specified by ASHRAE Standard 90.1–2013 were calculated relative to the efficiency levels that would result if ASHRAE Standard 90.1–2013 standards were adopted.

[50] Because DOE did not conduct additional analysis for oil-fired storage water heaters, estimates of environmental benefits for amended standards for that equipment type are not shown here.

TABLE VIII.31—CUMULATIVE EMISSIONS REDUCTION FOR POTENTIAL STANDARDS FOR WATER-SOURCE HEAT PUMPS (2016–2045 FOR ASHRAE LEVEL; 2020–2045 FOR MORE-STRINGENT LEVELS)

	Efficiency level					
	ASHRAE/0 *	1	2	3	4	5
Power Sector Emissions						
CO_2 *(million metric tons)*	—	1.4	16.3	30.5	41.5	56.7
SO_2 (*thousand tons*)	—	1.1	12.9	24.1	32.9	44.9
NO_X *(thousand tons)*	—	1.1	12.3	23.1	31.4	42.9
Hg (*tons*)	—	0.003	0.040	0.074	0.101	0.139
N_2O (*thousand tons*)	—	0.02	0.23	0.44	0.60	0.81
CH_4 (*thousand tons*)	—	0.14	1.63	3.06	4.16	5.68
Upstream Emissions						
CO_2 *(million metric tons)*	—	0.08	0.97	1.81	2.47	3.36
SO_2 (*thousand tons*)	—	0.01	0.17	0.32	0.43	0.59
NO_X *(thousand tons)*	—	1.2	13.8	25.9	35.2	48.0
Hg (*tons*)	—	0.00003	0.00037	0.00070	0.00095	0.00129
N_2O (*thousand tons*)	—	0.001	0.008	0.016	0.021	0.029
CH_4 (*thousand tons*)	—	7.0	80.4	150.7	205.0	279.6
Total FFC Emissions						
CO_2 *(million metric tons)*	—	1.5	17.3	32.3	44.0	60.1
SO_2 (*thousand tons*)	—	1.1	13.1	24.5	33.3	45.5
NO_X *(thousand tons)*	—	2.3	26.1	48.9	66.6	90.9
Hg (*tons*)	—	0.004	0.040	0.075	0.102	0.140
N_2O (*thousand tons*)	—	0.02	0.24	0.45	0.62	0.84
CH_4 (*thousand tons*)	—	7.2	82.0	153.8	209.1	285.3

Note: The potential emissions reduction for efficiency levels more stringent than those specified by ASHRAE Standard 90.1–2013 were calculated relative to the efficiency levels that would result if ASHRAE Standard 90.1–2013 standards were adopted.
* There are no reductions for the ASHRAE level because there is no market share projected at the Federal baseline in the base case.

As part of the analysis for this final rule, DOE estimated monetary benefits likely to result from the reduced emissions of CO_2 and NO_X estimated for each of the efficiency levels analyzed for small air-cooled air conditioners and heat pumps less than 65,000 Btu/h, water-source heat pumps, and oil-fired storage water heaters. As discussed in section VII.B.1, for CO_2, DOE used values for the SCC developed by an interagency process. The interagency group selected four sets of SCC values for use in regulatory analyses. Three sets are based on the average SCC from three integrated assessment models, at discount rates of 2.5 percent, 3 percent, and 5 percent. The fourth set, which represents the 95th-percentile SCC estimate across all three models at a 3-percent discount rate, is included to represent higher-than-expected impacts from temperature change further out in the tails of the SCC distribution. The four SCC values for CO_2 emissions reductions in 2015, expressed in 2014$, are $12.2/ton, $41.2/ton, $63.4/ton, and $121/ton. The values for later years are higher due to increasing emissions-related costs as the magnitude of projected climate change increases.

Table VIII.32 and Table VIII.33 present the global value of CO_2 emissions reductions at each efficiency level. For each of the four cases, DOE calculated a present value of the stream of annual values using the same discount rate as was used in the studies upon which the dollar-per-ton values are based. DOE calculated domestic values as a range from 7 percent to 23 percent of the global values, and these results are presented in chapter 10 of the final rule TSD.

TABLE VIII.32—GLOBAL PRESENT VALUE OF CO_2 EMISSIONS REDUCTION FOR POTENTIAL STANDARDS FOR SMALL THREE-PHASE AIR-COOLED AIR CONDITIONERS AND HEAT PUMPS <65,000 BTU/H

Efficiency level	SCC Scenario*			
	5% Discount rate, average	3% Discount rate, average	2.5% Discount rate, average	3% Discount rate, 95th percentile
	million 2014$			
Power Sector Emissions				
ASHRAE/0	24	115	184	356
1	57	273	437	846
2	110	521	832	1,613
3	136	646	1,031	1,999
4	159	754	1,204	2,334
5	170	804	1,283	2,489

TABLE VIII.32—GLOBAL PRESENT VALUE OF CO_2 EMISSIONS REDUCTION FOR POTENTIAL STANDARDS FOR SMALL THREE-PHASE AIR-COOLED AIR CONDITIONERS AND HEAT PUMPS <65,000 BTU/H—Continued

Efficiency level	SCC Scenario*			
	5% Discount rate, average	3% Discount rate, average	2.5% Discount rate, average	3% Discount rate, 95th percentile
Upstream Emissions				
ASHRAE/0	1.4	6.8	11	21
1	3.3	16	26	50
2	6.4	31	49	95
3	7.9	38	61	118
4	9.3	44	71	138
5	10	47	76	147
Total FFC Emissions				
ASHRAE/0	25	122	195	377
1	60	289	463	896
2	116	552	881	1,708
3	144	684	1,092	2,117
4	168	799	1,275	2,472
5	179	851	1,359	2,635

Note: The potential emissions reduction for efficiency levels more stringent than those specified by ASHRAE Standard 90.1–2013 were calculated relative to the efficiency levels that would result if ASHRAE Standard 90.1–2013 standards were adopted.
* For each of the four cases, the corresponding SCC value for emissions in 2015 is $12.2, $41.2, $63.4 and $121 per metric ton (2014$).

TABLE VIII.33—GLOBAL PRESENT VALUE OF CO_2 EMISSIONS REDUCTION FOR POTENTIAL STANDARDS FOR WATER-SOURCE HEAT PUMPS

Efficiency level	SCC Scenario*			
	5% Discount rate, average	3% Discount rate, average	2.5% Discount rate, average	3% Discount rate, 95th percentile
	million 2014$			
Power Sector Emissions				
ASHRAE/0**	—	—	—	—
1	9.3	44	71	137
2	106	504	805	1,560
3	198	943	1,507	2,922
4	270	1,285	2,052	3,979
5	370	1,758	2,808	5,446
Upstream Emissions				
ASHRAE/0**	—	—	—	—
1	0.5	2.6	4.1	8.0
2	6.1	30	47	92
3	12	55	89	172
4	16	75	121	234
5	21	103	165	320
Total FFC Emissions				
ASHRAE/0**	—	—	—	—
1	9.8	47	75	145
2	112	533	852	1,652
3	209	999	1,596	3,094
4	285	1,360	2,173	4,213
5	391	1,862	2,973	5,765

Note: The potential emissions reduction for efficiency levels more stringent than those specified by ASHRAE Standard 90.1–2013 were calculated relative to the efficiency levels that would result if ASHRAE Standard 90.1–2013 standards were adopted.
* For each of the four cases, the corresponding SCC value for emissions in 2015 is $12.2, $41.2, $63.4 and $121 per metric ton (2014$).
** There are no reductions for the ASHRAE level because there is no market share projected at the Federal baseline in the base case.

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 in this rulemaking on reducing CO_2 emissions is subject to change. DOE, together with other Federal agencies, will continue to review various methodologies for estimating the monetary value of reductions in CO_2 and other GHG emissions. This ongoing review will consider the comments on this subject that are part of the public record for this and other rulemakings, as well as other methodological assumptions and issues. However, consistent with DOE's legal obligations, and taking into account the uncertainty involved with this particular issue, DOE has included in this final rule the most recent values and analyses resulting from the interagency review process.

DOE also estimated a range for the cumulative monetary value of the economic benefits associated with NO_X emissions reductions anticipated to result from amended standards for the small air-cooled air conditioners and heat pumps less than 65,000 Btu/h, water-source heat pumps, and oil-fired storage water heaters that are the subject of this final rule. The dollar-per-ton values that DOE used are discussed in section VII.B.2.

Table VIII.34 and Table VIII.35 present the present value of cumulative NO_X emissions reductions for each efficiency level calculated using the average dollar-per-ton values and 7-percent and 3-percent discount rates.

TABLE VIII.34—PRESENT VALUE OF NO_X EMISSIONS REDUCTION FOR POTENTIAL STANDARDS FOR SMALL THREE-PHASE AIR-COOLED AIR CONDITIONERS AND HEAT PUMPS <65,000 Btu/h

[(2017–2046 for ASHRAE level; 2020–2046 for more-stringent levels; 2019–2048 for split-system air conditioners)]

Efficiency level	3% Discount rate	7% Discount rate
	million 2014$	
Power Sector Emissions		
ASHRAE/0	3.5	1.5
1	8.2	3.5
2	16	7.0
3	20	8.6
4	23	10
5	25	11
Upstream Emissions		
ASHRAE/0	3.8	1.5
1	9.0	3.6
2	17	7.2
3	22	8.9
4	25	10
5	27	11
Total FFC Emissions		
ASHRAE/0	7.3	3.0
1	17	7.1
2	33	14
3	41	17
4	48	20
5	51	22

Note: The potential emissions reduction for efficiency levels more stringent than those specified by ASHRAE Standard 90.1–2013 were calculated relative to the efficiency levels that would result if ASHRAE Standard 90.1–2013 standards were adopted.

TABLE VIII.35—PRESENT VALUE OF NO_X EMISSIONS REDUCTION FOR POTENTIAL STANDARDS FOR WATER-SOURCE HEAT PUMPS

[(2016–2045 for ASHRAE level; 2020–2045 for more-stringent levels)]

Efficiency level	3% Discount rate	7% Discount rate
	million 2014$	
Power Sector Emissions		
ASHRAE/0 *		
1	1.4	0.6
2	15	6.6
3	29	12
4	39	17
5	54	23
Upstream Emissions		
ASHRAE/0 *		
1	1.5	0.6

TABLE VIII.35—PRESENT VALUE OF NO_X EMISSIONS REDUCTION FOR POTENTIAL STANDARDS FOR WATER-SOURCE HEAT PUMPS—Continued

[(2016–2045 for ASHRAE level; 2020–2045 for more-stringent levels)]

Efficiency level	3% Discount rate	7% Discount rate
2	17	6.7
3	31	13
4	42	17
5	58	24
Total FFC Emissions		
ASHRAE/0 *	....	....
1	2.8	1.2
2	32	13
3	60	25
4	82	34
5	112	47

Note: The potential emissions reduction for efficiency levels more stringent than those specified by ASHRAE Standard 90.1–2013 were calculated relative to the efficiency levels that would result if ASHRAE Standard 90.1–2013 standards were adopted.

* There are no reductions for the ASHRAE level because there is no market share projected at the Federal baseline in the base case.

D. Amended Energy Conservation Standards

1. Small Commercial Air-Cooled Air Conditioners and Heat Pumps Less Than 65,000 Btu/h

As noted previously, EPCA specifies that, for any commercial and industrial equipment addressed under 42 U.S.C. 6313(a)(6)(A)(i), DOE may prescribe an energy conservation standard more stringent than the level for such equipment in ASHRAE Standard 90.1, as amended, only if ''clear and convincing evidence'' shows that a more-stringent standard would result in significant additional conservation of energy and is technologically feasible and economically justified. (42 U.S.C. 6313(a)(6)(A)(ii)(II)) This requirement also applies to split-system air conditioners evaluated under the 6-year look back. (42 U.S.C. 6313)(a)(6)(C)(i)(II))

In evaluating more-stringent efficiency levels than those specified by ASHRAE Standard 90.1–2013 for small air-cooled air conditioners and heat pumps less than 65,000 Btu/h, DOE reviewed the results in terms of their technological feasibility, significance of energy savings, and economic justification.

DOE has concluded that all of the SEER and HSPF levels considered by DOE are technologically feasible, as units with equivalent efficiency appeared to be available in the current market at all levels examined.

DOE examined the potential energy savings that would result from the efficiency levels specified in ASHRAE Standard 90.1–2013 and compared these to the potential energy savings that would result from efficiency levels more stringent than those in ASHRAE Standard 90.1–2013. DOE estimates that 0.05 quads of energy would be saved if DOE adopts the efficiency levels set in ASHRAE Standard 90.1–2013 for each small air-cooled air conditioner and heat pump class specified in that standard. If DOE were to adopt efficiency levels more stringent than those specified by ASHRAE Standard 90.1–2013, the potential additional energy savings range from 0.02 quads to 0.45 quads. Associated with proposing more-stringent efficiency levels for the three triggered equipment classes is a three-year delay in implementation compared to the adoption of energy conservation standards at the levels specified in ASHRAE Standard 90.1–2013 (see section V.E.10). This delay in implementation of amended energy conservation standards would result in a small amount of energy savings being lost in the first years (2017 through 2020) compared to the savings from adopting the levels in ASHRAE Standard 90.1–2013; however, this loss may be compensated for by increased savings in later years. Taken in isolation, the energy savings associated with more-stringent standards might be considered significant enough to warrant adoption of such standards. However, as noted previously, energy savings are not the only factor that DOE must consider.

In considering whether potential standards are economically justified, DOE also examined the LCC savings and national NPV that would result from adopting efficiency levels more stringent than those set forth in ASHRAE Standard 90.1–2013. The analytical results show negative average LCC savings and negative national NPV at both 7-percent and 3-percent discount rate for all efficiency levels in all four equipment classes. These results indicate that adoption of efficiency levels more stringent than those in ASHRAE Standard 90.1–2013 as Federal energy conservation standards would likely lead to negative economic outcomes for the Nation. Consequently, this criterion for adoption of more-stringent standard levels does not appear to have been met.

As such, DOE does not have ''clear and convincing evidence'' that any significant additional conservation of energy that would result from adoption of more-stringent efficiency levels than those specified in ASHRAE Standard 90.1–2013 would be economically justified. Comments on the NOPR did not provide any additional information to alter this conclusion. Therefore, DOE is adopting amended energy efficiency levels for this equipment as set forth in ASHRAE Standard 90.1–2013. For split-system air conditioners, for which the efficiency level was not updated in ASHRAE Standard 90.1–2013, DOE is making a determination that standards for the product do not need to be amended for the reasons stated above. Table VIII.36 presents the amended energy conservation standards and compliance dates for small air-cooled air conditioners and heat pumps less than 65,000 Btu/h.

TABLE VIII.36—AMENDED ENERGY CONSERVATION STANDARDS FOR SMALL THREE-PHASE AIR-COOLED AIR CONDITIONERS AND HEAT PUMPS <65,000 Btu/h

Equipment type	Efficiency level	Compliance date
Three-Phase Air-Cooled Split System Air Conditioners <65,000 Btu/h	13.0 SEER *	June 16, 2008.
Three-Phase Air-Cooled Single Package Air Conditioners <65,000 Btu/h	14.0 SEER	January 1, 2017.
Three-Phase Air-Cooled Split System Heat Pumps <65,000 Btu/h	14.0 SEER, 8.2 HSPF	January 1, 2017.
Three-Phase Air-Cooled Single Package Heat Pumps <65,000 Btu/h	14.0 SEER, 8.0 HSPF	January 1, 2017.

* 13.0 SEER is the existing Federal minimum energy conservation standard for three-phase air-cooled split system air conditioners <65,000 Btu/h.

2. Water-Source Heat Pumps

In evaluating more-stringent efficiency levels for water-source heat pumps than those specified by ASHRAE Standard 90.1–2013, DOE reviewed the results in terms of their technological feasibility, significance of energy savings, and economic justification.

DOE has concluded that all of the EER and COP levels considered by DOE are technologically feasible, as units with equivalent efficiency appeared to be available in the current market at all levels examined.

DOE examined the potential energy savings that would result from the efficiency levels specified in ASHRAE Standard 90.1–2013 and compared these to the potential energy savings that would result from efficiency levels more stringent than those in ASHRAE Standard 90.1–2013. DOE does not estimate any energy savings from adopting the levels set in ASHRAE Standard 90.1–2013, as very few models exist on the market below that level, and by 2020, DOE expects those models to be off the market. If DOE were to adopt efficiency levels more stringent than those specified by ASHRAE Standard 90.1–2013, the potential additional energy savings range from 0.03 quads to 1.0 quads. Associated with proposing more-stringent efficiency levels is a four-and-a-half-year delay in implementation compared to the adoption of energy conservation standards at the levels specified in ASHRAE Standard 90.1–2013 (see section VI.E.10). This delay in implementation of amended energy conservation standards would result in a small amount of energy savings being lost in the first years (2016 through 2020) compared to the savings from adopting the levels in ASHRAE Standard 90.1–2013; however, this loss may be compensated for by increased savings in later years. Taken in isolation, the energy savings associated with more-stringent standards might be considered significant enough to warrant adoption of such standards. However, as noted above, energy savings are not the only factor that DOE must consider.

In considering whether potential standards are economically justified, DOE also examined the NPV that would result from adopting efficiency levels more stringent than those set forth in ASHRAE Standard 90.1–2013. With a 7-percent discount rate, EL 1 results in positive NPV, and ELs 2 through 5 result in negative NPV. With a 3-percent discount rate, ELs 1 and 2 create positive NPV, while ELs 3 through 5 result in negative NPVs. These results indicate that adoption of efficiency levels more stringent than those in ASHRAE Standard 90.1–2013 as Federal energy conservation standards might lead to negative economic outcomes for the Nation, except at EL1, which offers very little energy savings.

Furthermore, although DOE based it analyses on the best available data when examining the potential energy savings and the economic justification of efficiency levels more stringent than those specified in ASHRAE Standard 90.1–2013, DOE believes there are several limitations regarding that data which should be considered before proposing amended energy conservation standards for water-source heat pumps.

First, DOE reexamined the uncertainty in its analysis of water-source heat pumps. As noted in section VI.D, DOE relied on cooling energy use estimates from a 2000 study. While DOE applied a scaling factor to attempt to account for changes in buildings since 2000, this is only a rough estimate. DOE considered running building simulations by applying a water-source heat pump module to reference buildings. However, DOE has been unable to obtain reliable information on the distribution of water-source heat pump applications. Therefore, it is not clear which building types would be most useful to simulate and how DOE would weight the results of the simulations. Furthermore, DOE has no field data with which to corroborate the results of the simulations. The analysis of heating energy use is also very uncertain; DOE relied on estimates for air-source heat pumps, but it is unclear whether water-source heat pumps would have similar heating usage, as they tend to be used in different applications. Any inaccuracy in UEC directly impacts the energy savings estimates and consumer impacts.

Second, in developing its analysis, DOE made refinements to various inputs, such as heating UEC and repair cost. DOE observed that the NPV results were highly sensitive to small changes in these inputs, with NPV for EL 2, for example, changing from positive to negative and back over several iterations. This model sensitivity, combined with high uncertainty in various inputs, makes it difficult for DOE to determine that the results provide clear and convincing evidence that higher standards would be economically justified.

Third, DOE relied on shipments estimates from the U.S. Census. As noted in the January 2015 NOPR, these estimates are considerably higher than those found in an EIA report. 80 FR 1171, 1206. Furthermore, DOE disaggregated the shipments into equipment class using data from over a decade ago. Although DOE requested comment, DOE has not received any information or data regarding the shipments of this equipment. Any inaccuracy in the shipment projection in total or by equipment class contributes to the uncertainty of the energy savings results and, thus, makes it difficult for DOE to determine that any additional energy savings are significant.

Fourth, due to the limited data on the existing distribution of shipments by efficiency level or historical efficiency trends, DOE was not able to assess possible future changes in either the available efficiencies of equipment in the water-source heat pump market or the sales distribution of shipments by efficiency level in the absence of setting more-stringent standards. Instead, DOE applied an efficiency trend from a commercial air conditioner rulemaking published 10 years ago. DOE recognizes that manufacturers may continue to make future improvements in water-source heat pump efficiencies even in the absence of mandated energy conservation standards. In particular, water-source heat pumps tend to be a fairly efficient product, and the distribution of model availability indicates that many commercial consumers are already purchasing equipment well above the baseline. Consequently, it is likely that the true improvements in efficiency in the absence of a standard may be higher than estimated. This possibility increases the uncertainty of the energy savings estimates. To the extent that manufacturers improve equipment efficiency and commercial consumers choose to purchase improved products in the absence of standards, the energy savings estimates would likely be reduced.

In light of the above, DOE would again restate the statutory test for adopting energy conservation standards more stringent than the levels in ASHRAE Standard 90.1. DOE must have ''clear and convincing'' evidence in order to propose efficiency levels more stringent than those specified in ASHRAE Standard 90.1–2013, and for the reasons explained in this document, the totality of information does not meet the level necessary to support these more-stringent efficiency levels for water-source heat pumps. Consequently, although certain stakeholders have recommended that DOE adopt higher efficiency levels for one water-source heat pump class (as discussed in section III.B), DOE has decided to adopt the efficiency levels in ASHRAE Standard 90.1–2013 as amended energy conservation standards for all three water-source heat pump equipment classes. Accordingly, Table VIII.37 presents the amended energy conservation standards and compliance dates for water-source heat pumps.

TABLE VIII.37—AMENDED ENERGY CONSERVATION STANDARDS FOR WATER-SOURCE HEAT PUMPS

Equipment type	Efficiency level	Compliance date
Water-Source (Water-to-Air, Water-Loop) HP <17,000 Btu/h	12.2 EER, 4.3 COP	October 9, 2015.
Water-Source (Water-to-Air, Water-Loop) HP ≥17,000 to <65,000 Btu/h	13.0 EER, 4.3 COP	October 9, 2015.
Water-Source (Water-to-Air, Water-Loop) HP ≥65,000 to 135,000 Btu/h	13.0 EER, 4.3 COP	October 9, 2015.

3. Commercial Oil-Fired Storage Water Heaters

EPCA specifies that, for any commercial and industrial equipment addressed under 42 U.S.C. 6313(a)(6)(A)(i), DOE may prescribe an energy conservation standard more stringent than the level for such equipment in ASHRAE Standard 90.1, as amended, only if ''clear and convincing evidence'' shows that a more-stringent standard would result in significant additional conservation of energy and is technologically feasible and economically justified. (42 U.S.C. 6313(a)(6)(A)(ii)(II))

In evaluating more-stringent efficiency levels for oil-fired storage water-heating equipment than those specified by ASHRAE Standard 90.1–2013, DOE reviewed the results in terms of the significance of their additional energy savings. DOE believes that the energy savings from increasing national energy conservation standards for oil-fired storage water heaters above the levels specified by ASHRAE Standard 90.1–2013 would be minimal. As noted in the January 2015 NOPR, DOE does not have ''clear and convincing evidence'' that significant additional conservation of energy would result from adoption of more-stringent standard levels. 80 FR 1171, 1226–27. Comments on the NOPR did not provide any additional information to alter this conclusion. Therefore, DOE did not examine whether the levels are economically justified, and DOE is adopting the energy efficiency levels for this equipment type as set forth in ASHRAE Standard 90.1–2013. Table VIII.38 presents the amended energy conservation standard and compliance date for oil-fired storage water heaters.

TABLE VIII.38—AMENDED ENERGY CONSERVATION STANDARDS FOR OIL-FIRED STORAGE WATER HEATERS

Equipment type	Efficiency level (Et)	Compliance date
Oil-Fired Storage Water Heaters >105,000 Btu/h and <4,000 Btu/h/gal	80%	October 9, 2015.

IX. Procedural Issues and Regulatory Review

A. Review Under Executive Order 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 small air-cooled air conditioners and heat pumps less than 65,000 Btu/h, water-source heat pumps, and oil-fired storage water heaters 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 small air-cooled air conditioners and heat pumps less than 65,000 Btu/h, water-source heat pumps, and oil-fired storage water heaters that are not captured by the users of such equipment. These benefits include externalities related to public health, environmental protection, and national energy security that are not reflected in energy prices, such as reduced emissions of air pollutants and greenhouse gases that impact human health and global warming. DOE attempts to quantify some of the external benefits through use of social cost of carbon values.

In addition, DOE has determined that the proposed regulatory action is not a ''significant regulatory action'' under section 3(f)(1) of Executive Order 12866. Accordingly, DOE has not prepared a regulatory impact analysis (RIA) for this rule, and the Office of Information and Regulatory Affairs (OIRA) in the Office of Management and Budget (OMB) has not reviewed this rule.

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

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

B. Review Under the Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*) requires preparation of an initial regulatory flexibility analysis (IRFA) for any rule that by law must be proposed for public comment, unless the agency certifies that the rule, if promulgated, will not have a significant economic impact on a substantial number of small entities. As required by Executive Order 13272, ''Proper Consideration of Small Entities in Agency Rulemaking,'' 67 FR 53461 (August 16, 2002), DOE published procedures and policies on February 19, 2003, to ensure that the potential impacts of its rules on small entities are properly considered during the rulemaking process. 68 FR 7990. DOE has made its procedures and policies available on the Office of the General Counsel's Web site (*http://energy.gov/gc/office-general-counsel*).

For manufacturers of small air-cooled air conditioners and heat pumps less than 65,000 Btu/h, water-source heat pumps, and oil-fired storage water heaters, the Small Business Administration (SBA) has set a size threshold, which defines those entities classified as ''small businesses'' for the purposes of the statute. DOE used the SBA's small business size standards to determine whether any small entities would be subject to the requirements of the rule. 65 FR 30836, 30848 (May 15, 2000), as amended at 65 FR 53533, 53544 (Sept. 5, 2000) and 77 FR 49991, 50000 (August 20, 2012), as codified at 13 CFR part 121. The size standards are listed by North American Industry Classification System (NAICS) code and industry description and are available at *http://www.sba.gov/sites/default/files/Size_Standards_Table.pdf*. The ASHRAE equipment covered by this rule are classified under NAICS 333318, ''Other Commercial and Service Industry Machinery Manufacturing'' (oil-fired water heaters) and NAICS 333415, ''Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing'' (all other equipment addressed by the notice). For an entity to be considered as a small business, the SBA sets a threshold of 1,000 employees or fewer for the first category including commercial water heaters and 750 employees or fewer for the second category.

DOE examined each of the manufacturers it found during its market assessment and used publicly-available information to determine if any manufacturers identified qualify as a small business under the SBA guidelines discussed previously. (For a list of all manufacturers of ASHRAE equipment covered by this rule, see chapter 2 of the final rule TSD.) DOE's research involved individual company Web sites and marketing research tools (*e.g.,* Hoovers reports [51]) to create a list of companies that manufacture the types of ASHRAE equipment affected by this rule. DOE screened out companies that do not have domestic manufacturing operations for ASHRAE equipment (*i.e.,* manufacturers that produce all of their ASHRAE equipment internationally). DOE also did not consider manufacturers that are subsidiaries of parent companies that exceed the applicable 1000-employee or 750-employee threshold set by the SBA to be small businesses. DOE identified 16 companies that qualify as small manufacturers: 5 central air conditioner manufacturers (of the 23 total identified), 7 water-source heat pump manufacturers (of the 18 total identified), and 7 oil-fired storage water heater manufacturers (of the 10 total identified). Please note that there are 3 small manufacturers that produce equipment in more than one of these categories.

Based on reviews of product listing data in the AHRI Directory for commercial equipment, DOE estimates that small manufacturers account for less than 1 percent of the market for covered three-phase central air conditioner equipment and less than 5 percent of the market for covered water-source heat pump equipment. In the oil-fired storage water heat market, DOE understands that one of the small manufacturers is a significant player in the market. That manufacturer accounts for 34 percent of product listings. DOE believes that the remaining oil-fired storage water heater manufacturers account for less than 5 percent of the market.

DOE has reviewed this rule under the provisions of the Regulatory Flexibility Act and the policies and procedures published on February 19, 2003. 68 FR 7990. As part of this rulemaking, DOE examined the potential impacts of amended standard levels on manufacturers, as well as the potential implications of the proposed revisions to the commercial warm air furnace test procedures on compliance burdens.

DOE examined the impact of raising the standards to the amended levels by examining the distribution of efficiencies of commercially-available models in the AHRI Directory. For water-source heat pumps and oil-fired storage water heaters, DOE found that all manufacturers in the directory, including the small manufacturers, already offer equipment at and above the amended standards. While these small manufacturers would have to discontinue a fraction of their models in order to comply with the standards adopted in this rulemaking, DOE does not believe that there would be a significant burden placed on industry,

[51] For more information see: *http://www.hoovers.com/*.

as the market would shift to the new baseline levels when compliance with the new standards is required.

For small commercial air-cooled air conditioners and heat pumps, DOE found one small manufacturer of single-package units in the directory with no models that could meet the adopted ASHRAE levels.

To estimate the impacts of the amended standard, DOE researched prior energy conservation standard analyses of the covered equipment, as well as any analyses of comparable single-phase products. The 2011 direct final rule for residential furnaces, central air conditioners, and heat pumps included analysis for a 14 SEER efficiency level for split-system as well as single-package air conditioners and heat pumps. 76 FR 37408 (June 27, 2011). The 2011 analysis indicated that manufacturers would need to include additional heat exchanger surface area and to include modulating components to reach the 14 SEER level from a 13 SEER baseline. The 2011 analyses further concluded that these improvements could be made without significant investments in equipment and production assets. The amended levels for oil-fired storage water heaters or water-source heat pumps have not been analyzed as a part of any prior energy conservation standard rulemakings.

However, DOE understands that the ASHRAE standards were developed through an industry consensus process, which included consideration of manufacturer input, including the impacts to small manufacturers, when increasing the efficiency of equipment. Because EPCA requires DOE to adopt the ASHRAE levels or to propose higher standards, DOE is limited in terms of the steps it can take to mitigate impacts to small businesses, but DOE reasons that such mitigation has already occurred since small manufacturers had input into the development of the industry consensus standard that DOE is statutorily required to adopt.

As for the specific changes being adopted for the commercial warm air furnace test procedure, the test procedures (ANSI Z21.47–2012 and ASHRAE 103–2007) that DOE is incorporating by reference do not include any updates to the methodology in those sections utilized in the DOE test procedure. Thus, DOE has concluded that this test procedure rulemaking would keep the DOE test procedure current with the latest version of the applicable industry testing standards, but it will not change the methodology used to generate ratings of commercial warm air furnaces. Consequently, the test procedure amendments would not be expected to have a substantive impact on manufacturers, either large or small.

For the reasons stated previously, DOE did not prepare an initial regulatory flexibility analysis for the final rule. DOE will transmit its certification and a supporting statement of factual basis to the Chief Counsel for Advocacy of the SBA for review pursuant to 5 U.S.C. 605(b).

C. Review Under the Paperwork Reduction Act of 1995

Manufacturers of the ASHRAE equipment subject to this final rule 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 applicable DOE test procedures for the relevant ASHRAE equipment, including any amendments adopted for those test procedures. DOE has established regulations for the certification and recordkeeping requirements for all covered consumer products and commercial equipment, including the ASHRAE equipment in this final rule. 76 FR 12422 (March 7, 2011); 80 FR 5099 (Jan. 30, 2015). 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.

D. Review Under the National Environmental Policy Act of 1969

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

E. Review Under Executive Order 13132

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

F. Review Under Executive Order 12988

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

G. Review Under the Unfunded Mandates Reform Act of 1995

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

DOE has concluded that this final rule contains neither an intergovernmental mandate nor a mandate that may result in the expenditure by State, local, and Tribal governments, in the aggregate, or by the private sector, of $100 million or more in any year. Accordingly, no assessment or analysis is required under the UMRA.

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

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

I. Review Under Executive Order 12630

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

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

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.

K. Review Under Executive Order 13211

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

DOE has concluded that this regulatory action, which sets forth amended energy conservation standards for certain types of ASHRAE equipment, is not a significant energy action because the standards are not a significant regulatory action under Executive Order 12866 and are not likely to have a significant adverse effect on the supply, distribution, or use of energy, nor has it been designated as such by the Administrator at OIRA. Accordingly, DOE has not prepared a Statement of Energy Effects on the final rule.

L. Review Under the Information Quality Bulletin for Peer Review

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

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

M. Congressional Notification

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

N. Description of Materials Incorporated by Reference

In this final rule, DOE updates its incorporations by reference to two industry standards related to the test procedure for commercial warm-air furnaces in 10 CFR 431.76. These standards include ANSI Z21.47–2012, ''*Standards for Gas-Fired Central Furnaces,''* and ASHRAE Standard 103–2007, ''Method of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers.'' sections 7.2.2.4, 7.8, 9.2, and 11.3.7. These are the most up-to-date industry-accepted standards used by manufacturers when testing furnaces in the United States. DOE previously referenced earlier versions of these same industry standards.

X. 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, Incorporation by reference, Reporting and recordkeeping requirements.

Issued in Washington, DC, on June 30, 2015.

David T. Danielson,

Assistant Secretary of Energy, 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 431.75 is amended by revising paragraphs (b) and (c) to read as follows:

§ 431.75 Materials incorporated by reference.

* * * * *

(b) *ANSI.* American National Standards Institute. 25 W. 43rd Street, 4th Floor, New York, NY 10036. (212) 642–4900 or go to *http://www.ansi.org.*

(1) ANSI Z21.47–2012, (''ANSI Z21.47'') ''*Standard for Gas-fired Central Furnaces,''* approved March 27, 2012, IBR approved for § 431.76.

(2) [Reserved]

(c) *ASHRAE.* American Society of Heating, Refrigerating and Air-Conditioning Engineers Inc., 1791 Tullie Circle NE., Atlanta, Georgia 30329, (404) 636–8400, or go to: *http://www.ashrae.org.*

(1) ANSI/ASHRAE Standard 103–2007, (''ASHRAE 103''), ''Method of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers,'' sections 7.2.2.4, 7.8, 9.2, and 11.3.7, approved June 27, 2007, IBR approved for § 431.76.

(2) [Reserved]

* * * * *

■ 3. Section 431.76 is revised to read as follows:

§ 431.76 Uniform test method for the measurement of energy efficiency of commercial warm air furnaces.

(a) *Scope.* This section covers the test requirements used to measure the energy efficiency of commercial warm air furnaces with a rated maximum input of 225,000 Btu per hour or more. On and after July 11, 2016, any representations made with respect to the energy use or efficiency of commercial warm air furnaces must be made in accordance with the results of testing pursuant to this section. At that time, you must use the relevant procedures in ANSI Z21.47 or UL 727–2006 (incorporated by reference, see § 431.75). On and after August 17, 2015 and prior to July 11, 2016, manufacturers must test commercial warm air furnaces in accordance with this amended section or the section as it appeared at 10 CFR part 430, subpart B in the 10 CFR parts 200 to 499 edition revised January 1, 2014. DOE notes that, because testing under this section is required as of July 11, 2016, manufacturers may wish to begin using this amended test procedure immediately. Any representations made with respect to the energy use or efficiency of such commercial warm air furnaces must be made in accordance with whichever version is selected.

(b) *Testing.* Where this section prescribes use of ANSI Z21.47 or UL 727–2006 (incorporated by reference, see § 431.75), perform only the procedures pertinent to the measurement of the steady-state efficiency, as specified in paragraph (c) of this section.

(c) *Test set-up.* (1) *Test set-up for gas-fired commercial warm air furnaces.* The test set-up, including flue requirement, instrumentation, test conditions, and measurements for determining thermal efficiency is as specified in sections 1.1 (Scope), 2.1 (General), 2.2 (Basic Test Arrangements), 2.3 (Test Ducts and Plenums), 2.4 (Test Gases), 2.5 (Test Pressures and Burner Adjustments), 2.6 (Static Pressure and Air Flow Adjustments), 2.39 (Thermal Efficiency), and 4.2.1 (Basic Test Arrangements for Direct Vent Central Furnaces) of ANSI Z21.47 (incorporated by reference, see § 431.75). The thermal efficiency test must be conducted only at the normal inlet test pressure, as specified in section 2.5.1 of ANSI Z21.47, and at the maximum hourly Btu input rating specified by the manufacturer for the product being tested.

(2) *Test setup for oil-fired commercial warm air furnaces.* The test setup, including flue requirement, instrumentation, test conditions, and measurement for measuring thermal efficiency is as specified in sections 1 (Scope), 2 (Units of Measurement), 3 (Glossary), 37 (General), 38 and 39 (Test Installation), 40 (Instrumentation, except 40.4 and 40.6.2 through 40.6.7, which are not required for the thermal efficiency test), 41 (Initial Test Conditions), 42 (Combustion Test—Burner and Furnace), 43.2 (Operation Tests), 44 (Limit Control Cutout Test), 45 (Continuity of Operation Test), and 46 (Air Flow, Downflow or Horizontal Furnace Test), of UL 727–2006 (incorporated by reference, see § 431.75). You must conduct a fuel oil analysis for heating value, hydrogen content, carbon content, pounds per gallon, and American Petroleum Institute (API) gravity as specified in section 8.2.2 of HI BTS–2000 (incorporated by reference, see § 431.75). The steady-state combustion conditions, specified in Section 42.1 of UL 727–2006, are attained when variations of not more than 5 °F in the

measured flue gas temperature occur for three consecutive readings taken 15 minutes apart.

(d) *Additional test measurements*—(1) *Measurement of flue CO_2 (carbon dioxide) for oil-fired commercial warm air furnaces.* In addition to the flue temperature measurement specified in section 40.6.8 of UL 727–2006 (incorporated by reference, see § 431.75), you must locate one or two sampling tubes within six inches downstream from the flue temperature probe (as indicated on Figure 40.3 of UL 727–2006). If you use an open end tube, it must project into the flue one-third of the chimney connector diameter. If you use other methods of sampling CO_2, you must place the sampling tube so as to obtain an average sample. There must be no air leak between the temperature probe and the sampling tube location. You must collect the flue gas sample at the same time the flue gas temperature is recorded. The CO_2 concentration of the flue gas must be as specified by the manufacturer for the product being tested, with a tolerance of ±0.1 percent. You must determine the flue CO_2 using an instrument with a reading error no greater than ±0.1 percent.

(2) *Procedure for the measurement of condensate for a gas-fired condensing commercial warm air furnace.* The test procedure for the measurement of the condensate from the flue gas under steady-state operation must be conducted as specified in sections 7.2.2.4, 7.8, and 9.2 of ASHRAE 103 (incorporated by reference, see § 431.75) under the maximum rated input conditions. You must conduct this condensate measurement for an additional 30 minutes of steady-state operation after completion of the steady-state thermal efficiency test specified in paragraph (c) of this section.

(e) *Calculation of thermal efficiency*—(1) *Gas-fired commercial warm air furnaces.* You must use the calculation procedure specified in section 2.39, Thermal Efficiency, of ANSI Z21.47 (incorporated by reference, see § 431.75).

(2) *Oil-fired commercial warm air furnaces.* You must calculate the percent flue loss (in percent of heat input rate) by following the procedure specified in sections 11.1.4, 11.1.5, and 11.1.6.2 of the HI BTS–2000 (incorporated by reference, see § 431.75). The thermal efficiency must be calculated as: Thermal Efficiency (percent) = 100 percent − flue loss (in percent).

(f) *Procedure for the calculation of the additional heat gain and heat loss, and adjustment to the thermal efficiency, for a condensing commercial warm air furnace.* (1) You must calculate the latent heat gain from the condensation of the water vapor in the flue gas, and calculate heat loss due to the flue condensate down the drain, as specified in sections 11.3.7.1 and 11.3.7.2 of ASHRAE 103 (incorporated by reference, see § 431.75), with the exception that in the equation for the heat loss due to hot condensate flowing down the drain in section 11.3.7.2, the assumed indoor temperature of 70 °F and the temperature term T_{OA} must be replaced by the measured room temperature as specified in section 2.2.8 of ANSI Z21.47 (incorporated by reference, see § 431.75).

(2) *Adjustment to the thermal efficiency for condensing furnaces.* You must adjust the thermal efficiency as calculated in paragraph (e)(1) of this section by adding the latent gain, expressed in percent, from the condensation of the water vapor in the flue gas, and subtracting the heat loss (due to the flue condensate down the drain), also expressed in percent, both as calculated in paragraph (f)(1) of this section, to obtain the thermal efficiency of a condensing furnace.

■ 4. Section 431.92 is amended by adding in alphabetical order the definition of ''water-source heat pump'' to read as follows:

§ 431.92 Definitions concerning commercial air conditioners and heat pumps.

* * * * *

Water-source heat pump means a single-phase or three-phase reverse-cycle heat pump that uses a circulating water loop as the heat source for heating and as the heat sink for cooling. The main components are a compressor, refrigerant-to-water heat exchanger, refrigerant-to-air heat exchanger, refrigerant expansion devices, refrigerant reversing valve, and indoor fan. Such equipment includes, but is not limited to, water-to-air water-loop heat pumps.

■ 5. Section 431.97 is amended by:

■ a. Revising paragraph (b);

■ b. Redesignating Tables 4 through 8 in paragraphs (c), (d), (e) and (f), as Tables 5 through 9 respectively; and

■ c. Revising the introductory text of paragraph (c).

The revisions read as follows:

§ 431.97 Energy efficiency standards and their compliance dates.

* * * * *

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

TABLE 1 TO § 431.97—MINIMUM COOLING EFFICIENCY STANDARDS FOR AIR-CONDITIONING AND HEATING EQUIPMENT (NOT INCLUDING SINGLE PACKAGE VERTICAL AIR CONDITIONERS AND SINGLE PACKAGE VERTICAL HEAT PUMPS, PACKAGED TERMINAL AIR CONDITIONERS AND PACKAGED TERMINAL HEAT PUMPS, COMPUTER ROOM AIR CONDITIONERS, AND VARIABLE REFRIGERANT FLOW MULTI-SPLIT AIR CONDITIONERS AND HEAT PUMPS)

Equipment category	Cooling capacity	Sub-category	Heating type	Efficiency level	Compliance date: equipment manufactured on and after. . .
Small Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled, 3-Phase, Split-System).	<65,000 Btu/h	AC	All	SEER = 13	June 16, 2008.
		HP	All	SEER = 13	June 16, 2008 [1].
Small Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled, 3-Phase, Single-Package).	<65,000 Btu/h	AC	All	SEER = 13	June 16, 2008 [1].

TABLE 1 TO § 431.97—MINIMUM COOLING EFFICIENCY STANDARDS FOR AIR-CONDITIONING AND HEATING EQUIPMENT (NOT INCLUDING SINGLE PACKAGE VERTICAL AIR CONDITIONERS AND SINGLE PACKAGE VERTICAL HEAT PUMPS, PACKAGED TERMINAL AIR CONDITIONERS AND PACKAGED TERMINAL HEAT PUMPS, COMPUTER ROOM AIR CONDITIONERS, AND VARIABLE REFRIGERANT FLOW MULTI-SPLIT AIR CONDITIONERS AND HEAT PUMPS)—Continued

Equipment category	Cooling capacity	Sub-category	Heating type	Efficiency level	Compliance date: equipment manufactured on and after. . .
		HP	All	SEER = 13	June 16, 2008 [1].
Small Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled).	≥65,000 Btu/h and <135,000 Btu/h.	AC	No Heating or Electric Resistance Heating.	EER = 11.2	January 1, 2010.
			All Other Types of Heating	EER = 11.0	January 1, 2010.
		HP	No Heating or Electric Resistance Heating.	EER = 11.0	January 1, 2010.
			All Other Types of Heating	EER = 10.8	January 1, 2010.
Large Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled).	≥135,000 Btu/h and <240,000 Btu/h.	AC	No Heating or Electric Resistance Heating.	EER = 11.0	January 1, 2010.
			All Other Types of Heating	EER = 10.8	January 1, 2010.
		HP	No Heating or Electric Resistance Heating.	EER = 10.6	January 1, 2010.
			All Other Types of Heating	EER = 10.4	January 1, 2010.
Very Large Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled).	≥240,000 Btu/h and <760,000 Btu/h.	AC	No Heating or Electric Resistance Heating.	EER = 10.0	January 1, 2010.
			All Other Types of Heating	EER = 9.8	January 1, 2010.
		HP	No Heating or Electric Resistance Heating.	EER = 9.5	January 1, 2010.
			All Other Types of Heating	EER = 9.3	January 1, 2010.
Small Commercial Package Air-Conditioning and Heating Equipment (Water-Cooled).	<65,000 Btu/h	AC	All	EER = 12.1	October 29, 2003.
	≥65,000 Btu/h and <135,000 Btu/h.	AC	No Heating or Electric Resistance Heating.	EER = 12.1	June 1, 2013.
			All Other Types of Heating	EER = 11.9	June 1, 2013.
Large Commercial Package Air-Conditioning and Heating Equipment (Water-Cooled).	≥135,000 and <240,000 Btu/h.	AC	No Heating or Electric Resistance Heating.	EER = 12.5	June 1, 2014.
			All Other Types of Heating	EER = 12.3	June 1, 2014.
Very Large Commercial Package Air-Conditioning and Heating Equipment (Water-Cooled).	≥240,000 and <760,000 Btu/h.	AC	No Heating or Electric Resistance Heating.	EER = 12.4	June 1, 2014.
			All Other Types of Heating	EER = 12.2	June 1, 2014.
Small Commercial Package Air-Conditioning and Heating Equipment (Evaporatively-Cooled).	<65,000 Btu/h	AC	All	EER = 12.1	October 29, 2003.
	≥65,000 and <135,000 Btu/h.	AC	No Heating or Electric Resistance Heating.	EER = 12.1	June 1, 2013.
			All Other Types of Heating	EER = 11.9	June 1, 2013.
Large Commercial Package Air-Conditioning and Heating Equipment (Evaporatively-Cooled).	≥135,000 and <240,000 Btu/h.	AC	No Heating or Electric Resistance Heating.	EER = 12.0	June 1, 2014.
			All Other Types of Heating	EER = 11.8	June 1, 2014.
Very Large Commercial Package Air-Conditioning and Heating Equipment (Evaporatively-Cooled).	≥240,000 and <760,000 Btu/h.	AC	No Heating or Electric Resistance Heating.	EER = 11.9	June 1, 2014.
			All Other Types of Heating	EER = 11.7	June 1, 2014.
Small Commercial Packaged Air-Conditioning and Heating Equipment (Water-Source: Water-to-Air, Water-Loop).	<17,000 Btu/h	HP	All	EER = 11.2	October 29, 2003 [2].
	≥17,000 Btu/h and <65,000 Btu/h.	HP	All	EER = 12.0	October 29, 2003 [2].

TABLE 1 TO § 431.97—MINIMUM COOLING EFFICIENCY STANDARDS FOR AIR-CONDITIONING AND HEATING EQUIPMENT (NOT INCLUDING SINGLE PACKAGE VERTICAL AIR CONDITIONERS AND SINGLE PACKAGE VERTICAL HEAT PUMPS, PACKAGED TERMINAL AIR CONDITIONERS AND PACKAGED TERMINAL HEAT PUMPS, COMPUTER ROOM AIR CONDITIONERS, AND VARIABLE REFRIGERANT FLOW MULTI-SPLIT AIR CONDITIONERS AND HEAT PUMPS)—Continued

Equipment category	Cooling capacity	Sub-category	Heating type	Efficiency level	Compliance date: equipment manufactured on and after. . .
	≥65,000 Btu/h and <135,000 Btu/h.	HP	All	EER = 12.0	October 29, 2003[2].

[1] And manufactured before January 1, 2017. See Table 3 of this section for updated efficiency standards.
[2] And manufactured before October 9, 2015. See Table 3 of this section for updated efficiency standards.

TABLE 2 TO § 431.97—MINIMUM HEATING EFFICIENCY STANDARDS FOR AIR-CONDITIONING AND HEATING EQUIPMENT (HEAT PUMPS)

Equipment category	Cooling capacity	Efficiency level	Compliance date: equipment manufactured on and after. . .
Small Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled, 3-Phase, Split-System).	<65,000 Btu/h	HSPF = 7.7	June 16, 2008.[1]
Small Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled, 3-Phase, Single-Package).	<65,000 Btu/h	HSPF = 7.7	June 16, 2008.[1]
Small Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled).	≥65,000 Btu/h and <135,000 Btu/h.	COP = 3.3	January 1, 2010.
Large Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled).	≥135,000 Btu/h and <240,000 Btu/h.	COP = 3.2	January 1, 2010.
Very Large Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled).	≥240,000 Btu/h and <760,000 Btu/h.	COP = 3.2	January 1, 2010.
Small Commercial Packaged Air-Conditioning and Heating Equipment (Water-Source: Water-to-Air, Water-Loop).	<135,000 Btu/h	COP = 4.2	October 29, 2003.[2]

[1] And manufactured before January 1, 2017. See Table 3 of this section for updated efficiency standards.
[2] And manufactured before October 9, 2015. See Table 3 of this section for updated efficiency standards.

TABLE 3 TO § 431.97—UPDATES TO THE MINIMUM COOLING EFFICIENCY STANDARDS FOR CERTAIN AIR-CONDITIONING AND HEATING EQUIPMENT

Equipment category	Cooling capacity	Sub-category	Heating type	Efficiency level	Compliance date: equipment manufactured on and after
Small Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled, 3-Phase, Split-System).	<65,000 Btu/h	AC	All	SEER = 13.0	June 16, 2008.
		HP	All	SEER = 14.0	January 1, 2017.
Small Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled, 3-Phase, Single-Package).	<65,000 Btu/h	AC	All	SEER = 14.0	January 1, 2017.
		HP	All	SEER = 14.0	January 1, 2017.
Small Commercial Packaged Air-Conditioning and Heating Equipment (Water-Source: Water-to-Air, Water-Loop).	<17,000 Btu/h	HP	All	EER = 12.2	October 9, 2015.
	≥17,000 Btu/h and <65,000 Btu/h.	HP	All	EER = 13.0	October 9, 2015.
	≥65,000 Btu/h and <135,000 Btu/h.	HP	All	EER = 13.0	October 9, 2015.

TABLE 4 TO § 431.97—UPDATES TO THE MINIMUM HEATING EFFICIENCY STANDARDS FOR CERTAIN AIR-CONDITIONING AND HEATING EQUIPMENT (HEAT PUMPS)

Equipment category	Cooling capacity	Efficiency level	Compliance date: equipment manufactured on and after . . .
Small Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled, 3-Phase, Split-System).	<65,000 Btu/h	HSPF = 8.2	January 1, 2017.
Small Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled, 3-Phase, Single-Package).	<65,000 Btu/h	HSPF = 8.0	January 1, 2017.
Small Commercial Packaged Air-Conditioning and Heating Equipment (Water-Source: Water-to-Air, Water-Loop).	<135,000 Btu/h	COP = 4.3	October 9, 2015.

(c) Each packaged terminal air conditioner (PTAC) and packaged terminal heat pump (PTHP) manufactured on or after January 1, 1994, and before October 8, 2012 (for standard size PTACs and PTHPs) and before October 7, 2010 (for non-standard size PTACs and PTHPs) must meet the applicable minimum energy efficiency standard level(s) set forth in Table 5 of this section. Each PTAC and PTHP manufactured on or after October 8, 2012 (for standard size PTACs and PTHPs) and on or after October 7, 2010 (for non-standard size PTACs and PTHPs) must meet the applicable minimum energy efficiency standard level(s) set forth in Table 6 of this section.

* * * * *

■ 6. Section 431.110 is amended by revising the table to read as follows:

§ 431.110 Energy conservation standards and their effective dates.

* * * * *

Equipment category	Size	Energy conservation standard [a]		
		Maximum standby loss [c] (equipment manufactured on and after October 29, 2003) [b]	Minimum thermal efficiency (equipment manufactured on and after October 29, 2003 and before October 9, 2015) [b]	Minimum thermal efficiency (equipment manufactured on and after October 9, 2015) [b]
Electric storage water heaters	All	$0.30 + 27/V_m$ (%/hr)	N/A	N/A
Gas-fired storage water heaters	≤155,000 Btu/hr	$Q/800 + 110(V_r)^{1/2}$ (Btu/hr)	80%	80%
	>155,000 Btu/hr	$Q/800 + 110(V_r)^{1/2}$ (Btu/hr)	80%	80%
Oil-fired storage water heaters	≤155,000 Btu/hr	$Q/800 + 110(V_r)^{1/2}$ (Btu/hr)	78%	80%
	>155,000 Btu/hr	$Q/800 + 110(V_r)^{1/2}$ (Btu/hr)	78%	80%
Gas-fired instantaneous water heaters and hot water supply boilers.	<10 gal	N/A	80%	80%
	≥10 gal	$Q/800 + 110(V_r)^{1/2}$ (Btu/hr)	80%	80%
Oil-fired instantaneous water heaters and hot water supply boilers.	<10 gal	N/A	80%	80%
	≥10 gal	$Q/800 + 110(V_r)^{1/2}$ (Btu/hr)	78%	78%

Equipment Category	Size	Minimum thermal insulation
Unfired hot water storage tank	All	R–12.5

[a] V_m is the measured storage volume, and V_r is the rated volume, both in gallons. Q is the nameplate input rate in Btu/hr.
[b] For hot water supply boilers with a capacity of less than 10 gallons: (1) The standards are mandatory for products manufactured on and after October 21, 2005, and (2) products manufactured prior to that date, and on or after October 23, 2003, must meet either the standards listed in this table or the applicable standards in subpart E of this part for a "commercial packaged boiler."
[c] Water heaters and hot water supply boilers having more than 140 gallons of storage capacity need not meet the standby loss requirement if: (1) The tank surface area is thermally insulated to R–12.5 or more; (2) a standing pilot light is not used; and (3) for gas or oil-fired storage water heaters, they have a fire damper or fan assisted combustion.

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

March 24, 2015

Anne Harkavy

Deputy General Counsel for Litigation, Regulation and Enforcement

U.S. Department of Energy Washington, DC

Dear Deputy General Counsel Harkavy: I am responding to your January 2, 2015 letter seeking the views of the Attorney General about the potential impact on competition of proposed energy conservation standards for certain types of commercial heating, air-conditioning, and water-heating equipment. Your request was submitted under Section 325(o)(2)(B)(i)(V) of the Energy Policy and Conservation Act, as amended 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 certain 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 manufacturers and consumers, and perhaps thwart the intent of the revised standards by inducing substitution to less efficient products.

We have reviewed the proposed standards contained in the Notice of Proposed Rulemaking (80 FR January 8, 2015) (NOPR). We have also reviewed supplementary information submitted to the Attorney General by the Department of Energy, including a transcript of the public meeting held on the proposed standards on February 6, 2015 Based on this review, our conclusion is that the proposed energy conservation standards for commercial heating, air-conditioning, and water-heating equipment are unlikely to have a significant adverse impact on competition.

Sincerely,

William J. Baer

[FR Doc. 2015–16927 Filed 7–16–15; 8:45 am]

BILLING CODE 6450–01–P