DEPARTMENT OF ENERGY

10 CFR Part 431

[EERE–2017–BT–STD–0017]

RIN 1904–AD92

Energy Conservation Standards for Computer Room Air Conditioners and Dedicated Outdoor Air Systems

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

ACTION: Notice of data availability and request for information.

SUMMARY: The U.S. Department of Energy (DOE) is publishing an analysis of the energy savings potential of amended industry consensus standards for certain classes of computer room air conditioners (CRACs) and new industry standards for dedicated outdoor air systems (DOASes), which are types of commercial and industrial equipment. The Energy Policy and Conservation Act of 1975, as amended (EPCA), requires DOE to evaluate and assess whether there is a need to update its energy conservation standards following changes to the relevant industry consensus standards in the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 90.1 (ASHRAE Standard 90.1). Additionally under EPCA, DOE must review the existing standards for this equipment at least once every six years and publish either a notice of proposed rulemaking (NOPR) to propose new standards or a notice of determination that the existing standards do not need to be amended. Accordingly, DOE is also initiating an effort to determine whether to amend the current energy conservation standards for classes of CRACs for which DOE has tentatively determined that the updated ASHRAE Standard 90.1 levels are not more stringent than the current Federal standards. This document solicits information from the public to help DOE determine whether amended standards for CRACs and new standards for DOASes would result in significant energy savings and whether such standards would be technologically feasible and economically justified. DOE welcomes written comments from the public on any subject within the scope of this document (including topics not raised in this document), as well as the submission of data and other relevant information.

DATES: Written comments and information are requested and will be accepted on or before October 28, 2019.

ADDRESSES: Interested persons are encouraged to submit comments using the Federal eRulemaking Portal at *http://www.regulations.gov.* Follow the instructions for submitting comments. Alternatively, interested persons may submit comments, identified by docket number EERE–2017–BT–STD–0017 by any of the following methods:

1. *Federal eRulemaking Portal: http://www.regulations.gov.* Follow the instructions for submitting comments.
2. *Email: CommACHeatingEquipCat2017STD0017@ee.doe.gov.* Include the docket number EERE–2017–BT–STD–0017 in the subject line of the message.
3. *Postal Mail:* Appliance and Equipment Standards Program, U.S. Department of Energy, Building Technologies Office, Mailstop EE–5B, Energy Conservation Standards NODA and RFI for Certain Categories of Commercial Air-Conditioning and Heating Equipment, 1000 Independence Avenue SW, Washington, DC 20585–0121. If possible, please submit all items on a compact disc (''CD''), in which case it is not necessary to include printed copies.
4. *Hand Delivery/Courier:* Appliance and Equipment Standards Program, U.S. Department of Energy, Building Technologies Office, 950 L'Enfant Plaza SW, 6th Floor, Washington, DC 20024. Telephone: (202) 287–1445. If possible, please submit all items on a CD, in which case it is not necessary to include printed copies.

No telefacsimilies (faxes) will be accepted. For detailed instructions on submitting comments and additional information on the rulemaking process, see section V of this document (Public Participation).

Docket: The docket for this activity, which includes **Federal Register** notices, comments, and other supporting documents/materials, is available for review at *http://www.regulations.gov* (search EERE–2017–BT–STD–0017). All documents in the docket are listed in the *http://www.regulations.gov* index. However, some documents listed in the index, such as those containing information that is exempt from public disclosure, may not be publicly available.

The docket web page can be found at: *https://www.regulations.gov/docket?D=EERE-2017-BT-STD-0017.* The docket web page contains instructions on how to access all documents, including public comments, in the docket. See section V of this document, Public Participation, for information on how to submit comments through *http://www.regulations.gov.*

FOR FURTHER INFORMATION CONTACT: Ms. Catherine Rivest, 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) 586–7335. Email: *ApplianceStandardsQuestions@ee.doe.gov.*

Mr. Eric Stas, U.S. Department of Energy, Office of the General Counsel, GC–33, 1000 Independence Avenue SW, Washington, DC 20585. Telephone: (202) 586–5827. Email: *Eric.Stas@hq.doe.gov.*

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

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I. Introduction

A. Authority

The Energy Policy and Conservation Act of 1975, as amended (''EPCA''; 42 U.S.C. 6291 *et seq.*),[1] established the Energy Conservation Program for Consumer Products Other Than Automobiles. Title III, Part C[2] of EPCA, Public Law 94–163 (42 U.S.C. 6311–6317, as codified), added by Public Law 95–619, Title IV, § 441(a), established the Energy Conservation Program for Certain Industrial Equipment. This covered equipment includes small, large, and very large commercial package air conditioning and heating equipment, which includes CRACs and DOASes, the subjects of this document. (42 U.S.C. 6311(1)(B)–(D))

Pursuant to EPCA, DOE's energy conservation program consists essentially of four parts: (1) Testing, (2) labeling, (3) Federal energy conservation standards, and (4) certification and enforcement procedures. Relevant provisions of the EPCA specifically include definitions (42 U.S.C. 6311), energy conservation standards (42 U.S.C. 6313), test procedures (42 U.S.C. 6314), labeling provisions (42 U.S.C. 6315), and the authority to require information and reports from manufacturers (42 U.S.C. 6316).

Federal energy efficiency requirements for covered equipment established under EPCA generally supersede State laws and regulations concerning energy conservation testing, labeling, and standards. (42 U.S.C. 6316(a) and (b); 42 U.S.C. 6297) DOE may, however, grant waivers of Federal preemption for particular State laws or regulations, in accordance with the procedures and other provisions set forth under 42 U.S.C. 6316(b)(2)(D).

In EPCA, Congress initially set mandatory energy conservation standards for certain types of 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) and 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 at levels that generally corresponded to the levels in ASHRAE Standard 90.1, *Energy Standard for Buildings Except Low-Rise Residential Buildings,* 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).

In acknowledgement of technological changes that yield energy efficiency benefits, Congress further directed DOE through EPCA to consider amending the existing Federal energy conservation standard for each type of equipment listed, each time ASHRAE amends Standard 90.1 with respect to such equipment. (42 U.S.C. 6313(a)(6)(A)) When triggered in this manner, DOE must undertake and publish an analysis of the energy savings potential of amended energy efficiency standards, and amend the Federal standards to establish a uniform national standard at the minimum level specified in the amended ASHRAE Standard 90.1, unless DOE determines that there is clear and convincing evidence to support a determination that a more-stringent standard 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 minimum 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, supported by clear and convincing evidence, that a more-stringent uniform national standard would result in significant additional conservation of energy and is technologically feasible and economically justified, then DOE must establish such more-stringent uniform national standard not later than 30 months after publication of the amended ASHRAE Standard 90.1.[3] (42 U.S.C. 6313(a)(6)(A)(ii)(II) and (B))

Although EPCA does not explicitly define the term ''amended'' in the context of what type of revision to ASHRAE Standard 90.1 would trigger DOE's obligation, DOE's longstanding interpretation has been that the statutory trigger is an amendment to the standard applicable to that equipment under ASHRAE Standard 90.1 that increases the energy efficiency level for that equipment. *See* 72 FR 10038, 10042 (March 7, 2007). In other words, if the revised ASHRAE Standard 90.1 leaves the energy efficiency level unchanged (or lowers the energy efficiency level), as compared to the energy efficiency level specified by the uniform national standard adopted pursuant to EPCA, regardless of the other amendments made to the ASHRAE Standard 90.1 requirement (*e.g.,* the inclusion of an additional metric), DOE has stated that it 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). *See* 74 FR 36312, 36313 (July 22, 2009) and 77 FR 28928, 28937 (May 16, 2012). However, DOE notes that Congress adopted amendments to these provisions related to ASHRAE Standard 90.1 equipment under the American Energy Manufacturing Technical Corrections Act (Pub. L. 112–210 (Dec. 18, 2012); ''AEMTCA''). In relevant part, DOE is prompted to act whenever ASHRAE Standard 90.1 is amended with respect to ''the standard levels or design requirements applicable under that standard'' to any of the enumerated types of commercial air conditioning, heating, or water heating equipment. (42 U.S.C. 6313(a)(6)(A)(i)).

EPCA does not detail the exact type of amendment that serves as a triggering event. However, DOE has considered whether its obligation is triggered in the context of whether the specific ASHRAE Standard 90.1 requirement on which the most current Federal requirement is

[1] All references to EPCA in this document refer to the statute as amended through America's Water Infrastructure Act of 2018, Public Law 115–270 (Oct. 23, 2018).

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

[3] In determining whether a more-stringent standard is economically justified, EPCA directs DOE to determine, after receiving views and comments from the public, whether the benefits of the proposed standard exceed the burdens of the proposed standard by, to the maximum extent practicable, considering the following:

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

(2) The savings in operating costs throughout the estimated average life of the product compared to any increases in the initial cost or maintenance expense;

(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)).

based is amended (*i.e.,* the regulatory metric). For example, if an amendment to ASHRAE Standard 90.1 changed the metric for the standard on which the Federal requirement was based, DOE would perform a crosswalk analysis to determine whether the amended metric under ASHRAE Standard 90.1 resulted in an energy efficiency level that was more stringent than the current DOE standard. Conversely, if an amendment to ASHRAE Standard 90.1 were to add an additional metric by which a class of equipment is to be evaluated, but did not amend the requirement that is in terms of the metric on which the Federal requirement was based, DOE would not consider its obligation triggered.[4]

In addition, DOE has explained that its authority to adopt an ASHRAE amendment is limited based on the definition of ''energy conservation standard.'' 74 FR 36312, 36322 (July 22, 2009). In general, an ''energy conservation standard'' is limited, per the statutory definition, to either a performance standard *or* a design requirement. (42 U.S.C. 6311(18)) Informed by the ''energy conservation standard'' definition, DOE has stated that adoption of an amendment to ASHRAE Standard 90.1 ''that establishes both a performance standard and a design requirement is beyond the scope of DOE's legal authority, as would be a standard that included more than one design requirement.'' 74 FR 36312, 36322 (July 22, 2009).

As noted, the ASHRAE Standard 90.1 provision in EPCA acknowledges technological changes that yield energy efficiency benefits, as well as continuing development of industry standards and test methods. Amendments to a uniform national standard provide Federal requirements that continue to reflect energy efficiency improvements identified by industry. Amendments to a uniform national standard that reflect the relevant amended versions of ASHRAE Standard 90.1 would also help reduce compliance and test burdens on manufacturers by harmonizing the Federal requirements, when appropriate, with industry best practices. This harmonization would be further facilitated by establishing not only consistent energy efficiency levels and design requirements between ASHRAE Standard 90.1 and the Federal requirements, but comparable metrics as well.

As stated previously, DOE has limited its review under the ASHRAE Standard 90.1 provisions in EPCA to the equipment classes that are subject to the ASHRAE Standard 90.1 amendment. DOE has stated that if ASHRAE has not amended a standard for an equipment class subject to 42 U.S.C. 6313, there is no change that would require action by DOE to consider amending the uniform national standard to maintain consistency with ASHRAE Standard 90.1. See, 72 FR 10038, 10042 (March 7, 2007); 77 FR 36312, 36320–36321 (July 22, 2009); 80 FR 42614, 42617 (July 17, 2015).

In those situations where ASHRAE has not acted to amend the levels in Standard 90.1 for the equipment types enumerated in the statute, EPCA also provides for a 6-year-lookback to consider the potential for amending the uniform national standards. (42 U.S.C. 6313(a)(6)(C)) Specifically, pursuant to the amendments to EPCA under AEMTCA, DOE is required to conduct an evaluation of each class of covered equipment in ASHRAE Standard 90.1 ''every 6 years'' to determine whether the applicable energy conservation standards need to be amended. (42 U.S.C. 6313(a)(6)(C)(i)) DOE must publish either a notice of proposed rulemaking (NOPR) to propose amended standards or a notice of determination that existing standards do not need to be amended. (42 U.S.C. 6313(a)(6)(C)) In proposing new standards under the 6-year review, DOE must undertake the same considerations as if it were adopting a standard that is more stringent than an amendment to ASHRAE Standard 90.1. (42 U.S.C. 6313(a)(6)(C)(i)(II)) This is a separate statutory review obligation, as differentiated from the obligation triggered by an ASHRAE Standard 90.1 amendment. While the statute continues to defer to ASHRAE's lead on covered equipment subject to Standard 90.1, it does allow for a comprehensive review of all such equipment and the potential for adopting more-stringent standards, where supported by the requisite clear and convincing evidence. That is, DOE interprets ASHRAE's not amending Standard 90.1 with respect to a product or equipment type as ASHRAE's determination that the standard applicable to that product or equipment type is already at an appropriate level of stringency, and DOE will not amend that standard unless there is clear and convincing evidence that a more stringent level is justified.

As a preliminary step in the process of reviewing the changes to ASHRAE Standard 90.1, EPCA directs DOE to publish in the **Federal Register** for public comment an analysis of the energy savings potential of amended standards within 180 days after ASHRAE Standard 90.1 is amended with respect to any of the covered equipment specified under 42 U.S.C. 6313(a). (42 U.S.C. 6313(a)(6)(A)).

On October 26, 2016, ASHRAE officially released for distribution and made public ASHRAE Standard 90.1–2016. This action by ASHRAE triggered DOE's obligations under 42 U.S.C. 6313(a)(6), as outlined previously. This notice of data availability (NODA) presents the analysis of the energy savings potential of amended energy efficiency standards, as required under 42 U.S.C. 6313(a)(6)(A)(i). DOE is also taking this opportunity to collect data and information regarding other CRAC equipment classes for which it was not triggered by ASHRAE but for which DOE plans to conduct a concurrent 6-year-lookback review. (42 U.S.C. 6313(a)(6)(C)) Such information will help DOE inform its decisions, consistent with its obligations under EPCA.

CRAC Issue 1: DOE seeks comment on whether, in the context of its consideration of more-stringent standards, there have been sufficient technological or market changes for CRACs since the most recent standards update that may justify a new rulemaking to consider more-stringent standards. Specifically, DOE seeks data and information that could enable the agency to determine whether DOE should propose a ''no new standard'' determination because a more-stringent standard: (1) Would not result in significant additional savings of energy; (2) is not technologically feasible; (3) is not economically justified; or (4) any combination of the foregoing.

B. Purpose of the Notice of Data Availability

As explained previously, DOE is publishing this NODA as a preliminary step pursuant to EPCA's requirements for DOE to consider amended standards for certain categories of commercial equipment covered by ASHRAE Standard 90.1, whenever ASHRAE amends its standard to increase the energy efficiency level for an equipment class within a given equipment category. Specifically, this NODA presents for public comment DOE's analysis of the potential energy savings for amended national energy conservation standards for these categories of commercial equipment

[4] See the May 16, 2012, final rule for small, large, and very large water-cooled and evaporatively-cooled commercial package air conditioners, and variable refrigerant flow (VRF) water-source heat pumps with cooling capacity less than 17,000 Btu/h, in which DOE states that ''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). 77 FR 28928, 28929 (emphasis added). See also, 74 FR 36312, 36313 (July 22, 2009).

based on: (1) The amended efficiency levels contained within ASHRAE Standard 90.1–2016, and (2) more-stringent efficiency levels. DOE describes these analyses and preliminary conclusions and seeks input from interested parties, including the submission of data and other relevant information. DOE is also taking the opportunity to consider the potential for more-stringent standards for the other equipment classes of the subject equipment types (*i.e.,* where DOE was not triggered) under EPCA's 6-year-lookback authority.

DOE carefully examined the changes for equipment in ASHRAE Standard 90.1 in order to thoroughly evaluate the amendments in ASHRAE 90.1–2016, thereby permitting DOE to determine what action, if any, is required under its statutory mandate. DOE also will carefully examine the energy savings potential for other equipment classes where it was not triggered, so as to conduct a thorough review for an entire equipment category. Section II of this NODA contains DOE's evaluation of the amendments in ASHRAE 90.1–2016. For equipment classes preliminarily determined to have increased efficiency levels or changes in design requirements in ASHRAE Standard 90.1–2016, DOE subjected that equipment to further analysis as discussed in section III of this NODA. Section IV requests comment for those equipment classes for which efficiency levels and design requirements have not been increased or changed in ASHRAE 90.1–2016, but are undergoing review under EPCA's 6-year lookback authority.

In summary, the energy savings analysis presented in this NODA is a preliminary step required under 42 U.S.C. 6313(a)(6)(A)(i). DOE is also treating it as an opportunity to gather information regarding its obligations under 42 U.S.C. 6313(a)(6)(C). After review of the public comments on this NODA, if DOE determines that the amended efficiency levels in ASHRAE Standard 90.1–2016 have the potential for additional energy savings for classes of equipment currently covered by uniform national standards, DOE will commence a rulemaking to amend standards based upon the efficiency levels in ASHRAE Standard 90.1–2016 or, where supported by clear and convincing evidence, consider more-stringent efficiency levels that would be expected to result in significant additional conservation of energy and are technologically feasible and economically justified. If DOE determines it appropriate to conduct such a rulemaking under the statute, DOE will address the anti-backsliding provision,[5] and if DOE determines it appropriate to conduct a rulemaking to establish more-stringent efficiency levels, DOE will also address the general rulemaking requirements applicable under 42 U.S.C. 6313(a)(6)(B), such as, the criteria for making a determination of economic justification as to whether the benefits of the proposed standard exceed the burden of the proposed standard,[6] and the prohibition on making unavailable existing products with performance characteristics generally available in the United States.[7]

C. Rulemaking Background

EPCA defines ''commercial package air conditioning and heating equipment'' as air-cooled, water-cooled, evaporatively-cooled, or water source (not including ground water source) electrically operated, unitary central air conditioners and central air conditioning heat pumps for commercial application. (42 U.S.C. 6311(8)(A); 10 CFR 431.92) EPCA further classifies ''commercial package air conditioning and heating equipment'' into categories based on cooling capacity (*i.e.,* small, large, and very large categories). (42 U.S.C. 6311(8)(B)–(D); 10 CFR 431.92) ''Small commercial package air conditioning and heating equipment'' means equipment rated below 135,000 Btu per hour (cooling capacity). (42 U.S.C. 6311(8)(B); 10 CFR 431.92) ''Large commercial package air conditioning and heating equipment'' means equipment rated: (i) At or above 135,000 Btu per hour; and (ii) below 240,000 Btu per hour (cooling capacity). (42 U.S.C. 6311(8)(C); 10 CFR 431.92) ''Very large commercial package air conditioning and heating equipment'' means equipment rated: (i) At or above 240,000 Btu per hour; and (ii) below 760,000 Btu per hour (cooling capacity). (42 U.S.C. 6311(8)(D); 10 CFR 431.92) DOE generally refers to these broad classifications as ''equipment types.''

Pursuant to its authority under EPCA (42 U.S.C. 6313(a)(6)(A)) and in response to updates to ASHRAE Standard 90.1, DOE has established additional categories of equipment that meet the EPCA definition of ''commercial package air conditioning and heating equipment,'' but which EPCA did not expressly identify. These equipment categories include CRACs (*see* 10 CFR 431.92 and 10 CFR 431.97) and DOASes, for which ASHRAE Standard 90.1–2016 established a new category. Within these additional equipment categories, further distinctions are made at the equipment class level based on capacity and other equipment attributes.

DOE's current energy conservation standards for 30 equipment classes of CRACs are codified at 10 CFR 431.97. DOE defines ''computer room air conditioner'' as a commercial package air-conditioning and heating equipment (packaged or split) that is: Used in computer rooms, data processing rooms, or other information technology cooling applications; rated for sensible coefficient of performance (SCOP) and tested in accordance with 10 CFR 431.96, and is not a covered product under 42 U.S.C. 6291(1)–(2) and 6292. A computer room air conditioner may be provided with, or have as available options, an integrated humidifier, temperature, and/or humidity control of the supplied air, and reheating function. 10 CFR 431.92.

DOE's regulations include test procedures and energy conservation standards that apply to the current CRAC equipment classes that are differentiated by condensing system type (air-cooled, water-cooled, water-cooled with fluid economizer, glycol-cooled, or glycol-cooled with fluid economizer), net sensible cooling capacity (less than 65,000 Btu/h, greater than or equal to 65,000 Btu/h and less than 240,000 Btu/h, or greater than or equal to 240,000 Btu/h and less than 760,000 Btu/h), and direction of

[5] The anti-backsliding provision mandates that the Secretary may not prescribe 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)).

[6] In deciding whether a potential standard's benefits outweigh its burdens, DOE must consider to the maximum extent practicable, the following seven factors:

(1) The economic impact on manufacturers and consumers of the product 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 product utility or performance of the product likely to result from the standard;

(5) The impact of any lessening of competition, as determined in writing by the Attorney General, 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)(I)–(VII)).

[7] The Secretary may not prescribe an amended standard if interested persons have established by a preponderance of evidence that the amended standard would likely result in unavailability in the U.S. of any covered product type (or class) of performance characteristics (including reliability, features, capacities, sizes, and volumes) that are substantially the same as those generally available in the U.S. at the time of the Secretary's finding. (42 U.S.C. 6313(a)(6)(B)(iii)(II)).

conditioned air over the cooling coil (upflow or downflow). 10 CFR 431.96 and 10 CFR 431.97, respectively.

DOE's test procedure for CRACs, set forth at 10 CFR 431.96, currently incorporates by reference ANSI/ASHRAE Standard 127–2007 (''ASHRAE 127–2007''), ''Method of Testing for Rating Computer and Data Processing Room Unitary Air Conditioners,'' (omit section 5.11), with additional provisions indicated in 10 CFR 431.96(c) and (e). The energy efficiency metric is sensible coefficient of performance (SCOP) for all CRAC equipment classes. ASHRAE 90.1–2016 updated its test procedure reference for CRACs from ASHRAE 127–2007 to AHRI 1360–2016, ''Performance Rating of Computer and Data Processing Room Air Conditioners,'' which in turn references ANSI/ASHRAE Standard 127–2012, ''Method of Testing for Rating Computer and Data Processing Room Unitary Air Conditioners''.

The energy conservation standards for CRACs were most recently amended through the final rule for energy conservation standards and test procedures for certain commercial HVAC and water heating equipment published in the **Federal Register** on May 16, 2012 (''May 2012 final rule''). 77 FR 28928. The May 2012 final rule established separate equipment classes for CRACs and adopted energy conservation standards that generally correspond to the levels in the 2010 revision of ASHRAE Standard 90.1 for most of the equipment classes.

As noted previously, on October 26, 2016, ASHRAE officially released for distribution and made public ASHRAE Standard 90.1–2016. ASHRAE Standard 90.1–2016 revised the efficiency levels for certain commercial equipment, including certain classes of CRACs (as discussed in the following section). Also, as stated, ASHRAE Standard 90.1–2016 established a new category for DOASes.[8]

II. Discussion of Changes in ASHRAE Standard 90.1–2016

Before beginning an analysis of the potential energy savings that would result from adopting a uniform national standard as specified by ASHRAE Standard 90.1–2016 or more-stringent uniform national standards, DOE must first determine whether the ASHRAE Standard 90.1–2016 standard levels actually represent an increase in efficiency above the current Federal standard levels or whether ASHRAE Standard 90.1–2016 adopted new design requirements, thereby triggering DOE action.

This section contains a discussion of each equipment class where the ASHRAE Standard 90.1–2016 efficiency levels differ from the ASHRAE Standard 90.1–2013 level(s)[9] (based on a rating metric used in the relevant Federal energy conservation standards) or where ASHRAE created new equipment classes, along with DOE's preliminary conclusion regarding the appropriate action to take with respect to that equipment. DOE is also examining the other equipment classes for the triggered equipment categories under its 6-year-lookback authority. (42 U.S.C. 6313(a)(6)(C)).

As noted above, ASHRAE Standard 90.1–2016 adopted efficiency levels for all CRAC equipment classes in terms of NSenCOP (measured per AHRI 1360–2016), whereas DOE's current standards are in terms of SCOP (measured per ASHRAE 127–2007). For this NODA, DOE's analysis focuses on whether DOE has been triggered by ASHRAE 90.1–2016 updates to minimum efficiency levels for CRACs and whether more-stringent standards are warranted; DOE will consider whether to adopt the NSenCOP metric for all CRAC equipment classes as part of the ongoing test procedure rulemaking. As discussed in detail in the following section, DOE has conducted a crosswalk analysis of the ASHRAE Standard 90.1 standard levels that rely on NSenCOP and the efficiency levels of the corresponding Federal energy conservation standard that rely on SCOP to compare the stringencies. DOE has tentatively determined that the updates in ASHRAE Standard 90.1–2016 increased the stringency of efficiency levels for five equipment classes, maintained equivalent levels for three equipment classes, and reduced stringency for 37 classes of CRACs relative to the current Federal standard. In addition, ASHRAE Standard 90.1–2016 added efficiency levels for 15 classes of horizontal-flow[10] CRACs which do not currently have a Federal standard.

ASHRAE Standard 90.1–2016 also adopted standards for DOASes, which previously did not have energy efficiency levels specified. ASHRAE Standard 90.1–2016 specifies standards for 12 classes of DOASes. As currently there are no Federal standards for DOASes, no comparison of efficiency levels to the current DOE standards levels was necessary.

Table II.1 shows the CRAC and DOAS equipment classes provided in ASHRAE Standard 90.1–2016, the efficiency levels for these classes in ASHRAE Standard 90.1–2016, and the corresponding efficiency levels in ASHRAE Standard 90.1–2013 (for CRACs only). For CRACs, Table II.1 also displays the corresponding existing Federal energy conservation standards. As noted previously, for CRACs, ASHRAE Standard 90.1–2016 adopted efficiency levels in terms of NSenCOP (based on the AHRI 1360 test procedure), whereas DOE's current standards are in terms of SCOP (based on the test procedures in ASHRAE 127–2007). DOE performed an analysis to translate the current DOE standards to NSenCOP values (''crosswalk analysis''). The crosswalk analysis then allowed DOE to compare whether the ASHRAE Standard 90.1–2016 efficiency levels are more stringent than the corresponding Federal standards. (See section II.A of this NODA for further discussion on the crosswalk analysis performed for CRACs.) Table II.1 also indicates whether the update in ASHRAE Standard 90.1–2016 triggers DOE's evaluation as required under EPCA (*i.e.,* whether the update results in a standard level more stringent than the current Federal level). For DOASes, there are currently no Federal standards; therefore, DOE's evaluation as required under EPCA is triggered for all DOAS efficiency levels added in ASHRAE Standard 90.1–2016. The remainder of this section assesses each of these equipment classes and describes whether the amendments in ASHRAE Standard 90.1–2016 constitute amendments necessitating further analysis of the potential energy savings from corresponding amendments to the Federal energy conservation standards.

[8] ASHRAE Standard 90.1–2016 also revised standards for certain classes of VRF multi-split systems. DOE is addressing VRF multi-split systems in a separate document, as this equipment is the subject of a negotiated rulemaking under the auspices of the Appliance Standards and Rulemaking Federal Advisory Committee (ASRAC).

See, *https://www1.eere.energy.gov/buildings/appliance_standards/standards.aspx?productid=71&action=viewlive.* For the remaining equipment, ASHRAE left in place the preexisting levels (*i.e.,* the efficiency levels specified in EPCA or the efficiency levels in ASHRAE Standard 90.1–2013).

[9] ASHRAE Standard 90.1–2016 did not change any of the design requirements for the commercial heating, air conditioning, and water heating equipment covered by EPCA, so this potential category of change is not discussed in this section.

[10] ''Horizontal flow'' refers to the direction of airflow of the unit.

TABLE II.1—ENERGY EFFICIENCY LEVELS FOR CRACS AND DOASES IN ASHRAE STANDARD 90.1–2016, AND THE CORRESPONDING LEVELS IN ASHRAE STANDARD 90.1–2013 AND THE FEDERAL ENERGY CONSERVATION STANDARDS [1]

ASHRAE standard 90.1–2016 equipment class [1]	Energy efficiency levels in ASHRAE standard 90.1–2013 (as corrected) [2]	Energy efficiency levels in ASHRAE standard 90.1–2016	Federal energy conservation standards	DOE triggered by ASHRAE standard 90.1–2016 amendment?
Commercial Package Air-Conditioning and Heating Equipment—Computer Room Air Conditioners [3]				
CRAC, Air-Cooled, <65,000 Btu/h, Downflow	2.20 SCOP	2.30 NSenCOP	2.20 SCOP	No.[4]
CRAC, Air-Cooled, <65,000 Btu/h, Horizontal-flow	N/A	2.45 NSenCOP	N/A	Yes.[5]
CRAC, Air-Cooled, <65,000 Btu/h, Upflow Ducted	2.09 SCOP	2.10 NSenCOP	2.09 SCOP	No.[4]
CRAC, Air-Cooled, <65,000 Btu/h, Upflow Non-Ducted.	2.09 SCOP	2.09 NSenCOP	2.09 SCOP	No.[6]
CRAC, Air-Cooled, ≥65,000 and <240,000 Btu/h, Downflow.	2.10 SCOP	2.20 NSenCOP	2.10 SCOP	No.[4]
CRAC, Air-Cooled, ≥65,000 and <240,000 Btu/h, Horizontal-flow.	N/A	2.35 NSenCOP	N/A	Yes.[5]
CRAC, Air-Cooled, ≥65,000 and <240,000 Btu/h, Upflow Ducted.	1.99 SCOP	2.05 NSenCOP	1.99 SCOP	No.[4]
CRAC, Air-Cooled, ≥65,000 and <240,000 Btu/h, Upflow Non-Ducted.	1.99 SCOP	1.99 NSenCOP	1.99 SCOP	No.[6]
CRAC, Air-Cooled, ≥240,000 Btu/h and <760,000 Btu/h, Downflow.	1.90 SCOP	2.00 NSenCOP	1.90 SCOP	No.[4]
CRAC, Air-Cooled, ≥240,000 Btu/h and <760,000 Btu/h, Horizontal-flow.	N/A	2.15 NSenCOP	N/A	Yes.[5]
CRAC, Air-Cooled, ≥240,000 Btu/h and <760,000 Btu/h, Upflow Ducted.	1.79 SCOP	1.85 NSenCOP	1.79 SCOP	No.[4]
CRAC, Air-Cooled, ≥240,000 Btu/h and <760,000 Btu/h, Upflow Non-ducted.	1.79 SCOP	1.79 NSenCOP	1.79 SCOP	No.[6]
CRAC, Water-Cooled, <65,000 Btu/h, Downflow	2.60 SCOP	2.50 NSenCOP	2.60 SCOP	No.[4]
CRAC, Water-Cooled, <65,000 Btu/h, Horizontal-flow.	N/A	2.70 NSenCOP	N/A	Yes.[5]
CRAC, Water-Cooled, <65,000 Btu/h, Upflow Ducted.	2.49 SCOP	2.30 NSenCOP	2.49 SCOP	No.[4]
CRAC, Water-Cooled, <65,000 Btu/h, Upflow Non-ducted.	2.49 SCOP	2.25 NSenCOP	2.49 SCOP	No.[4]
CRAC, Water-Cooled, ≥65,000 and <240,000 Btu/h, Downflow.	2.50 SCOP	2.40 NSenCOP	2.50 SCOP	No.[4]
CRAC, Water-Cooled, ≥65,000 and <240,000 Btu/h, Horizontal-flow.	N/A	2.60 NSenCOP	N/A	Yes.[5]
CRAC, Water-Cooled, ≥65,000 and <240,000 Btu/h, Upflow Ducted.	2.39 SCOP	2.20 NSenCOP	2.39 SCOP	No.[4]
CRAC, Water-Cooled, ≥65,000 and <240,000 Btu/h, Upflow Non-ducted.	2.39 SCOP	2.15 NSenCOP	2.39 SCOP	No.[4]
CRAC, Water-Cooled, ≥240,000 Btu/h and <760,000 Btu/h, Downflow.	2.40 SCOP	2.25 NSenCOP	2.40 SCOP	No.[4]
CRAC, Water-Cooled, ≥240,000 Btu/h and <760,000 Btu/h, Horizontal-flow.	N/A	2.45 NSenCOP	N/A	Yes.[5]
CRAC, Water-Cooled, ≥240,000 Btu/h and <760,000 Btu/h, Upflow Ducted.	2.29 SCOP	2.10 NSenCOP	2.29 SCOP	No.[4]
CRAC, Water-Cooled, ≥240,000 Btu/h and <760,000 Btu/h, Upflow Non-ducted.	2.29 SCOP	2.05 NSenCOP	2.29 SCOP	No.[4]
CRAC, Water-Cooled with fluid economizer, <65,000 Btu/h, Downflow.	2.55 SCOP	2.45 NSenCOP	2.55 SCOP	No.[4]
CRAC, Water-Cooled with fluid economizer, <65,000 Btu/h, Horizontal-flow.	N/A	2.60 NSenCOP	N/A	Yes.[5]
CRAC, Water-Cooled with fluid economizer, <65,000 Btu/h, Upflow Ducted.	2.44 SCOP	2.25 NSenCOP	2.44 SCOP	No.[4]
CRAC, Water-Cooled with fluid economizer, <65,000 Btu/h, Upflow Non-ducted.	2.44 SCOP	2.20 NSenCOP	2.44 SCOP	No.[4]
CRAC, Water-Cooled with fluid economizer, ≥65,000 and <240,000 Btu/h, Downflow.	2.45 SCOP	2.35 NSenCOP	2.45 SCOP	No.[4]
CRAC, Water-Cooled with fluid economizer, ≥65,000 and <240,000 Btu/h, Horizontal-flow.	N/A	2.55 NSenCOP	N/A	Yes.[5]
CRAC, Water-Cooled with fluid economizer, ≥65,000 and <240,000 Btu/h, Upflow Ducted.	2.34 SCOP	2.15 NSenCOP	2.34 SCOP	No.[4]
CRAC, Water-Cooled with fluid economizer, ≥65,000 and <240,000 Btu/h, Upflow Non-ducted.	2.34 SCOP	2.10 NSenCOP	2.34 SCOP	No.[4]
CRAC, Water-Cooled with fluid economizer, ≥240,000 Btu/h and <760,000 Btu/h, Downflow.	2.35 SCOP	2.20 NSenCOP	2.35 SCOP	No.[4]
CRAC, Water-Cooled with fluid economizer, ≥240,000 Btu/h and <760,000 Btu/h, Horizontal-flow.	N/A	2.40 NSenCOP	N/A	Yes.[5]

TABLE II.1—ENERGY EFFICIENCY LEVELS FOR CRACS AND DOASES IN ASHRAE STANDARD 90.1–2016, AND THE CORRESPONDING LEVELS IN ASHRAE STANDARD 90.1–2013 AND THE FEDERAL ENERGY CONSERVATION STANDARDS [1]—Continued

ASHRAE standard 90.1–2016 equipment class [1]	Energy efficiency levels in ASHRAE standard 90.1–2013 (as corrected) [2]	Energy efficiency levels in ASHRAE standard 90.1–2016	Federal energy conservation standards	DOE triggered by ASHRAE standard 90.1–2016 amendment?
CRAC, Water-Cooled with fluid economizer, ≥240,000 Btu/h and <760,000 Btu/h, Upflow Ducted.	2.24 SCOP	2.05 NSenCOP	2.24 SCOP	No.[4]
CRAC, Water-Cooled with fluid economizer, ≥240,000 Btu/h and <760,000 Btu/h, Upflow Non-ducted.	2.24 SCOP	2.00 NSenCOP	2.24 SCOP	No.[4]
CRAC, Glycol-Cooled, <65,000 Btu/h, Downflow	2.50 SCOP	2.30 NSenCOP	2.50 SCOP	No.[4]
CRAC, Glycol-Cooled, <65,000 Btu/h, Horizontal-flow.	N/A	2.40 NSenCOP	N/A	Yes.[5]
CRAC, Glycol-Cooled, <65,000 Btu/h, Upflow Ducted.	2.39 SCOP	2.10 NSenCOP	2.39 SCOP	No.[4]
CRAC, Glycol-Cooled, <65,000 Btu/h, Upflow Non-ducted.	2.39 SCOP	2.00 NSenCOP	2.39 SCOP	No.[4]
CRAC, Glycol-Cooled, ≥65,000 and <240,000 Btu/h, Downflow.	2.15 SCOP	2.05 NSenCOP	2.15 SCOP	No.[4]
CRAC, Glycol-Cooled, ≥65,000 and <240,000 Btu/h, Horizontal-flow.	N/A	2.15 NSenCOP	N/A	Yes.[5]
CRAC, Glycol-Cooled, ≥65,000 and <240,000 Btu/h, Upflow Ducted.	2.04 SCOP	1.85 NSenCOP	2.04 SCOP	No.[4]
CRAC, Glycol-Cooled, ≥65,000 and <240,000 Btu/h, Upflow Non-ducted.	2.04 SCOP	1.85 NSenCOP	2.04 SCOP	Yes.
CRAC, Glycol-Cooled, ≥240,000 Btu/h and <760,000 Btu/h, Downflow.	2.10 SCOP	1.95 NSenCOP	2.10 SCOP	No.[4]
CRAC, Glycol-Cooled, ≥240,000 Btu/h and <760,000 Btu/h, Horizontal-flow.	N/A	2.10 NSenCOP	N/A	Yes.[5]
CRAC, Glycol-Cooled, ≥240,000 Btu/h and <760,000 Btu/h, Upflow Ducted.	1.99 SCOP	1.80 NSenCOP	1.99 SCOP	No.[4]
CRAC, Glycol-Cooled, ≥240,000 Btu/h and <760,000 Btu/h, Upflow Non-ducted.	1.99 SCOP	1.75 NSenCOP	1.99 SCOP	Yes.
CRAC, Glycol-Cooled with fluid economizer, <65,000 Btu/h, Downflow.	2.45 SCOP	2.25 NSenCOP	2.45 SCOP	No.[4]
CRAC, Glycol-Cooled with fluid economizer, <65,000 Btu/h, Horizontal-flow.	N/A	2.35 NSenCOP	N/A	Yes.[5]
CRAC, Glycol-Cooled with fluid economizer, <65,000 Btu/h, Upflow Ducted.	2.34 SCOP	2.10 NSenCOP	2.34 SCOP	No.[4]
CRAC, Glycol-Cooled with fluid economizer, <65,000 Btu/h, Upflow Non-ducted.	2.34 SCOP	2.00 NSenCOP	2.34 SCOP	Yes.
CRAC, Glycol-Cooled with fluid economizer, ≥65,000 and <240,000 Btu/h, Downflow.	2.10 SCOP	1.95 NSenCOP	2.10 SCOP	No.[4]
CRAC, Glycol-Cooled with fluid economizer, ≥65,000 and <240,000 Btu/h, Horizontal-flow.	N/A	2.10 NSenCOP	N/A	Yes.[5]
CRAC, Glycol-Cooled with fluid economizer, ≥65,000 and <240,000 Btu/h, Upflow Ducted.	1.99 SCOP	1.80 NSenCOP	1.99 SCOP	No.[4]
CRAC, Glycol-Cooled with fluid economizer, ≥65,000 and <240,000 Btu/h, Upflow Non-ducted.	1.99 SCOP	1.75 NSenCOP	1.99 SCOP	Yes.
CRAC, Glycol-Cooled with fluid economizer, ≥240,000 Btu/h and <760,000 Btu/h, Downflow.	2.05 SCOP	1.90 NSenCOP	2.05 SCOP	No.[4]
CRAC, Glycol-Cooled with fluid economizer, ≥240,000 Btu/h and <760,000 Btu/h, Horizontal-flow.	N/A	2.10 NSenCOP	N/A	Yes.[5]
CRAC, Glycol-Cooled with fluid economizer, ≥240,000 Btu/h and <760,000 Btu/h, Upflow Ducted.	1.94 SCOP	1.80 NSenCOP	1.94 SCOP	No.[4]
CRAC, Glycol-Cooled with fluid economizer, ≥240,000 Btu/h and <760,000 Btu/h, Upflow Non-ducted.	1.94 SCOP	1.70 NSenCOP	1.94 SCOP	Yes.
Electrically-Operated Direct Expansion (DX)-Dedicated Outdoor Air System Units, Single-Package and Remote Condenser				
DOAS, Air-Cooled, without energy recovery	N/A	4.0 ISMRE	N/A	Yes.
DOAS, Air-Cooled, with energy recovery	N/A	5.2 ISMRE	N/A	Yes.
DOAS, Air-Source heat pumps, without energy recovery.	N/A	4.0 ISMRE, 2.7 ISCOP	N/A	Yes.[7]
DOAS, Air-Source heat pumps, with energy recovery.	N/A	5.2 ISMRE, 3.3 ISCOP	N/A	Yes.[7]

TABLE II.1—ENERGY EFFICIENCY LEVELS FOR CRACS AND DOASES IN ASHRAE STANDARD 90.1–2016, AND THE CORRESPONDING LEVELS IN ASHRAE STANDARD 90.1–2013 AND THE FEDERAL ENERGY CONSERVATION STANDARDS [1]—Continued

ASHRAE standard 90.1–2016 equipment class [1]	Energy efficiency levels in ASHRAE standard 90.1–2013 (as corrected) [2]	Energy efficiency levels in ASHRAE standard 90.1–2016	Federal energy conservation standards	DOE triggered by ASHRAE standard 90.1–2016 amendment?
DOAS, Water-cooled: Cooling tower condenser water, without energy recovery.	N/A	4.9 ISMRE	N/A	Yes.[7]
DOAS, Water-cooled: Cooling tower condenser water, with energy recovery.	N/A	5.3 ISMRE	N/A	Yes.[7]
DOAS, Water-cooled: Chilled water, without energy recovery.	N/A	6.0 ISMRE	N/A	Yes.[8]
DOAS, Water-cooled: Chilled water, with energy recovery.	N/A	6.6 ISMRE	N/A	Yes.[9]
DOAS, Water-source: Ground-source, closed loop, without energy recovery.	N/A	4.8 ISMRE, 2.0 ISCOP	N/A	Yes.[10]
DOAS, Water-source: Ground-source, closed loop, with energy recovery.	N/A	5.2 ISMRE, 3.8 ISCOP	N/A	Yes.[11]
DOAS, Water-source: Ground-water source, without energy recovery.	N/A	5.0 ISMRE, 3.2 ISCOP	N/A	Yes.
DOAS, Water-source: Ground-water source, with energy recovery.	N/A	5.8 ISMRE, 4.0 ISCOP	N/A	Yes.
DOAS, Water-source: Water-source, without energy recovery.	N/A	4.0 ISMRE, 3.5 ISCOP	N/A	Yes.[7]
DOAS, Water-source: Water-source, with energy recovery.	N/A	4.8 ISMRE, 4.8 ISCOP	N/A	Yes.[7]

[1] Note that equipment classes specified in ASHRAE Standard 90.1–2016 do not necessarily correspond to the equipment classes defined in DOE's regulations.

[2] This table represents values in ASHRAE 90.1–2013 as corrected by various errata sheets issued by ASHRAE.

[3] For CRACs, ASHRAE Standard 90.1–2016 adopted efficiency levels in terms of NSenCOP based on test procedures in AHRI 1360–2016, while DOE's current standards are in terms of SCOP based on the test procedures in ANSI/ASHRAE 127–2007. DOE performed a crosswalk analysis to compare the stringency of the ASHRAE Standard 90.1–2016 efficiency levels with the current Federal standards. See section II.A of this NODA for further discussion on the crosswalk analysis performed for CRACs.

[4] The preliminary CRAC crosswalk analysis indicates that the ASHRAE Standard 90.1–2016 level for this class is less stringent than the current applicable DOE standard.

[5] Horizontal-flow CRACs are identified in ASHRAE Standard 90.1–2016 as a new equipment class, and DOE does not have any data to indicate the market share of horizontal-flow units. In the absence of data regarding market share and efficiency distribution, DOE is unable to estimate potential savings for horizontal-flow equipment classes.

[6] The preliminary CRAC crosswalk analysis indicates that there is no difference in stringency of efficiency levels for this class between ASHRAE 90.1–2016 and the current Federal standard.

[7] DOE did not conduct an energy use analysis on this DOAS equipment class, as it is one of six equipment classes for which the combined market share is estimated to be approximately 5 percent, and as such, standards would result in minimal national energy savings.

[8] DOE evaluated as a single class water-cooled, chilled water DOAS without energy recovery product class and water-cooled, cooling tower condenser water DOAS without energy recovery product class. See section III.A.2 for more details.

[9] DOE evaluated as a single class water-cooled, chilled water DOAS with energy recovery product class and water-cooled, cooling tower condenser water DOAS with energy recovery product class. See section III.A.2 for more details.

[10] DOE evaluated as a single class water-source: Ground-source DOAS without energy recovery product class and water-source: Water-source DOAS without energy recovery product class. See section III.A.2 for more details.

[11] DOE evaluated as a single class water-source: Ground-source DOAS with energy recovery product class and water-source: Water-source DOAS with energy recovery product class. See section III.A.2 for more details.

A. Computer Room Air Conditioners

DOE currently prescribes energy conservation standards for 30 equipment classes of CRACs at 10 CFR 431.97. The current CRAC equipment classes are differentiated by condensing system type (air-cooled, water-cooled, water-cooled with fluid economizer, glycol-cooled, or glycol-cooled with fluid economizer), net sensible cooling capacity (less than 65,000 Btu/h, greater than or equal to 65,000 Btu/h and less than 240,000 Btu/h, or greater than or equal to 240,000 Btu/h and less than 760,000 Btu/h), and direction of conditioned air over the cooling coil (upflow or downflow). Federal standards established in 10 CFR 431.97 are specified in terms of SCOP, based on rating conditions in ANSI/ASHRAE Standard 127–2007, *Method of Testing Computer and Data Processing Room Unitary Air Conditioners* (ANSI/ASHRAE 127–2007). 10 CFR 431.96(b)(2).

ASHRAE 90.1–2016 disaggregates the upflow CRAC equipment classes into upflow ducted and upflow non-ducted equipment classes, and it establishes different sets of efficiency levels for upflow ducted and upflow non-ducted equipment classes based on the corresponding rating conditions specified in AHRI Standard 1360–2016, *Performance Rating of Computer and Data Processing Room Air Conditioners* (AHRI 1360–2016). Section II.A.1 of this document includes a detailed discussion of the differences in rating conditions between DOE's current test procedure for CRACs (which references ANSI/ASHRAE 127–2007) and AHRI 1360–2016. In contrast, DOE currently specifies the same set of standards at 10 CFR 431.97 for all covered upflow CRACs, regardless of ducting configuration. Additionally, ASHRAE 90.1–2016 includes efficiency levels for 15 horizontal-flow equipment classes. The equipment in these 15 classes is not currently subject to Federal standards set forth in 10 CFR 431.97.

DOE considered whether there were any increases in stringency in the ASHRAE 90.1–2016 levels for CRAC classes covered by DOE standards, thus triggering DOE obligations under EPCA.

For CRACs, this assessment has been complicated because the current standards established in 10 CFR 431.97 are specified in terms of SCOP and based on the rating conditions in ANSI/ASHRAE 127–2007, while the efficiency levels for CRACs set forth in ASHRAE 90.1–2016 are specified in terms of NSenCOP and based on rating conditions in AHRI 1360–2016. While EPCA does not expressly state how DOE is to consider a change to an ASHRAE efficiency metric, DOE is guided by the criteria established under EPCA for the evaluation of amendments to the test procedures referenced in ASHRAE Standard 90.1. For ASHRAE equipment under 42 U.S.C. 6313(a)(6)(A)(i), EPCA directs that if the applicable test procedure referenced in ASHRAE Standard 90.1 is amended, DOE must amend the Federal test procedure to be consistent with the amended industry test procedure, unless DOE makes a determination, supported by clear and convincing evidence, that to do so would result in a test procedure that is not reasonably designed to provide results representative of use during an average use cycle, or is unduly burdensome to conduct. (42 U.S.C. 6314(a)(4)(B)) In evaluating an update to an industry test procedure referenced in ASHRAE Standard 90.1, DOE must also consider any potential impact on the measured energy efficiency as compared to the current Federal test procedure and in the context of the current Federal standard. (42 U.S.C. 6314(a)(4)(C) and 42 U.S.C. 6293(e))

As discussed in section II.A.1 of this document, the rating conditions in AHRI 1360–2016 differ from those specified in ANSI/ASHRAE 127–2007 for most upflow and downflow CRAC equipment classes. DOE conducted a crosswalk analysis for the classes affected by rating condition changes to determine whether the revised ASHRAE 90.1–2016 levels in terms of NSenCOP are more stringent than DOE's current standards in terms of SCOP.

DOE conducted the crosswalk analysis to determine equivalent NSenCOP values corresponding to DOE's current SCOP-based CRAC standards in order to perform the analysis required by EPCA. The crosswalk allows DOE to determine whether any of the levels specified in the updated ASHRAE Standard 90.1 are more stringent than the current DOE standards, and therefore amended for the purpose of the evaluation required by EPCA. (42 U.S.C. 6313(a)(6)(A)(i)) To the extent that the crosswalk identifies amended standards (*i.e.,* ASHRAE Standard 90.1 levels more stringent than the Federal standards), the crosswalk also allows DOE to conduct an analysis of the energy savings potential of amended standards, also as required by EPCA. (*Id.*) Additionally, in order to make the required determination of whether adoption of a uniform national standard more stringent than the amended ASHRAE Standard 90.1 level is technologically feasible and economically justified (42 U.S.C. 6313(a)(6)(A)(ii)), DOE must understand the relationship between the current Federal standard and the corresponding ASHRAE Standard 90.1 efficiency level. Finally, for any standard that DOE does not make more stringent because the Federal standard is already more stringent than the ASHRAE Standard 90.1 level and where more-stringent levels are not justified (under the 6-year-lookback), DOE must express these levels in terms of the new efficiency metric so as to be consistent with the relevant industry test procedure (42 U.S.C. 6314(a)(4)).

1. Methodology for Efficiency and Capacity Crosswalk Analyses

a. General

DOE performed a crosswalk analysis to compare the stringency of the current Federal standards (represented in terms of SCOP based on the current DOE test procedure) for CRACs to the stringency of the energy efficiency for this equipment in ASHRAE Standard 90.1–2016 (represented in terms of NSenCOP based on AHRI 1360–2016). For the crosswalk, DOE analyzed the CRAC equipment classes in ASHRAE 90.1–2016 that are currently subject to Federal standards (*i.e.,* all upflow and downflow classes).[11] ASHRAE 90.1–2016 includes separate sets of efficiency levels for upflow ducted and upflow non-ducted CRACs to reflect the differences in rating conditions for upflow ducted and upflow non-ducted units in AHRI 1360–2016 (*e.g.,* return air temperature and external static pressure (ESP)). The Federal test procedure does not specify different rating conditions for upflow ducted as compared to upflow non-ducted CRACs, and DOE's current standards set forth in 10 CFR 431.97 do not differentiate between upflow ducted and upflow non-ducted CRACs. For the purpose of the efficiency crosswalk analysis, DOE converted the single set of current Federal SCOP standards for all upflow CRACs to sets of ''crosswalked'' NSenCOP standards for both the upflow ducted and upflow non-ducted classes established in ASHRAE Standard 90.1–2016.

As explained, the standards for CRACs as updated in ASHRAE Standard 90.1–2016 rely on a different metric (NSenCOP) and test procedure (AHRI 1360–2016) than the metric and test procedure required under the Federal standards (SCOP and ANSI/ASHRAE 127–2007, respectively). AHRI 1360–2016 and ANSI/ASHRAE 127–2007 specify different rating conditions, which are listed in Table II.2.[12]

TABLE II.2—DIFFERENCES IN RATING CONDITIONS BETWEEN DOE'S CURRENT TEST PROCEDURE AND AHRI 1360–2016

Test parameter	Affected equipment categories	Current DOE test procedure (ANSI/ASHRAE 127–2007)		AHRI 1360–2016	
Return air dry-bulb temperature (RAT).	Upflow ducted and downflow.	75 °F dry-bulb temperature.		85 °F dry-bulb temperature.	
Entering water temperature (EWT)	Water-cooled	86 °F		83 °F	
ESP (varies with NSCC)	Upflow ducted	<20 kW	0.8 in H_2O	<65 kBtu/h	0.3 in H_2O.

[11] ASHRAE Standard 90.1–2016 includes efficiency levels for horizontal-flow classes of CRAC. DOE does not currently prescribe standards for horizontal-flow classes, so these classes were not included in the crosswalk analysis.

[12] Pursuant to EPCA, DOE is conducting a separate evaluation of its current test procedure as compared to AHRI 1360–2016 (and the subsequently released 2017 version of AHRI Standard 1360). (42 U.S.C. 6314(a)(4)(B)).

TABLE II.2—DIFFERENCES IN RATING CONDITIONS BETWEEN DOE'S CURRENT TEST PROCEDURE AND AHRI 1360–2016—Continued

Test parameter					
		≥20 kW	1.0 in H_2O	≥65 kBtu/h and <240 kBtu/h.	0.4 in H_2O.
				≥240 kBtu/h and <760 kBtu/h.	0.5 in H_2O.
Adder for heat rejection fan and pump power (add to total power. consumption).	Water-cooled and glycol-cooled.	No added power consumption for heat rejection fan and pump.		5 percent of NSCC for water-cooled CRACs. 7.5 percent of NSCC for glycol-cooled CRACs.	

In addition to necessitating a crosswalk to compare standards that use different metrics, the differences in the test procedures required DOE to crosswalk the capacity limits that provide the boundaries for the CRAC equipment classes. The capacity values that bound the equipment classes are in terms of net sensible cooling capacity (NSCC). NSCC values determined according to AHRI 1360–2016, the test procedure specified in ASHRAE Standard 90.1–2016, are higher than the NSCC values determined according to ANSI/ASHRAE 127–2007, the required Federal test procedure. Because the test procedure in ASHRAE Standard 90.1–2016 results in an increased NSCC value for certain equipment classes, applying ASHRAE Standard 90.1–2016, as compared to the current Federal requirement, would result in some CRACs switching classes (*i.e.,* move into a higher capacity equipment class) if the equipment class boundaries are not changed. Based on the calculated capacity changes, approximately 15–20 percent of CRAC models listed in DOE's Compliance Certification Database for CRACs[13] would shift into higher capacity equipment classes as a result of the test procedure changes in AHRI 1360–2016.

As the equipment class capacity increases, the stringency of the both the ASHRAE Standard 90.1 efficiency level and the Federal standard decreases. As a result, class switching would subject some CRAC models to an efficiency level under ASHRAE Standard 90.1–2016 that is less stringent than the standard level that is applicable to that model under the current Federal requirements. This backsliding would result in an inappropriate evaluation of ASHRAE Standard 90.1–2016.

To provide for an appropriate comparison and to address potential backsliding, a capacity crosswalk was conducted to adjust the NSCC boundaries that separate equipment classes to account for the difference in measured NSCC values between ASHRAE Standard 90.1–2016 and the current Federal requirements. The capacity crosswalk calculated increases in the capacity boundaries of affected equipment classes (*i.e.,* equipment classes with test procedure changes that increase NSCC) to prevent this equipment class switching issue and avoid potential backsliding that would occur if capacity boundaries were not adjusted.

Both the efficiency and capacity crosswalk analyses have a similar structure and the data for both analyses came from several of the same sources. The crosswalk analyses were informed by numerous sources, including public manufacturer literature, manufacturer performance data obtained through non-disclosure agreements (NDAs), results from DOE's testing of two CRAC units, and DOE's Compliance Certification Database for CRACs. DOE analyzed each test procedure change independently and used the available data to determine an aggregated percentage by which that change impacted efficiency (SCOP) and/or NSCC. Updated SCOP levels and NSCC equipment class boundaries were calculated for each class (as applicable) by combining the percentage changes for every test procedure change applicable to that class.

The following sub-sections describe the approaches used to analyze the impacts on the measured efficiency and capacity of each difference in rating conditions between DOE's current test procedure and AHRI 1360–2016.

b. Increase in Return Air Dry-Bulb Temperature From 75 °F to 85 °F

ANSI/ASHRAE 127–2007, which is referenced by DOE's current test procedure, specifies a return air dry-bulb temperature (RAT) of 75 °F for testing all CRACs. AHRI 1360–2016 specifies an RAT of 85 °F for upflow ducted and downflow CRACs, but specifies an RAT for upflow non-ducted units of 75 °F. SCOP and NSCC both increase with increasing RAT for two reasons. First, a higher RAT increases the cooling that must be done for the air to approach its dew point temperature (*i.e.,* the temperature at which water vapor will condense if there is any additional cooling). Second, a higher RAT will tend to raise the evaporating temperature of the refrigerant, which in turn raises the temperature of fin and tube surfaces in contact with the air—the resulting reduction in the portion of the heat exchanger surface that is below the air's dew point temperature reduces the potential for water vapor to condense on these surfaces. This is seen in product specifications which show that the sensible heat ratio[14] is consistently higher at a RAT of 85 °F than at 75 °F. Because SCOP is calculated with NSCC, an increase in the fraction of total cooling capacity that is sensible cooling rather than latent cooling also inherently increases SCOP.

To analyze the impacts of increasing RAT for upflow ducted and downflow CRACs on SCOP and NSCC, DOE gathered data from three separate sources and aggregated the results for each crosswalk analysis. First, DOE used product specifications for several CRAC models that provide SCOP and NSCC ratings for RATs ranging from 75 °F to 95 °F. Second, DOE analyzed manufacturer performance data obtained under NDAs that showed the performance impact of individual test condition changes, including the increase in RAT. Third, DOE used results from testing two CRAC units: One air-cooled upflow ducted and one air-cooled downflow unit. DOE

[13] DOE's Compliance Certification Database can be found at: *https://www.regulations.doe.gov/certification-data/#q=Product_Group_s%3A**.

[14] "Sensible heat ratio" is the ratio of sensible cooling capacity to the total cooling capacity. The total cooling capacity includes both sensible cooling capacity (cooling associated with reduction in temperature) and latent cooling capacity (cooling associated with dehumidification).

combined the results of these sources to find the aggregated increases in SCOP and NSCC due to the increase in RAT. The increase in SCOP due to the change in RAT was found to be approximately 19 percent, and the increase in capacity was found to be approximately 22 percent.

c. Decrease in Entering Water Temperature for Water-Cooled CRACs

ANSI/ASHRAE 127–2007, which is referenced by DOE's current test procedure, specifies an entering water temperature (EWT) of 86 °F for water-cooled CRACs, while AHRI 1360–2016 specifies an entering water temperature of 83 °F. A decrease in the EWT for water-cooled CRACs increases the temperature difference between the water and hot refrigerant in the condenser coil, thus increasing cooling capacity and decreasing compressor power. To analyze the impact of this decrease in EWT on SCOP and NSCC, DOE analyzed manufacturer data obtained through NDAs and a publicly-available presentation from a major CRAC manufacturer and calculated an SCOP increase of approximately 2 percent and an NSCC increase of approximately 1 percent.

d. Changes in External Static Pressure Requirements for Upflow Ducted CRACs

For upflow ducted CRACs, AHRI 1360–2016 specifies lower ESP requirements than ANSI/ASHRAE 127–2007, which is referenced in DOE's current test procedure. The ESP requirements in both industry test standards vary with NSCC; however, the capacity bins (*i.e.,* capacity ranges over which each ESP requirement applies) are different in each test standard. Testing with a lower ESP decreases the indoor fan power input without a corresponding decrease in cooling capacity, thus increasing the measured efficiency. Additionally, the reduction in fan heat entering the indoor air stream that results from lower fan power also slightly increases NSCC.

To determine the impacts on measured SCOP and NSCC of the changes in ESP requirements between DOE's current test procedure and AHRI 1360–2016, DOE aggregated data from its analysis of fan power consumption changes, manufacturer data obtained through NDAs, and results from DOE testing. More details on each of these sources are included in the following paragraphs. The impact of changes in ESP requirements on SCOP and NSCC was calculated separately for each capacity range specified in AHRI 1360–2016 (*i.e.,* <65 kBtu/h, 65–240 kBtu/h, and ≥240 kBtu/h).

DOE conducted an analysis to estimate the change in fan power consumption due to the changes in ESP requirements using performance data and product specifications for 77 upflow CRAC models with certified SCOP ratings at or near the current applicable SCOP standard level in DOE's Compliance Certification Database. Using the certified SCOP and NSCC values, DOE determined each model's total power consumption for operation at the rating conditions specified in DOE's current test procedure. DOE then used fan performance data for each model to estimate the change in indoor fan power that would result from the lower ESP requirements in AHRI 1360–2016, and modified the total power consumption for each model by the calculated value. For several models, detailed fan performance data were not available, so DOE used fan performance data for comparable air conditioning units with similar cooling capacity, fan drive, and fan motor horsepower.

DOE also received manufacturer data (obtained through NDAs) showing the impact on efficiency and NSCC of the change in ESP requirements. Additionally, DOE conducted tests on an upflow-ducted CRAC at ESPs of 1 in. H_2O and 0.4 in. H_2O (the applicable ESP requirements specified in ANSI/ASHRAE 127–2007 and AHRI 1360–2016), and included the results of those tests in this analysis.

For each of the three capacity ranges for which ESP requirements are specified in AHRI 1360–2016, Table II.3 shows the approximate aggregated percentage increases in SCOP and NSCC associated with the decreased ESP requirements specified in AHRI 1360–2016 for upflow ducted units.

TABLE II.3—PERCENTAGE INCREASE IN SCOP AND NSCC FROM DECREASES IN EXTERNAL STATIC PRESSURE REQUIREMENTS FOR UPFLOW DUCTED UNITS BETWEEN DOE'S CURRENT TEST PROCEDURE AND AHRI 1360–2016

Net sensible cooling capacity range (kBtu/h) *	ESP requirements in DOE's current test procedure (ANSI/ASHRAE 127–2007) (in H_2O)	ESP requirements in AHRI 1360–2016 (in H_2O)	Approx. average percentage increase in SCOP	Approx. average percentage increase in NSCC
<65	0.8	0.3	7	2
≥65 to <240				
≥65 to <68.2 **	0.8	0.4	*** 8	*** 2
≥68.2 to <240 **	1			
≥240 to <760	1	0.5	6	2

* These boundaries are consistent with ANSI/ASHRAE 127–2007 and AHRI 1360–2016, and do not reflect the expected capacity increases for certain equipment classes at the AHRI 1360–2016 test conditions.

** 68.2 kBtu/h is equivalent to 20 kW, which is the capacity value that separates ESP requirements in ANSI/ASHRAE 127–2007, which is referenced in DOE's current test procedure.

*** This average percentage increase is an average across upflow ducted CRACs with net sensible cooling capacity ≥65 and <240 kBtu/h, including models with capacity <20 kW and ≥ 20 kW. DOE's Compliance Certification Database shows that most of the upflow CRACs with a net sensible cooling capacity ≥65 kBtu/h and <240 kBtu/h have a net sensible cooling capacity ≥20 kW.

e. Power Adder to Account for Pump and Heat Rejection Fan Power in NSenCOP Calculation for Water-Cooled and Glycol-Cooled CRACs

Energy consumption for heat rejection components for air-cooled CRACs (*i.e.,* condenser fan motor(s)) is measured in the industry test standards for CRACs; however, energy consumption for heat rejection components for water-cooled and glycol-cooled CRACs is not measured because these components (*i.e.,* water/glycol pump, dry cooler/cooling tower fan(s)) are not considered to be part of the CRAC unit. ANSI/ASHRAE 127–2007, which is referenced in DOE's current test procedure, does not include any factor in the calculation of SCOP to account for the power consumption of heat rejection components for water-cooled and glycol-cooled CRACs. In contrast, AHRI 1360–2016 specifies to increase the measured total power input for CRACs to account for the power consumption of fluid pumps and heat rejection fans. Specifically, Notes 5 and 6 to Table 2 of AHRI 1360–2016 specify to add a percentage of the measured net sensible cooling capacity (5 percent for water-cooled CRACs and 7.5 percent for glycol-cooled CRACs) in kW to the total power input used to calculate NSenCOP. DOE calculated the impact of these additions on SCOP using Equation 1:

$$SCOP_1 = \frac{SCOP}{1 + (x * SCOP)}$$

Equation 1

Where, χ is equal to 5 percent for water-cooled CRACs and 7.5 percent for glycol-cooled CRACs, and $SCOP_1$ is the SCOP value adjusted for the energy consumption of heat rejection pumps and fans.

f. Calculating Overall Changes in Measured Efficiency and Capacity From Test Procedure Changes

Different combinations of the test procedure changes between DOE's current test procedure and AHRI 1360–2016 affect each of the CRAC equipment classes considered in the crosswalk analyses. To combine the impact on SCOP of the changes to rating conditions (*i.e.,* increase in RAT, decrease in condenser EWT for water-cooled units, and decrease of the ESP requirements for upflow ducted units), DOE multiplied together the calculated adjustment factors representing the measurement changes corresponding to each individual rating condition change, as applicable, as shown in Equation 2. These adjustment factors are equal to 100 percent plus the calculated percent change in measured efficiency.

To account for the impact of the adder for heat rejection pump and fan power for water-cooled and glycol-cooled units, DOE used Equation 3. Hence, DOE determined crosswalked NSenCOP levels corresponding to the current Federal SCOP standards for each CRAC equipment class using the following two equations.

$$NSenCOP_1 = SCOP * (1 + x_1) * (1 + x_2) * (1 + x_3)$$

Equation 2

$$NSenCOP = \frac{NSenCOP_1}{1 + (x_4 * NSenCOP_1)}$$

Equation 3

In these equations, $NSenCOP_1$ refers to a partially-crosswalked NSenCOP level that incorporates the impacts of changes in RAT, condenser EWT, and indoor fan ESP (as applicable), but not the impact of adding the heat rejection pump and fan power; χ_1, χ_2, and χ_3 represent the percentage change in SCOP due to changes in RAT, condenser EWT, and indoor fan ESP requirements, respectively; and χ_4 is equal to 5 percent for water-cooled equipment classes and 7.5 percent for glycol-cooled equipment classes. For air-cooled classes, χ_4 is equal to 0 percent; therefore, for these classes, NSenCOP is equal to $NSenCOP_1$.

To combine the impact on NSCC of the changes to rating conditions, DOE used a methodology similar to that used for determining the impact on SCOP. To determine adjusted NSCC equipment class boundaries, DOE multiplied together the calculated adjustment factors representing the measurement changes corresponding to each individual rating condition change, as applicable, as shown in Equation 4. These adjustment factors are equal to 100 percent plus the calculated percent change in measured NSCC. In this equation, Boundary refers to the original NSCC boundaries (*i.e.,* 65,000 Btu/h, 240,000 Btu/h, or 760,000 Btu/h as determined according to ANSI/ASHRAE 127–2007), $Boundary_1$ refers to the updated NSCC boundaries as determined according to AHRI 1360–2016, and y_1, y_2, and y_3 represent the percentage changes in NSCC due to changes in RAT, condenser EWT, and indoor fan ESP requirements, respectively.

$$Boundary_1 = Boundary * (1 + y_1) * (1 + y_2) * (1 + y_3)$$

Equation 4

In November 2018, ASHRAE published the Second Public Review Draft of Addendum 'be' to ASHRAE 90.1–2016 (''the second public review draft;'' *https://www.ashrae.org/news/esociety/public-reviews-november-2018*), which includes adjusted equipment class capacity boundaries for only upflow-ducted and downflow equipment classes.[15] The adjusted class boundaries for these categories in the second public review draft are <80,000 Btu/h, ≥80,000 Btu/h and <295,000 Btu/h, and ≥295,000 Btu/h. The capacity boundaries of upflow non-ducted classes were left unchanged at 65,000 Btu/h and 240,000 Btu/h. DOE's capacity crosswalk analysis indicates that the primary driver for increasing NSCC is increasing RAT. The increases in RAT in AHRI 1360–2016, as compared to ANSI/ASHRAE 127–2007, only apply to upflow ducted and downflow equipment classes. Based on

[15] In May 2019, ASHRAE published the Third Public Review Draft of Addendum 'be' to ASHRAE 90.1–2016, which includes only minor changes to column labels in the CRAC efficiency tables proposed in the second public review draft.

the analysis performed for this document, DOE found that all the equipment class boundaries in the second public review draft, which are in multiples of 5,000 Btu/h, are within 1.4 percent of the boundaries calculated under the methodology used to develop DOE's capacity crosswalk. As such, to more closely align DOE's analysis with ASHRAE Standard 90.1 (and the ASHRAE proceedings), DOE has used the equipment class boundaries in the second public review draft as the preliminary adjusted boundaries for the crosswalk analysis. Use of the equipment class boundaries from the second public review draft allows for an appropriate comparison between the energy efficiency levels and equipment classes specified in ASHRAE Standard 90.1 and those in the current DOE standards, while addressing the backsliding potential discussed previously.

ASHRAE 90.1–2016 does not include an upper capacity limit for coverage of CRACs; therefore, the second public review draft does not include an adjusted upper capacity limit. DOE's current standards only cover CRACs with an NSCC less than 760,000 Btu/h.[16] 10 CFR 431.97(e). (*See also* 42 U.S.C. 6311(8)(D)) In order to account for all equipment currently subject to the Federal standards, DOE adjusted the 760,000 Btu/h equipment class boundary for certain equipment classes as part of its capacity crosswalk analysis. This adjustment to the upper boundary of the equipment classes applies only for downflow and upflow-ducted classes (the classes for which the RAT increase applies). Consistent with the adjustments made by ASHRAE in the second public review draft, DOE averaged the cross-walked capacity results across the affected equipment classes, and rounded to the nearest 5,000 Btu/h. Following this approach, DOE has used 930,000 Btu/h as the adjusted upper capacity limit for downflow and upflow-ducted CRACs in the analysis presented in this notice. The 930,000 Btu/h upper capacity limit (as measured per AHRI 1360–2016) used in the crosswalk analysis is equivalent to the 760,000 Btu/h upper capacity limit (as measured per ANSI/ASHRAE 127–2007) established in the current DOE standards.

2. Crosswalk Results

The ''crosswalked'' DOE efficiency levels (in terms of NSenCOP) and adjusted equipment class capacity boundaries were then compared with the NSenCOP efficiency levels and capacity boundaries specified in ASHRAE Standard 90.1–2016 to determine whether the ASHRAE Standard 90.1–2016 requirements are more stringent than current Federal standards. Table II.4 presents the preliminary results for the crosswalk analysis (see section II.A.1 of this document for detailed discussion of the methodology for the crosswalk analysis). The last column in the table, labeled ''Crosswalk Comparison,'' indicates whether the ASHRAE Standard 90.1–2016 levels are less stringent, equivalent to, or more stringent than the current Federal standards, based on DOE's analysis.

TABLE II.4—CROSSWALK RESULTS

Condenser system type	Airflow configuration	Current NSCC range (kBtu/h)	Current Federal standard (SCOP)	Test procedure changes affecting efficiency *	Cross-walked NSCC range (kBtu/h)	Cross-walked current Federal standard (NSenCOP)	ASHRAE 90.1–2016 NSenCOP level	Crosswalk comparison
Air-cooled	Downflow	<65	2.20	Return air dry-bulb temperature.	<80	2.62	2.30	Less Stringent.
Air-cooled	Downflow	≥65 and <240	2.10		≥80 and <295	2.50	2.20	Less Stringent.
Air-cooled	Downflow	≥240 and <760	1.90		≥295 and <930	2.26	2.00	Less Stringent.
Water-cooled	Downflow	<65	2.60	Return air dry-bulb temperature.	<80	2.73	2.50	Less Stringent.
Water-cooled	Downflow	≥65 and <240	2.50		≥80 and <295	2.63	2.40	Less Stringent.
Water-cooled	Downflow	≥240 and <760	2.40	Condenser entering water temperature.	≥295 and <930	2.54	2.25	Less Stringent.
Water-cooled with fluid economizer.	Downflow	<65	2.55		<80	2.68	2.45	Less Stringent.
Water-cooled with fluid economizer.	Downflow	≥65 and <240	2.45	Add allowance for heat rejection components to total power input.	≥80 and <295	2.59	2.35	Less Stringent.
Water-cooled with fluid economizer.	Downflow	≥240 and <760	2.35		≥295 and <930	2.50	2.20	Less Stringent.
Glycol-cooled	Downflow	<65	2.50	Add allowance for heat rejection components to total power input.	<80	2.43	2.30	Less Stringent.
Glycol-cooled	Downflow	≥65 and <240	2.15		≥80 and <295	2.15	2.05	Less Stringent.
Glycol-cooled	Downflow	≥240 and <760	2.10		≥295 and <930	2.11	1.95	Less Stringent.
Glycol-cooled with fluid economizer.	Downflow	<65	2.45		<80	2.39	2.25	Less Stringent.
Glycol-cooled with fluid economizer.	Downflow	≥65 and <240	2.10		≥80 and <295	2.11	1.95	Less Stringent.
Glycol-cooled with fluid economizer.	Downflow	≥240 and <760	2.05		≥295 and <930	2.06	1.90	Less Stringent.
Air-cooled	Upflow Ducted	<65	2.09	Return air dry-bulb temperature.	<80	2.65	2.10	Less Stringent.
Air-cooled	Upflow Ducted	≥65 and <240	1.99		≥80 and <295	2.55	2.05	Less Stringent.
Air-cooled	Upflow Ducted	≥240 and <760	1.79	ESP requirements.	≥295 and <930	2.26	1.85	Less Stringent.
Water-cooled	Upflow Ducted	<65	2.49	Return air dry-bulb temperature.	<80	2.77	2.30	Less Stringent.
Water-cooled	Upflow Ducted	≥65 and <240	2.39		≥80 and <295	2.70	2.20	Less Stringent.
Water-cooled	Upflow Ducted	≥240 and <760	2.29	Condenser entering water temperature.	≥295 and <930	2.56	2.10	Less Stringent.
Water-cooled with fluid economizer.	Upflow Ducted	<65	2.44	ESP requirements.	<80	2.72	2.25	Less Stringent.

[16] In initially establishing standards CRACs, DOE noted that the energy efficiency levels from ASHRAE Standard 90.1 adopted as the Federal standards were based on ANSI/ASHRAE 127–2007. 77 FR 28928, 28945 (May 16, 2012). This includes the relevant capacity values.

TABLE II.4—CROSSWALK RESULTS—Continued

Condenser system type	Airflow configuration	Current NSCC range (kBtu/h)	Current Federal standard (SCOP)	Test procedure changes affecting efficiency *	Cross-walked NSCC range (kBtu/h)	Cross-walked current Federal standard (NSenCOP)	ASHRAE 90.1–2016 NSenCOP level	Crosswalk comparison
Water-cooled with fluid economizer.	Upflow Ducted	≥65 and <240	2.34	Add allowance for heat rejection components to total power input.	≥80 and <295	2.65	2.15	Less Stringent.
Water-cooled with fluid economizer.	Upflow Ducted	≥240 and <760	2.24		≥295 and <930	2.51	2.05	Less Stringent.
Glycol-cooled	Upflow Ducted	<65	2.39	Return air dry-bulb temperature. ESP requirements. Add allowance for heat rejection components to total power input.	<80	2.47	2.10	Less Stringent.
Glycol-cooled	Upflow Ducted	≥65 and <240	2.04		≥80 and <295	2.19	1.85	Less Stringent.
Glycol-cooled	Upflow Ducted	≥240 and <760	1.99		≥295 and <930	2.11	1.80	Less Stringent.
Glycol-cooled with fluid economizer.	Upflow Ducted	<65	2.34		<80	2.43	2.10	Less Stringent.
Glycol-cooled with fluid economizer.	Upflow Ducted	≥65 and <240	1.99		≥80 and <295	2.14	1.80	Less Stringent.
Glycol-cooled with fluid economizer.	Upflow Ducted	≥240 and <760	1.94		≥295 and <930	2.07	1.80	Less Stringent.
Air-cooled	Upflow Non-Ducted.	<65	2.09	No changes	<65	2.09	2.09	Equivalent.
Air-cooled	Upflow Non-Ducted.	≥65 and <240	1.99		≥65 and <240	1.99	1.99	Equivalent.
Air-cooled	Upflow Non-Ducted.	≥240 and <760	1.79		≥240 and <760	1.79	1.79	Equivalent.
Water-cooled	Upflow Non-Ducted.	<65	2.49	Condenser entering water temperature.	<65	2.25	2.25	Less Stringent.
Water-cooled	Upflow Non-Ducted.	≥65 and <240	2.39		≥65 and <240	2.17	2.15	Less Stringent.
Water-cooled	Upflow Non-Ducted.	≥240 and <760	2.29		≥240 and <760	2.09	2.05	Less Stringent.
Water-cooled with fluid economizer.	Upflow Non-Ducted.	<65	2.44	Add allowance for heat rejection components to total power input.	<65	2.21	2.20	Less Stringent.
Water-cooled with fluid economizer.	Upflow Non-Ducted.	≥65 and <240	2.34		≥65 and <240	2.13	2.10	Less Stringent.
Water-cooled with fluid economizer.	Upflow Non-Ducted.	≥240 and <760	2.24		≥240 and <760	2.05	2.00	Less Stringent.
Glycol-cooled	Upflow Non-Ducted.	<65	2.39	Add allowance for heat rejection components to total power input.	<65	2.03	2.00	Less Stringent.
Glycol-cooled	Upflow Non-Ducted.	≥65 and <240	2.04		≥65 and <240	1.77	1.85	More Stringent.
Glycol-cooled	Upflow Non-Ducted.	≥240 and <760	1.99		≥240 and <760	1.73	1.75	More Stringent.
Glycol-cooled with fluid economizer.	Upflow Non-Ducted.	<65	2.34		<65	1.99	2.00	More Stringent.
Glycol-cooled with fluid economizer.	Upflow Non-Ducted.	≥65 and <240	1.99		≥65 and <240	1.73	1.75	More Stringent.
Glycol-cooled with fluid economizer.	Upflow Non-Ducted.	≥240 and <760	1.94		≥240 and <760	1.69	1.70	More Stringent.

* Refer to Table II.3 of this document for specific changes in rating conditions.

CRAC Issue 2: DOE requests comment on the methodology and results for the crosswalk analysis.

As indicated by the crosswalk, a number of the standard levels established for CRACs in ASHRAE 90.1–2016 are less stringent than the current Federal standards. DOE is aware that ASHRAE is currently working on the next version of ASHRAE Standard 90.1, which is expected to be issued sometime in 2019. (Generally, ASHRAE updates the standard on a three-year cycle.) A preliminary review of the second public review draft of Addendum 'be' to ASHRAE 90.1–2016 indicates that a number of the draft efficiency levels for CRACs would be more efficient than the current Federal standards. The draft addendum also would update capacity bin boundaries for upflow ducted and downflow CRAC equipment classes, to reflect the increase in NSCC that results from changes in the test procedure and metric adopted in the updates under ASHRAE Standard 90.1–2016 (as discussed in previous sections).

DOE continues to monitor the efforts of ASHRAE in development of the consensus industry standard, and upon publication of the updated ASHRAE Standard 90.1, DOE will conduct an analysis as required under EPCA of any updated efficiency levels for CRACs.

3. CRAC Standards Amended Under ASHRAE Standard 90.1

As discussed, DOE has analyzed the updated CRAC efficiency levels in ASHRAE 90.1–2016 for the purpose of 42 U.S.C. 6313(a)(6)(A). DOE identified five equipment classes for which the ASHRAE 90.1–2016 efficiency levels are more stringent than current DOE efficiency levels (expressed in NSenCOP, see the crosswalk results presented in section II.A.2 of this document), and 15 classes of CRACs for which standards are specified in ASHRAE Standard 90.1–2016 that are not currently subject to DOE's standards (*i.e.,* horizontal-flow). DOE has conducted an energy savings analysis, presented in section III of this document, for the five CRAC classes that currently have DOE standards and that DOE identified as having more stringent standards under ASHRAE 90.1–2016. Regarding the energy efficiency levels for the horizontal-flow equipment classes, DOE was unable to perform an energy savings potential for those 15 equipment classes, because DOE lacked the necessary market share data to disaggregate shipments for horizontal-flow units from total shipments for the entire CRAC market. Based on information received in response to this document or otherwise identified, DOE may consider disaggregating horizontal-flow classes in the NOPR and analyzing them separately.

DOE notes that ceiling-mounted CRACs, both ducted and non-ducted, are covered equipment under the definition of ''computer room air conditioner'' established at 10 CFR 431.92. The current definition of ''computer room air conditioner'' makes no distinction based on the mounting (floor versus ceiling, for example), airflow direction, or whether the unit installation requires supply air ductwork.[17] Additionally, the currently applicable test procedure in 10 CFR 431.96 (*i.e.,* ANSI/ASHRAE 127–2007) is not specific as to mounting or airflow direction (*e.g.,* upflow, downflow, horizontal) and provides procedures for both ducted systems (ANSI/ASHRAE 127–2007 section 5.1.4.5.1) and non-ducted systems (ANSI/ASHRAE 127–2007 section 5.1.4.5.3). As a result, ceiling-mounted CRACs are covered equipment and are currently subjected to testing and rating under the DOE regulations.

DOE specifies minimum efficiency standards for certain equipment classes of CRACs, specifically for upflow and downflow units. See 10 CFR 431.97. In an October 7, 2015 draft guidance, DOE stated that because the terms ''upflow'' and ''downflow'' do not apply to ceiling-mounted units, the current Federal standards are not applicable to those models that are exclusively ceiling-mounted CRACs.[18] DOE requested comment on the October 7, 2015 draft guidance. For the purpose of the analysis presented in this notice, DOE maintains that ceiling-mounted units are not subject to the current Federal standards for CRACs.

The 2016 update to ASHRAE Standard 90.1 does not directly address ceiling-mounted CRACs, but it specifies equipment classes of: Upflow ducted, upflow non-ducted, downflow, and horizontal flow. Consistent with the application of ''upflow'' and ''downflow'' in the draft guidance, the equipment classes specified in ASHRAE Standard 90.1–2016 do not include ceiling-mounted CRACs. As such, DOE did not include ceiling-mounted CRACs in the current analysis. DOE is aware that the second public review draft of Addendum 'be' to ASHRAE 90.1–2016 includes minimum efficiency levels for ceiling-mounted CRACs. To the extent the next amendment to ASHRAE Standard 90.1 includes efficiency levels for ceiling-mounted CRACs, DOE will evaluate energy efficiency standards for them to the extent required under EPCA.

B. Dedicated Outdoor Air Systems

DOASes appear to meet the EPCA definition for ''commercial package air conditioning and heating equipment,''[19] and could be considered as a category of that covered equipment. (42 U.S.C. 6311(8)(A)) However, DOE has tentatively concluded that if DOASes are a category of ''commercial package air conditioning and heating equipment,'' there are no existing DOE test procedures or energy conservation standards for that category of commercial package air conditioning and heating equipment. Specifically, DOE does not believe that DOASes are among the commercial ''central air conditioners and central air conditioning heat pumps'' for which EPCA originally established standards (42 U.S.C. 6313(a)(1)–(2),(7)–(9)), and for which the current test procedure and standards are codified in Table 1 to 10 CFR 431.96 and Tables 1–4 of 10 CFR 431.97, respectively.

DOASes operate similarly to central air conditioners and central air conditioning heat pumps, in that they provide space conditioning using a refrigeration cycle consisting of a compressor, condenser, expansion valve, and evaporator. However, DOASes are designed to provide 100 percent outdoor air to the conditioned space, while outdoor air makes up a only a small portion of the total airflow for typical commercial air conditioners, usually less than 50 percent. When operating in humid conditions, the dehumidification load is a much larger percentage of total cooling load for a DOAS than for a typical commercial air conditioner. Additionally, compared to a typical commercial air conditioner, the amount of total cooling (both sensible and latent) is much greater per pound of air for a DOAS at design conditions (*i.e.,* the warmest/most humid expected summer conditions), and a DOAS is designed to accommodate greater variation in entering air temperature and humidity. DOASes are typically installed in addition to a primary cooling system (*e.g.,* CUAC, VRF, chilled water system, water-source heat pumps)—the DOAS conditions the outdoor ventilation air, while the primary system provides cooling to balance building shell and interior loads and solar heat gain.

ASHRAE Standard 90.1–2016 created 14 separate equipment classes for direct expansion-DOAS units that are single-package and remote condenser (referred to generally as DOAS), as shown in Table II.1 of this document, and set minimum efficiency levels using the integrated seasonal moisture removal efficiency (ISMRE) metric for all DOAS classes in dehumidification mode, as well as the integrated seasonal coefficient of performance (ISCOP) metric for air-source heat pump and water-source heat pump DOAS classes in heating mode.

If ASHRAE Standard 90.1 is amended with respect to the standard levels or design requirements applicable under that standard to any small, large, or very large commercial package air conditioning and heating equipment, DOE must publish an analysis of the energy savings potential of amended energy efficiency standards, and adopt uniform national standards for that equipment as required under EPCA. (42 U.S.C. 6313(a)(6)(A))

The 14 separate DOAS classes created by ASHRAE Standard 90.1–2016 (see Table II.1) are differentiated by condensing type (air-cooled, air-source heat pump, water-cooled, and water-source heat pump). The water-cooled condensing type is further divided by cooling tower condenser water and chilled water. The water-source heat pump condensing type is further separated by ground-source closed loop, ground-water-source, and water-source. Additionally, all equipment classes are separated into those without energy recovery and those with energy recovery. On July 25, 2017, DOE published an RFI in response to relevant updates to the test procedures referenced in ASHRAE Standard 90.1–

[17] ''Computer Room Air Conditioner'' is defined as ''a basic model of commercial package air-conditioning and heating equipment (packaged or split) that is: Used in computer rooms, data processing rooms, or other information technology cooling applications; rated for sensible coefficient of performance (SCOP) and tested in accordance with 10 CFR 431.96, and is not a covered consumer product under 42 U.S.C. 6291(1)–(2) and 6292. A computer room air conditioner may be provided with, or have as available options, an integrated humidifier, temperature, and/or humidity control of the supplied air, and reheating function.'' 10 CFR 431.92

[18] See, *https://www1.eere.energy.gov/buildings/appliance_standards/pdfs/crac_faq_2015-10-07.pdf.*

[19] Under the statute, ''commercial package air conditioning and heating equipment'' means air-cooled, water-cooled, evaporatively-cooled, or water-source (not including ground-water-source) electrically operated, unitary central air conditioners and central air conditioning heat pumps for commercial application. (42 U.S.C. 6311(8)(A))

2016. 82 FR 34427 (July 2017 ASHRAE TP RFI). As noted in the ASHRAE TP RFI, the EPCA definition for ''commercial package air conditioning and heating equipment'' does not include ground-water-source equipment. 82 FR 34427, 34438 (July 25, 2017). (*See also,* 42 U.S.C. 6311(8)(A)) As such, DOE is only considering the remaining 12 DOAS equipment classes.

DOE considered whether to evaluate separately the two water-cooled DOAS classes or whether the water-cooled cooling tower condenser water classes and the water-cooled chilled water classes should be grouped together and represented as water-cooled DOASes (with classes still disaggregated by those models with energy recovery and those models without energy recovery). DOE also considered whether to evaluate separately the two remaining water-source heat pump classes or whether the water-source heat pump ground-source closed loop classes and the water-source heat pump water-source classes should be grouped together and represented as water-source heat pump DOASes (with classes still disaggregated by those models with energy recovery and those models without energy recovery). Based on DOE's review of equipment specifications of water-cooled and water-source heat pump DOASes and comments from AHRI on the concurrent test procedure evaluation,[20] DOE determined that most water-cooled DOASes use the same equipment for different applications and that water-source heat pump DOASes use the same equipment design for different applications. DOE is not aware of water-cooled DOAS units that are exclusively designed for use with cooling tower or chilled water. Likewise, DOE is not aware of water-source heat pump DOAS units that are exclusively designed for use with water-source or ground-source closed-loop applications. It is also DOE's understanding that ASHRAE Standard 90.1 efficiency levels are different across comparable classes within the water-cooled condensing type (*e.g.,* comparing energy recovery classes to energy recovery classes) and across comparable classes within the water-source condensing type because of the different test/application conditions, as opposed to equipment design differences. For example, when testing a DOAS to obtain a water-cooled chilled water DOAS rating, a colder condenser water entering temperature is used than when testing it to obtain a water-cooled cooling tower DOAS rating, reflecting the typically cooler temperature of chilled water loops in commercial buildings, as compared with cooling tower water loops.

As a result, DOE combined the water-cooled cooling tower condenser water classes and the water-cooled chilled water classes and evaluated water-cooled DOASes as a single set of classes (with classes disaggregated by those models with energy recovery and those models without energy recovery) that is subject to a single set of operating conditions. DOE also combined the water-source heat pump ground-source closed loop classes and the water-source heat pump water-source classes and evaluated the water-source heat pump DOASes as a single set of classes (with classes still disaggregated by those models with energy recovery and those models without energy recovery) that is subject to a single set of operating conditions.

This approach is consistent with other commercial package air conditioning and heating equipment. For example, water-source heat pumps include application test conditions for water-loop, ground-water, and ground-loop heat pumps, but DOE only requires that equipment be rated using the water-loop conditions (see Table 3 to 10 CFR 431.97). DOE notes that this approach avoids testing under multiple application conditions for a single equipment design. In addition, even if tested at different application conditions because the DOAS equipment uses a single design, it is expected that the relative ranking of equipment efficiency would be the same.

The current industry test standard for DOASes, ANSI/AHRI Standard 920–2015, ''*2015 Standard for Performance Rating of DX-Dedicated Outdoor Air System Units,*'' references ANSI/ASHRAE Standard 198–2013, ''*Method of Test for Rating DX-Dedicated Outdoor Air Systems for Moisture Removal Capacity and Moisture Removal Efficiency*'' (ANSI/ASHRAE 198–2013), as the method of test for DOASes. In the July 2017 ASHRAE TP RFI, DOE also noted that section 2 of ANSI/ASHRAE 198–2013 specifically excludes DOASes with water coils that are supplied by a chiller located outside of the unit. 82 FR 34427, 33438 (July 25, 2017). However, Table 2 in ANSI/AHRI 920–2015 includes operating conditions for which a water-cooled condenser is supplied with chilled water, and ASHRAE 90.1–2016 established standard levels for DOASes that operate with chilled water as the condenser cooling fluid. *Id.* As part of the concurrent test procedure evaluation, AHRI commented that the industry test standard for DOASes was designed for units that contain vapor compression cycle based cooling and dehumidification with direct expansion coils. AHRI stated that direct application of chilled water coils to cool and dehumidify is outside the scope of the standard as the energy for cooling is expended at an external source of chilled water. (EERE–2017–BT–TP–0018–0011[21] at p. 18) Carrier commented that chillers should only be used for cooling coils and not for condenser heat rejection unless there is heat reclaim, and that this should be addressed with a building efficiency standard such as ASHRAE Standard 90.1. (EERE–2017–BT–TP–0018–0006 at p. 7) Based on these comments, DOE did not evaluate DOAS units that use chilled water coils directly for cooling and dehumidifying.

As discussed above, AHRI commented on the concurrent test procedure evaluation that in almost all cases, a single design is used for water-cooled equipment used with cooling tower water and chilled water, and similarly, a single design is used for all of the water-source applications, adding that for each of these cases, a single set of water conditions can be used for testing. (EERE–2017–BT–TP–0018–0011 at p. 17) AHRI recommended as part of the on-going process to update ANSI/AHRI 920–2015 that the cooling tower condenser water entering temperature be used for testing and rating all water-cooled DOASes and that the water-source inlet fluid temperature conditions be used for testing and rating all water-source heat pump DOASes. Based on this, DOE evaluated water-cooled DOASes using the cooling tower condenser water entering temperature conditions specified in Table 2 of ANSI/AHRI 920–2015, and water-source heat pump DOASes using the water-source (rather than ground-source) inlet fluid temperature conditions specified in Table 3 of ANSI/AHRI 920–2015. In addition, DOE conducted the analysis for water-cooled DOASes based on the efficiency levels established in ASHRAE Standard 90.1–2016 for the water-cooled cooling tower condenser water equipment classes, and for water-source heat pump DOASes based on the efficiency levels established in ASHRAE Standard 90.1–2016 for the water-source (rather than ground-source) equipment classes. This reduces the considered equipment classes to eight.

DOAS Issue 1: DOE requests comment on the approach of evaluating water-cooled DOASes as a single category (with classes

[20] *See* EERE–2017–BT–TP–0018–0011 at p. 17.

[21] Docket No. EERE–2017–BT–TP–0018 is available at *https://www.regulations.gov/docket?D=EERE-2017-BT-TP-0018*.

still disaggregated by those models with energy recovery and those models without energy recovery) using the specified cooling tower condenser water entering temperature conditions, and evaluating water-source heat pump DOASes as a single category (with classes still disaggregated by those models with energy recovery and those models without energy recovery) using the specified water-source (rather than ground-source) inlet fluid temperature conditions.

Among the eight equipment classes, DOE identified two classes, the air-cooled dehumidification-only (*i.e.,* no heat pump function) classes (including both energy recovery and non-energy recovery), as representing 95-percent of the DOAS market. The remaining five-percent of the market is split between the remaining four water-cooled and water-source equipment classes. DOE is not aware of significant market share of air-source heat pump DOAS. Due to the low market share and corresponding minimal potential energy savings, DOE did not evaluate the energy savings potential for these six equipment classes. Therefore, DOE conducted an analysis of energy savings potential for only the two air-cooled dehumidification-only equipment classes, which is described in section III of this document.

As discussed, no DOE test procedures or Federal uniform national standards exist for DOASes, a category of commercial package air conditioning and heating equipment. ASHRAE Standard 90.1–2016 includes a test procedure for DOASes (*i.e.,* ANSI/AHRI Standard 920–2015). DOE must amend the Federal test procedure to be consistent with the amended industry test procedure, unless DOE determines that to do so would result in a test procedure that is not reasonably designed to provide results representative of use during an average use cycle, or is unduly burdensome to conduct. (42 U.S.C. 6314(a)(4)(A)–(B))

AHRI is currently revising AHRI 920, and DOE is participating in that process. DOE may consider updates to the industry test standard when finalized, including evaluating potential impacts of any test procedure changes. ASHRAE Standard 90.1–2016 established minimum efficiency levels for DOASes, based on testing according to ANSI/AHRI 920–2015. Based on DOE's participation in the revision process, DOE notes that, if adopted, the proposed changes to AHRI 920 may alter the measured efficiency compared to that under the industry test standard referenced in ASHRAE 90.1–2016 (*i.e.,* ANSI/AHRI 920–2015). If DOE adopts the test procedures changes in the revised AHRI 920, DOE may develop a crosswalk from the efficiency levels in ASHRAE 90.1–2016 to the levels that would result under the revised AHRI 920 to appropriately evaluate the ASHRAE Standard 90.1–2016 provisions regarding DOASes.

DOAS Issue 2: DOE requests comment and data on developing a potential crosswalk from the efficiency levels in ASHRAE 90.1–2016 based on ANSI/AHRI 920–2015 to efficiency levels based on the revisions to AHRI 920.

C. Test Procedures

EPCA requires the Secretary to amend the test procedures for ASHRAE equipment to the latest version generally accepted by industry 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 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).[22] (42 U.S.C. 6314(a)(4)(B)) ASHRAE Standard 90.1–2016 updated several of its test procedures for ASHRAE equipment. Specifically, ASHRAE Standard 90.1–2016 updated to a more recent industry test standard for CRACs (AHRI 1360–2016) and adopted a test procedure for DOASes (ANSI/AHRI 920–2015). As stated, DOE is addressing the statutorily required evaluation of the test procedure updates separate from the evaluation presented in this document. In the ASHRAE TP RFI, DOE summarized its review of the updated industry test procedures, including changes as compared to the existing DOE test procedures, and requested comments and supporting data regarding representative and repeatable methods for measuring the energy use of the equipment. 82 FR 34427 (July 25, 2017).

[22] Specifically, the relevant provisions (42 U.S.C. 6314(a)(2)–(3)) provide that test procedures must be reasonably designed to produce test results that reflect energy efficiency, energy use, and estimated operating costs of a type (or class) of industrial equipment during a representative average use cycle and must not be unduly burdensome to conduct. Moreover, if the test procedure is for determining estimated annual operating costs, it must provide that such costs will be calculated from measurements of energy use in a representative average-use cycle, and from representative average unit costs of the energy needed to operate the equipment during such cycle. The Secretary must provide information to manufacturers of covered equipment regarding representative average unit costs of energy.

III. Analysis of Standards Amended and Newly Established by ASHRAE Standard 90.1–2016

As required under 42 U.S.C. 6313(a)(6)(A), for CRAC equipment classes with ASHRAE standard levels more stringent than the current Federal standards and DOASes for which ASHRAE established new standard levels, DOE performed an analysis to determine the energy-savings potential of amending Federal CRAC standards to the amended ASHRAE levels and adopting Federal DOAS standard levels as specified in ASHRAE Standard 90.1–2016.

As discussed, if DOE determines by rule published in the **Federal Register**, and supported by clear and convincing evidence, that adoption of a uniform national standard more stringent than the amended ASHRAE Standard 90.1 level would result in significant additional conservation of energy and is technologically feasible and economically justified, DOE must adopt the more-stringent standard. (42 U.S.C. 6313(a)(6)(A)(ii)(II) and (B)(i)) Therefore, for the CRAC equipment classes for which the ASHRAE 90.1 levels are more stringent than the current Federal standards and for DOASes for which ASHRAE established standards, DOE is also evaluating whether more stringent standards would meet the specified statutory criteria.

DOE performed an analysis of the potential energy savings at standard levels more stringent than the amended ASHRAE standards for CRACs and the established ASHRAE standards for DOASes. DOE's energy savings analysis is limited to equipment classes for which a market exists and sufficient data are available.

To determine whether a standard is economically justified, EPCA requires that DOE determine whether the benefits of the standard exceed its burdens by considering, to the greatest extent practicable, the following seven factors:

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

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

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

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

(7) Other factors the Secretary of Energy (Secretary) considers relevant.

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

DOE fulfills these and other applicable requirements by conducting a series of analyses throughout the rulemaking process. Table III.1 shows the individual analyses that are performed to satisfy each of the requirements within EPCA.

TABLE III.1—EPCA REQUIREMENTS AND CORRESPONDING DOE ANALYSIS

EPCA requirement	Corresponding DOE analysis
Significant Energy Savings	• Shipments Analysis • National Impact Analysis • Energy and Water Use Determination
Technological Feasibility	• Market and Technology Assessment • Screening Analysis • Engineering Analysis
Economic Justification:	
1. Economic impact on manufacturers and consumers	• Manufacturer Impact Analysis • Life-Cycle Cost and Payback Period Analysis • Life-Cycle Cost Subgroup Analysis • Shipments Analysis
2. Lifetime operating cost savings compared to increased cost for the product.	• Markups for Product Price Determination • Energy and Water Use Determination • Life-Cycle Cost and Payback Period Analysis
3. Total projected energy savings	• Shipments Analysis • National Impact Analysis
4. Impact on utility or performance	• Screening Analysis • Engineering Analysis
5. Impact of any lessening of competition	• Manufacturer Impact Analysis
6. Need for national energy and water conservation	• Shipments Analysis • National Impact Analysis
7. Other factors the Secretary considers relevant	• Employment Impact Analysis • Utility Impact Analysis • Emissions Analysis • Monetization of Emission Reductions Benefits • Regulatory Impact Analysis

The following discussion provides an overview of the energy savings analysis conducted for 5 classes of CRACs and 2 classes of DOASes as defined by ASHRAE Standard 90.1–2016, followed by summary results of that analysis. Although ASHRAE Standard 90.1–2016 introduced levels for 15 horizontal flow CRAC equipment classes, DOE was unable to estimate energy savings due to a lack of data (see section III.B.1 for details).

The issues relevant to the energy use analysis are also relevant to the technical and economic analyses DOE intends to conduct for CRACs and DOASes as necessary. In addition to the specific issues identified in the following sections on which DOE requests comment, DOE requests comment on its overall approach and analyses used to evaluate potential standard levels for CRACs and DOASes.

For the equipment classes where ASHRAE Standard 90.1–2016 prescribed more-stringent levels, DOE calculated the potential energy savings to the Nation associated with adopting ASHRAE Standard 90.1–2016 as the difference between a no-new-standards case projection (*i.e.,* without amended standards) and the ASHRAE Standard 90.1–2016 standards-case projection (*i.e.,* with adoption of ASHRAE Standard 90.1–2016 levels). For each higher efficiency level analyzed, DOE also calculated potential additional energy savings to the Nation as the difference between the ASHRAE Standard 90.1–2016 standards-case projection (*i.e.,* with adoption of ASHRAE Standard 90.1–2016 levels) and a more-stringent standards-case projection (*i.e.,* with more-stringent amended standards).

The national energy savings (NES) refers to cumulative lifetime energy savings for equipment purchased in a 30-year period that differs by equipment (*i.e.,* the compliance date differs by equipment class (*i.e.,* capacity) depending upon whether DOE is acting under the ASHRAE trigger or the 6-year-lookback (*see* 42 U.S.C. 6313(a)(6)(D)). In the standards case, equipment that is more efficient gradually replaces less-efficient equipment over time. This affects the calculation of the potential energy savings, which are a function of the total number of units in use and their efficiencies. Savings depend on annual shipments and equipment lifetime. Inputs to the energy savings analysis are presented in this notice, and details are available in the CRAC/DOAS NODA and RFI technical support document (TSD) on DOE's website.[23]

A. Annual Energy Use

The purpose of the energy use analysis is to assess the energy savings potential of different equipment efficiencies in the building types that utilize the equipment. DOE uses the annual energy consumption and energy-savings potential in the life-cycle cost (LCC) and payback period (PBP) analyses[24] to establish the savings in consumer operating costs at various equipment efficiency levels.

The Federal standard and higher efficiency levels are expressed in terms of an efficiency metric or metrics. For each equipment class, this section describes how DOE developed estimates

[23] The CRAC/DOAS NODA and RFI TSD is available on the web page for ASHRAE Products at: *http://www1.eere.energy.gov/buildings/appliance_standards/commercial/ashrae_products_docs_meeting.html.*

[24] The purpose of the LCC and PBP analyses are to analyze the effects of potential amended energy conservation standards on commercial consumers of CRACs and DOASes by determining how a potential amended standard affects the commercial consumers' operating expenses (usually decreased) and total installed costs (usually increased).

of annual energy consumption at the baseline efficiency level and at higher levels for each equipment category. These annual unit energy consumption (UEC) estimates form the basis of the national energy savings estimates discussed in section III.F of this document. More detailed discussion is found in the chapter 2 of the CRAC/DOAS NODA and RFI TSD.

1. Computer Room Air Conditioners

a. Equipment Classes and Analytical Scope

As noted previously in section II.A.3, DOE has conducted an energy savings analysis for the five CRAC classes that currently have both DOE standards and more-stringent standards under ASHRAE Standard 90.1. For horizontal-flow classes, DOE was unable to obtain market data to disaggregate energy savings potential for these equipment classes. Based on information received in response to this document or otherwise identified, DOE may disaggregate horizontal-flow classes in the NOPR and analyze them separately.

DOE conducted an energy analysis for 15 downflow CRAC equipment classes as part of the May 2012 final rule. 77 FR 28928, 28954 (May 16, 2012). In the May 2012 final rule, DOE used a modified outside temperature bin analysis. For each air-cooled equipment class, DOE calculated fan energy and condensing unit power consumption at each 5 °F outdoor air dry bulb temperature bin. The condensing unit power in this context included the compressor(s) and condenser fan(s) and/or pump(s) included as part of the equipment rating. For water-cooled and glycol-cooled equipment, the May 2012 final rule analysis first estimated the entering fluid temperature from either an evaporative cooling tower or a dry cooler for water-cooled and for glycol-cooled CRAC equipment, respectively, based on binned weather data. Using these results, DOE then estimated the condensing unit power consumption and adds to this the estimated supply fan power. The sum of the CRAC condensing unit power and the CRAC supply fan power is the estimated average CRAC total power consumption for each temperature bin. Annual estimates of energy use are developed by multiplying the power consumption at each temperature bin by the number of hours in that bin for each climate analyzed. In the May 2012 final rule, DOE then took a population-weighted average over results for 239 different climate locations to derive nationally representative CRAC annual energy use values. DOE assumed energy savings estimates derived for downflow equipment classes would be representative of upflow equipment. 77 FR 28928, 28954 (May 16, 2012). In this document, DOE is using the results from the May 2012 final rule as the basis for the energy savings potential analysis of the five CRAC equipment classes analyzed for this document.

b. Efficiency Levels

DOE identified the baseline, intermediate, and maximum technologically feasible (max-tech) efficiency levels for each equipment class. DOE used the Federal standard and the ASHRAE Standard 90.1–2016 level as baselines. The Federal standard is used as a baseline when estimating energy savings associated with adopting the ASHRAE Standard 90.1–2016 level. Savings from higher efficiency levels are measured relative to the ASHRAE Standard 90.1–2016 baseline. EL 0 refers to the ASHRAE Standard 90.1–2016 level.

To determine the intermediate and max-tech efficiency levels, DOE created an equipment database composed of CRAC models rated in terms of SCOP found in DOE's Compliance Certification Database.[25] Using this database, DOE created efficiency distribution plots for each equipment class and identified intermediate efficiency levels that correspond to efficiencies with a higher frequency of models available on the market. The max-tech efficiency levels correspond to units with the maximum efficiency observed in each equipment class. Intermediate and max-tech SCOP levels were translated into NSenCOP levels for the analyzed equipment classes in order to perform the energy savings determination analysis using the crosswalk analysis described in section II.A.1 of this document. Table III.2 shows the efficiency levels in NSenCOP used for the energy savings determination. Note that the table displays results in terms of current net sensible cooling capacity ranges (measured per the current DOE test procedure), rather than crosswalked NSCC ranges (see section II.A of this NODA for further discussion of the capacity crosswalk and equipment class switching issue for CRACs).

TABLE III.2—NSENCOP EFFICIENCY LEVELS FOR CRACS ENERGY SAVINGS ANALYSIS

Equipment type	Cooling medium	Net sensible cooling capacity	Current federal standard	EL 0*	EL 1	EL 2	EL 3	EL 4	Max-Tech
			(NSenCOP)						
Upflow, non-ducted	Glycol-Cooled without a Fluid Economizer.	≥65,000 Btu/h and <240,000 Btu/h.	1.77	1.85	1.87**	1.89	1.99	2.14**	2.29
		≥240,000 Btu/h and <760,000 Btu/h.	1.73	1.75	1.78**	1.81	1.94	2.01	2.04
	Glycol-Cooled with a Fluid Economizer.	<65,000 Btu/h	1.99	2.00	2.04**	2.07	2.14	2.20	2.24
		≥65,000 Btu/h and <240,000 Btu/h.	1.73	1.75	1.77	1.88	1.94	2.08**	2.22
		≥240,000 Btu/h and <760,000 Btu/h.	1.69	1.70	1.72	1.77	1.87	1.90	1.97

* EL 0 represents the ASHRAE Standard 90.1–2016 level.
** EL was interpolated between adjacent levels.

c. Analysis Method and Annual Energy Use Results

To derive UECs for the equipment classes analyzed in this document, DOE started with the adopted standard level UECs (*i.e.,* the current DOE standard) for the two glycol-cooled greater than 65,000 btu/h and three glycol-cooled with a fluid economizer downflow equipment classes analyzed in the May 2012 final rule. DOE assumed that these UECs correspond to the NSenCOP

[25] *https://www.regulations.doe.gov/certification-data/CCMS-4-Air_Conditioners_and_Heat_Pumps_-_Computer_Room_Air_Conditioners.html#q=Product_Group_s%3A%22Air%20Conditioners%20and%20Heat%20Pumps%20-%20Computer%20Room%20Air%20Conditioners%22.*

derived through the crosswalk analysis (*i.e.,* ''Cross-walked Current Federal Standard'' column in Table II.4). For higher efficiency levels, DOE determined the UEC by dividing the baseline NSenCOP level by the NSenCOP for each higher EL and multiplied the resulting percentage by the baseline UEC.

In the May 2012 final rule, DOE assumed energy savings estimates derived for downflow equipment classes would be representative of upflow equipment classes which differed by a fixed 0.11 SCOP. 77 FR 28928, 28954 (May 16, 2012). Because of the fixed 0.11 SCOP difference between upflow and downflow CRAC units in ASHRAE 90.1–2013, DOE determined that the per-unit energy savings benefits for corresponding CRACs at higher efficiency levels could be represented using the 15 downflow equipment classes. However, in this document, the efficiency levels for the upflow non-ducted equipment classes do not differ from the downflow equipment class by a fixed amount. For this document, DOE assumed that the fractional increase/decrease in NSenCOP between upflow and downflow units corresponds to a proportional decrease/increase in the baseline UEC within a given equipment class grouping of condenser system and capacity. Details can be found in chapter 3 of the CRAC/DOAS NODA and RFI TSD.

CRAC Issue 3: DOE seeks comment on the appropriateness of using UECs derived for the May 2012 final rule, specifically whether energy use has changed significantly since the 2012 analysis due to changes in operational behavior. DOE also requests feedback on scaling UECs using NSenCOP values for higher efficiency levels.

CRAC Issue 4: DOE seeks comment on its approach to determining the UEC of upflow units using the fractional increase or decrease in NSenCOP relative to the baseline downflow unit in a given equipment class grouping of condenser system and capacity.

Table III.3 and Table III.4 show UEC estimates for the equipment classes amended by ASHRAE Standard 90.1–2016 (*i.e.,* equipment classes for which the ASHRAE Standard 90.1–2016 energy efficiency level is more stringent than the current applicable Federal standard). The ''max-tech'' levels represent the market maximum identified in DOE's Compliance Certification Database and the California Energy Commission (CEC) database as of March 2019.

TABLE III.3—NATIONAL UEC ESTIMATES (kWh/year) FOR GLYCOL-COOLED, UPFLOW, NON-DUCTED CRACs

	≥65,000 Btu/h and <240,000 Btu/h	≥240,000 Btu/h and <760,000 Btu/h
Baseline—Federal Standard	119,105	266,479
Efficiency Level 0	113,955	263,434
Efficiency Level 1	112,736	258,994
Efficiency Level 2	111,543	254,701
Efficiency Level 3	105,938	237,633
Efficiency Level 4	98,512	229,358
Efficiency Level 5—''Max-Tech''	92,060	225,985

TABLE III.4—NATIONAL UEC ESTIMATES (KWH/YEAR) FOR GLYCOL-COOLED WITH FLUID ECONOMIZER, UPFLOW, NON-DUCTED CRACs

	<65,000 Btu/h	≥65,000 Btu/h and <240,000 Btu/h	≥240,000 Btu/h and <760,000 Btu/h
Baseline—Federal Standard	22,992	95,830	214,348
Efficiency Level 0	22,877	94,735	213,087
Efficiency Level 1	22,428	93,510	210,609
Efficiency Level 2	22,103	88,135	204,741
Efficiency Level 3	21,380	85,467	194,103
Efficiency Level 4	20,797	79,690	191,082
Efficiency Level 5—''Max-Tech''	20,426	74,678	183,986

2. Dedicated Outdoor Air Systems

a. Equipment Classes and Analytical Scope

DOE conducted an analysis of energy savings potential for two equipment classes of DOASes: (1) DOAS, air-cooled, without energy recovery and (2) DOAS, air-cooled, with energy recovery.

b. Efficiency Levels

DOE defines baseline efficiency levels, for each equipment class, to serve as a basis of comparison for any changes in equipment cost and energy use resulting from efficiency improvements that would be required under potential amended standards. As discussed in section I.A of this document, EPCA directs DOE to establish an amended ''uniform national standard'' at the minimum level specified in the amended ASHRAE Standard 90.1, unless it is determined by rule, and supported by clear and convincing evidence, that adoption of a uniform national standard more stringent that the amended ASHRAE Standard 90.1 would result in significant additional conservation of energy and is technologically feasible and economically justified. (42 U.S.C. 6313(a)(6)(A)(ii)) For the DOAS equipment classes evaluated in this document, DOE selected baseline efficiency levels equivalent to the performance standards established in ASHRAE Standard 90.1–2016; these standards are specified in terms of ISMRE for dehumidification and ISCOP for heating. Table III.5 shows the evaluated baseline efficiency levels for air-cooled DOASes.

TABLE III.5—BASELINE EFFICIENCY LEVELS FOR AIR-COOLED DOASES

Equipment class		Baseline efficiency level
Air-Cooled	w/o Energy Recovery	4.0 ISMRE
	w/Energy Recovery	5.2 ISMRE

For each air-cooled DOAS equipment class, DOE analyzed several efficiency levels. The AHRI Directory does not currently list DOAS equipment performance ratings. Similarly, DOE was not able to find ISMRE or ISCOP ratings in much of the manufacturer equipment specifications. DOE notes that one manufacturer[26] does provide capacities, ISMRE, and ISCOP by equipment class. However, as discussed in section II.B of this document, AHRI is currently revising AHRI 920, and DOE notes that AHRI 920-Draft includes changes and clarifications to the current industry test standard. Because of the current development of updates to AHRI 920–2015, DOE decided not to rely on existing ratings based on this test standard as the basis for the efficiency levels established for this document.

Instead, DOE relied on manufacturer equipment literature for currently available 20-ton capacity air-cooled DOAS models with sufficient design details of key components and performance data to evaluate efficiency. DOE considered equipment that included EER and IEER ratings based on the CUAC test procedure in appendix A, but that were also capable of dehumidifying 100 percent outdoor air to a 55 °F dew point operating under Standard Rating Condition A, as defined in ANSI/AHRI 920–2015. These included only air-cooled equipment without energy recovery. DOE estimated the ISMRE for this equipment by correlating EER to ISMRE based on manufacturer-provided data. As part of this investigation, DOE also considered the specific incremental design options used to achieve higher efficiency levels.

Based on this analysis, DOE is analyzing the two efficiency levels above the baseline for air-cooled DOASes without energy recovery. Although DOE did not identify any models with scaled EER-to-ISMRE efficiencies using the correlation described above at the baseline efficiency level, DOE determined based on manufacturer feedback that the baseline design would likely include staged compressors, and that the design change from the baseline efficiency level to EL 1 would involve changing from staged compressor operation to variable-capacity digital scroll compressors. The design changes from EL 1 to EL 2 include increasing the condenser heat exchanger size and fin density, increasing the total condenser fans horsepower, and reducing the capacity of the compressors needed.

For air-cooled DOASes with energy recovery, due to the similarity in designs, DOE considered that the same design options and resulting increase in efficiency from the analysis for DOASes without energy recovery would be applied for the DOASes with energy recovery equipment class.

Table III.6 presents the analyzed efficiency levels for both air-cooled DOAS equipment classes.

TABLE III.6—ANALYZED INCREMENTAL EFFICIENCY LEVELS FOR AIR-COOLED DOASES

Equipment class	Efficiency levels (ISMRE)		
	Baseline	EL 1	EL 2
Air-Cooled:			
w/o Energy Recovery	4.0	5.0	6.0
w/Energy Recovery	5.2	6.2	7.2

DOAS Issue 3: DOE requests information about the ranges of ISMRE and ISCOP levels that are available on the market by equipment class and capacity, in order to assist with selection of efficiency levels, including the market baseline.

c. Energy Use Simulations and Annual Energy Use Results

DOE used CBECS 2012 to develop a building sample to estimate the baseline UEC for the two DOAS equipment classes. CBECS 2012 has two variables that identify if a building's heating or cooling ventilation is provided by a DOAS. CBECS 2012 also provides variables to indicate the square footage per building, the representative national sample weight for each building, the ventilation energy use, the cooling energy use, and the main cooling equipment in a building. As CBECS 2012 uses separate variables for heating and cooling ventilation, DOE only included buildings that used a DOAS for both heating and cooling ventilation in its sample. The two DOAS equipment classes being analyzed are both air cooled. Therefore, DOE built its sample using buildings whose main cooling was provided by air-cooled equipment (residential style AC, package air conditioners, and room air conditioners).

The manufacturer literature shows that DOAS equipment is sized in tons of cooling capacity; therefore, DOE began its analysis by estimating the tons of cooling required for each building in the DOAS sample. DOE used square footage per ton of cooling estimates, presented in Table III.7 from PDH Online[27] to calculate the tons of cooling required for each building in the sample.

TABLE III.7—SQUARE FOOTAGE PER TON OF COOLING BY BUILDING TYPE

Building type	Sq. ft. per ton of cooling
Education	250
Enclosed mall	300
Food sales	350
Food service	200
Healthcare	280
Lodging	400
Non-refrigerated warehouse	400
Nursing	280

[26] Desert Aire DOAS Performance Catalog (Available at: *http://www.desert-aire.com/sites/default/files/Brochure-DOAS-Performance-Catalog-DA430.pdf.pdf*).

[27] Bhatia, A., HVAC Refresher—Facilities Standard for the Building Services (Part 2), PDH Online (Available at: *https://pdhonline.com/courses/m216/m216content.pdf*) (Last accessed March 28, 2019).

TABLE III.7—SQUARE FOOTAGE PER TON OF COOLING BY BUILDING TYPE—Continued

Building type	Sq. ft. per ton of cooling
Office	340
Public assembly	* N/A
Religious	* N/A
Retail (other than mall)	300
Service	340
Strip shopping	225

* Sized based on occupancy, 20 people per ton

A DOAS is used for latent cooling and ventilation, and CBECS 2012 provides the cooling energy and ventilation energy for each building. DOE divided the total ventilation energy use and the total cooling energy use by the tons of cooling required for each building to come up with a kWh/ton energy use metric per building. DOE then incorporated the building weights to calculate a national weighted average kWh/ton value for cooling and ventilation energy use. To determine the kWh/ton for a DOAS, DOE added 30 percent[28] of the cooling kWh/ton to the ventilation kWh/ton. This accounts for latent cooling and ventilation provided by the DOAS. DOE then multiplied the national weighted average kWh/ton by 20 tons (the size of the representative capacity unit) to determine the baseline energy use. CBECS 2012 does not provide information about the existence of an energy recovery wheel; however, manufacturer feedback has indicated that approximately 60 percent of the DOASes sold do not have energy recovery wheels. Therefore, the kWh/ton value from CBECS 2012 was used to determine the baseline unit energy consumption (UEC) for DOASes without energy recovery. To estimate the baseline UEC for DOASes with energy recovery, DOE scaled the UECs based on the percentage difference between the ISMRE baseline equipment without energy recovery and baseline equipment with energy recovery. DOE calculated energy use for efficiency levels beyond the ASHRAE baseline by dividing the baseline ISMRE by the ISMRE of each higher efficiency level, for each equipment class. The resulting percentage was then multiplied by the baseline UEC.

DOAS Issue 4: DOE requests comment on the appropriateness of using the above approach to develop UECs for DOASes, whether alternative assumptions should be made in the calculations, or whether an alternate source of DOAS unit energy consumption values is available. If DOE receives performance data for DOASes, then it will derive UECs by matching building loads to DOAS performance.

Table III.8 show the UEC estimates for the ASHRAE Standard 90.1–2016 levels, and the higher efficiency levels for the two air-cooled DOAS equipment classes analyzed.

TABLE III.8—ANNUAL UNIT ENERGY CONSUMPTION FOR AIR-COOLED DOASES BY EQUIPMENT CLASS

Efficiency level	Without heat recovery	With heat recovery
EL 0—ASHRAE	28,796	22,151
EL 1	23,037	18,578
EL 2—"Max Tech"	19,198	15,998

DOAS Issue 5: DOE requests data from field studies and laboratory testing which show system performance curves and how capacity and efficiency vary with outdoor air temperature, heating/cooling load, ventilation load, and any other factors that impact capacity and efficiency.

B. Shipments

DOE uses shipment projections by equipment class to calculate the national impacts of standards on energy consumption, as well as net present value and future manufacturer cash flows. DOE shipments projections typically are based on available historical data broken out by equipment. Current sales estimates allow for a more accurate model that captures recent trends in the market.

1. Computer Room Air Conditioners

In the May 2012 final rule, as a result of lack of CRAC shipment data for the United States, DOE estimated CRAC shipments by scaling historical data for the Australian CRAC market based on the relative number of businesses between the two countries and extrapolating shipments for future years. 77 FR 28928, 28960 (May 16, 2012). However, DOE stated that it is unknown whether the United States market mirrors the Australian market or whether model availability approximates shipment distributions. Id. at 28982. Thus, it is not fully clear the extent to which historical shipments data of the Australian CRAC market are representative of the current US market. In addition, a 2016 report by the Lawrence Berkeley National Laboratory (LBNL) on data center energy consumption[29] noted trends toward consolidation of smaller data centers into large, hyper-scale data centers which usually rely on air handling units (AHU) with chilled water coils served by chillers[30] rather than CRACs. An extrapolation of historical trends may not be appropriate as the small server rooms served by CRACs are replaced by large, hyper-scale data centers. Accordingly, for this document, DOE instead estimates CRAC shipments by analyzing trends in the cooling demand required from CRAC-cooled data centers. DOE's approach in this document estimates total annual shipments for the entire CRAC market and then uses market share data to estimate shipments for ASHRAE Standard 90.1–2016 triggered equipment classes.

DOE first estimated the installed base stock of CRACs using information on data centers in the 2012 Commercial Business Energy Consumption Survey (CBECS). CBECS identifies buildings that contain data centers, the number of servers in the data center, and associated square footage. Although CBECS does not specifically inquire about the presence of CRACs, DOE assumed any building identified as having a data center that did not have a central chiller or district chilled water system would be serviced by a CRAC. DOE assumed that a building with a central chiller or district chilled water system would use a computer room air handler (CRAH) and not a CRAC for its

[28] Sensible heat ratios in most buildings range between 0.6 and 0.8. Therefore, the latent portion of cooling load ranges from 0.2 to 0.4. DOE chose the midpoint for this exercise. (Available at: *https://www.engineeringtoolbox.com/shr-sensible-heat-ratio-d_700.html*) (Last accessed April 3, 2019).

[29] Shehabi, A., Smith, S.J., Horner, N., Azevedo, I., Brown, R., Koomey, J., Masanet, E., Sartor, D., Herrlin, M. and Lintner, W., *United States data center energy usage report* (2016) Lawrence Berkeley National Laboratory, Berkeley, California. LBNL–1005775 (Available at: *https://datacenters.lbl.gov/sites/all/files/DataCenterEnergyReport2016_0.pdf*) (Last accessed June 6, 2019).

[30] DOE does not regulate the efficiency of chillers.

data center cooling, and, thus, such building was not included in the analysis.

CBECS includes buildings that do not identify the presence of a data center, but do contain a significant number of servers, which would require some form of dedicated cooling. DOE assumed buildings with 10 or more servers that did not identify as having a data center and did not have a central chiller or district chilled water system would be serviced by CRAC units.

CRAC Issue 5: DOE assumed that buildings that do not identify the presence of a data center, but contain more than 10 servers would require a CRAC in the absence of a central chiller or district chilled water system. DOE requests comment on the appropriateness of using 10 servers as a threshold for assigning a CRAC unit for cooling.

In order to estimate the CRAC cooling capacity required for each data center in CBECS 2012, DOE first had to estimate the amount of heat generated from servers, networks, and storage equipment within data centers. Based on estimates from the LBNL data center report, DOE estimated average power consumption of volume servers, network equipment, and storage equipment at 330 Watts, 13 Watts, and 75 Watts, respectively.[31] Servers that were not in a data center were assumed to only have network equipment, while servers in a data center had both network and storage equipment, and thus a higher power draw.[32] DOE assumed 100 percent of the power draw was converted into heat exhaust that would need to be removed by a CRAC. DOE calculated the cooling load for each data center by multiplying the total server power draw by the number of servers in each building with a data center or more than 10 servers in CBECS 2012. The total cooling load was then multiplied by an oversize factor of 1.3. Oversizing of the cooling load gives the data center operator the flexibility to add more servers (and thus more heat) without having to increase the size of the cooling system.[33]

CRAC Issue 6: DOE requests input and data on the typical amount of oversizing employed by CRAC customers. DOE specifically requests comment on its decision to use an oversize factor of 30 percent in its energy use analysis. Additionally, DOE requests comment and supporting data indicating whether the oversize factor would change with equipment capacity or equipment class. DOE also requests comment on whether it is appropriate to apply its cooling calculation to data centers of all sizes.

CRAC Issue 7: DOE requests comment on its server power consumption estimates and any information or data on expectations of future server stock and energy use in small data centers.

One ton of cooling can remove 3.5 kW of heat from a space.[34] All data centers without central chillers were assumed to have CRACs, and the cooling capacity of the CRAC units were based on the three representative capacities analyzed in the May 2012 final rule. 77 FR 28928, 28954 (May 16, 2012). For CRACs with a cooling capacity of less than 65,000 Btu/h, a 3-ton unit was assigned as the representative capacity; cooling capacities from 65,000 Btu/h to 240,000 Btu/h were assigned a representative capacity of 11 tons, and air conditioners greater than or equal to 240,000 Btu/h and less than 760,000 Btu/h were assigned a 24-ton unit.

The final part of the stock methodology is estimating the redundancy requirements of the data center which reduces the per-unit energy use and increases the total estimated shipment of CRACs. Redundancy varies significantly across data centers ranging from having one extra unit (N+1 redundancy) to having complete redundancy (2N redundancy).[35] DOE assigned redundancy depending on the data center square footage provided in CBECS 2012. Categories 1–4 (data centers under 10,000 square feet) were given N+1 redundancy; category 5 (greater than 10,000+ sq. ft.) was assigned 2N redundancy. DOE assumed that servers that were not in a data center do not have cooling redundancy.

CRAC Issue 8: DOE seeks information and comment on the ratio of redundant to active equipment. DOE requests comment on whether installed redundancy practices differ by customer type (*i.e.,* private business versus government) or by CRAC capacity. If so, DOE seeks information and comment on factors that would affect the ratio of equipment redundancy for different consumers.

No-new standards case shipments (*i.e.,* shipments in the absence of an amended standard) were projected using the 2012 stock number of CRACs estimated from CBECS 2012. From 2012, a linear trend was used to develop a historical stock going back the average CRAC lifetime, which is estimated to be 15 years (see section III.D.1 of this document). To estimate the future market for CRACs given projected trends in data centers, DOE then took the sample of buildings from CBECS 2012 used to develop the 2012 stock and estimated what the stock would be in 2050. DOE used two variables to change the stock: (1) A 10-percent reduction in the number of servers in small data centers in 2050 and (2) a doubling of the power per server in 2050. DOE then went about calculating the stock using the same approach as described above. Once the stock in 2050 was calculated, DOE used a linear approach to estimate the stock for the years 2013–2049. New shipments were equal to the year-over-year difference in stock, and replacements were equal to the shipments from 15 years prior. Details can be found in chapter 4 of the CRAC/DOAS NODA and RFI TSD.

As the power and density of individual servers increase, the cooling load will increase, despite the reduction of the population of servers in smaller data centers. While overall shipments are not expected to change significantly between 2012 and 2050, there will be a shift to CRACs with a larger cooling capacity. Table III.9 shows the reference case shipments used to estimate potential energy savings.

[31] Shehabi, A., Smith, S.J., Horner, N., Azevedo, I., Brown, R., Koomey, J., Masanet, E., Sartor, D., Herrlin, M. and Lintner, W., *United States data center energy usage report* (2016), Lawrence Berkeley National Laboratory, LBNL–1005775 (Available at: *https://datacenters.lbl.gov/sites/all/files/DataCenterEnergyReport2016_0.pdf*) (Last accessed June 6, 2019).

[32] *Id.*

[33] Rasmussen, N., *Calculating Total Cooling Requirements for Data Centers—White paper 25. Schneider Electric* (Available at: *https://www.apcdistributors.com/white-papers/Cooling/WP-25%20Calculating%20Total%20Cooling%20Requirements%20for%20Data%20Centers.pdf*) (Last accessed June 6, 2019).

[34] *Id.*

[35] Shehabi, A., Smith, S.J., Horner, N., Azevedo, I., Brown, R., Koomey, J., Masanet, E., Sartor, D., Herrlin, M. and Lintner, W., *United States data center energy usage report* (2016) Lawrence Berkeley National Laboratory, LBNL–1005775 (Available at: *https://datacenters.lbl.gov/sites/all/files/DataCenterEnergyReport2016_0.pdf*) (Last accessed June 6, 2019).

TABLE III.9—ESTIMATED CRAC SHIPMENTS BY SCOP NET SENSIBLE COOLING CAPACITY

	<65,000 Btu/h	≥65,000 Btu/h and <240,000 Btu/h	≥240,000 Btu/h and <760,000 Btu/h	Total shipments
2012 Shipments	8,522	779	671	9,973
2050 Shipments	6,198	2,884	1,197	10,279

DOE's analysis of CBECS server stock provides estimates of shipments by cooling capacity. To further disaggregate shipments by equipment class, DOE used model counts of units in DOE's Compliance Certification Database. Table III.10 shows CRAC market share by equipment class grouping. Note that the table displays results in terms of current net sensible cooling capacity ranges (measured per the current DOE test procedure), rather than crosswalked NSCC ranges (see section II.A of this NODA for further discussion of the capacity crosswalk and equipment class switching issue for CRACs).

TABLE III.10—ESTIMATED MARKET SHARE FOR CRAC EQUIPMENT CLASSES BY EQUIPMENT CLASS

Condenser system	Orientation	<65,000 Btu/h * (%)	≥65,000 Btu/h and <240,000 Btu/h * (%)	≥240,000 Btu/h and <760,000 Btu/h * (%)
Air-cooled	Downflow	3.2	8.1	6.8
	Upflow	4.8	11.0	6.2
Water-cooled	Downflow	1.2	4.0	1.2
	Upflow	2.2	4.6	1.6
Water-cooled with fluid economizer	Downflow	1.8	5.5	1.2
	Upflow	1.7	6.1	2.1
Glycol-cooled	Downflow	1.1	2.7	0.5
	Upflow	2.1	3.3	0.5
Glycol-cooled with fluid economizer	Downflow	2.5	4.5	0.6
	Upflow	2.5	5.3	0.8

* Capacity measured per the current Federal test procedure.

DOE's Compliance Certification Database does not distinguish between upflow ducted and upflow non-ducted CRACs. DOE assumed upflow market share would be evenly split between the upflow ducted and upflow non-ducted equipment classes. DOE's database also does not include horizontal flow classes, as those models do not yet have standards. Table III.11 presents CRAC shipments in 2018 and 2050 for equipment classes analyzed for potential energy savings in this document. Note that the capacity ranges for upflow, non-ducted equipment classes listed in Table III.11 are not impacted by the change from SCOP to NSenCOP (see section II.A.1 for details.)

TABLE III.11—ESTIMATED SHIPMENTS FOR EQUIPMENT CLASSES ANALYZED IN THIS DOCUMENT

Equipment class	Shipments in 2018	Shipments in 2050
Glycol-cooled, ≥65,000 and <240,000 Btu/h, Upflow Non-ducted	44	87
Glycol-cooled, ≥240,000 and <760,000 Btu/h, Upflow Non-ducted	10	14
Glycol-cooled with economizer, <65,000 Btu/h, Upflow Non-ducted	412	329
Glycol-cooled with economizer, ≥65,000 and <240,000 Btu/h, Upflow Non-ducted	72	139
Glycol-cooled with economizer, ≥240,000 and <760,000 Btu/h, Upflow Non-ducted	17	23

CRAC Issue 9: DOE's approach to estimating energy savings relies on estimates for annual shipments for the total CRAC market. DOE seeks historical shipments data for CRACs and projections for growth of the market based on trends stakeholders have observed. Specifically, DOE requests as many years of historical shipments as can be provided, consistent with the example table in Table III.12.

TABLE III.12—REQUEST FOR HISTORICAL SHIPMENTS

	2012	2013	2014	2015	2016	2017	2018
Annual CRAC Shipments	....	....	....	....	....	....	....

CRAC Issue 10: In order to accurately disaggregate energy savings by equipment class, DOE is interested in market data by equipment class, efficiency level, and climatic region.

CRAC Issue 11: DOE requests data and feedback on its methodology for determining market share by equipment class. DOE also requests data on the breakdown of upflow units between upflow ducted and upflow non-ducted and data on shipments for horizontal-flow equipment classes.

CRAC Issue 12: DOE requests data and feedback on its stock calculation, particularly data about the number of small data centers that use CRACs, the assumption that buildings with a chiller or chilled water system will not use CRACs, and any data or information about the current stock of CRACs.

2. Dedicated Outdoor Air Systems

DOE developed its DOAS shipments estimates based on manufacturer feedback that shipments in 2016 were around 36,000 units and that DOAS growth is expected to be similar to that of VRF multi-split system equipment. A report by Cadeo Group [36] estimated VRF shipments to have double-digit growth through 2022. Therefore, to project shipments past 2016, DOE used a 10-percent growth rate through 2022 and then followed the same growth rate as other CUAC equipment, basing that growth rate on the reference case shipment projections in the National Impact Analysis spreadsheet [37] from the January 15, 2016 direct final rule for commercial unitary air conditioners and heat pumps and commercial warm air furnaces. 81 FR 2420 (''CUAC–CUHP CWAF DFR'').

Manufacturers estimate that air-cooled DOASes represent 95 percent of all DOAS shipments, and DOE assumed that this percentage would remain constant for the duration of the 30-year shipments analysis. As DOE is only analyzing the two air-cooled DOAS equipment classes, DOE reduced the annual shipments projections developed above by 5 percent to capture only the air-cooled product classes. Next, DOE allocated 59-percent of shipments to air-cooled DOAS without energy recovery and 41-percent of shipments to air-cooled DOAS with energy recovery, based on manufacturer estimates of the breakdown by product class.

DOAS Issue 6: DOE seeks historical data on DOAS shipments and forecasted growth of DOAS shipments by efficiency level, equipment class, and capacity.

DOAS Issue 7: DOE seeks information about the most common kinds of local, in-space cooling system with which a DOAS is paired. DOE seeks comment on the assumption that DOAS shipments will grow in line with VRF multi-split systems and water-source heat pumps in future years.

C. No-New-Standards-Case Efficiency Distribution

For CRACs, DOE estimated the no-new-standards case efficiency distributions for each equipment class using model counts from DOE's Compliance Certification Database. DOE bundled the efficiency levels into ''efficiency ranges'' and determined the percentage of models within each range. The distribution of efficiencies in the no-new-standards case for each equipment class can be found in chapter 4 of the CRAC/DOAS NODA and RFI TSD. DOE did not have any information on the market share of DOASes; therefore, a uniform distribution was used with 1/3rd of the market at each efficiency level to estimate national energy savings.

For the standards cases for all equipment addressed in this document, DOE assumed shipments at lower efficiencies were most likely to roll up into higher efficiency levels in response to more-stringent standards. For each efficiency level analyzed within a given equipment class, DOE used a ''roll-up'' scenario to establish the market shares by efficiency level for the year that standards would become effective (*e.g.,* 2019, 2020, or 2023). Available information also suggests that all equipment efficiencies in the no-new standards case that were above the standard level under consideration would not be affected. Table III.13 shows the no-new standards case efficiency distribution for CRACs.

TABLE III.13—CRACS NO-NEW-STANDARDS-CASE EFFICIENCY DISTRIBUTION

Equipment class	Federal (%)	Level 0 (%)	Level 1 (%)	Level 2 (%)	Level 3 (%)	Level 4 (%)	Level 5 (%)	Total (%)
Glycol-cooled, Upflow, Non-ducted, ≥65,000 Btu/h and <240,000 Btu/h	35.6	6.8	3.4	18.6	30.5	3.4	1.7	100
Glycol-cooled, Upflow, Non-ducted, ≥240,000 Btu/h	22.2	22.2	0.0	11.1	11.1	11.1	22.2	100
Glycol-cooled with a Fluid Economizer, Upflow, Non-ducted, <65,000 Btu/h	0.0	0.0	4.5	4.5	31.8	45.5	13.6	100
Glycol-cooled with a Fluid Economizer, Upflow, Non-ducted, ≥65,000 Btu/h and <240,000 Btu/h	12.6	10.5	29.5	22.1	23.2	1.1	1.1	100
Glycol-cooled with a Fluid Economizer, Upflow, Non-ducted, ≥240,000	0.0	26.7	33.3	6.7	6.7	13.3	13.3	100

CRAC Issue 13: DOE seeks input on its determination of the no-new-standards case distribution of efficiencies for CRACs and its projection of how amended energy conservation standards would affect the distribution of efficiencies in each standards case.

DOAS Issue 8: DOE also seeks input on how best to determine the no-standards-case efficiency distribution for DOASes.

Using the distribution of efficiencies in the no-new-standards case and in the standards cases for each equipment class analyzed in this document, as well as the UECs for each specified efficiency level (discussed previously), DOE calculated market-weighted average efficiency values. The market-weighted average efficiency value represents the average efficiency of the total units shipped at a specified amended standard level. The market-weighted average efficiency values for the no-new-standards case and the standards cases for each efficiency level analyzed within the equipment classes is provided in chapter 4 of the CRAC/DOAS NODA and RFI TSD.

DOAS Issue 9: DOE seeks historical shipment-weighted efficiency data for DOASes by equipment class.

D. Other Analytical Inputs

1. Equipment Lifetime

DOE defines ''equipment lifetime'' as the age at which a unit is retired from service. DOE used a 15-year lifetime for all CRAC equipment classes. This is the average lifetime used in the May 2012 final rule. 77 FR 28928, 28958 (May 16, 2012).

[36] Cadeo report, Docket ID EERE–2017–BT–TP–0018–0002.

[37] DOE Energy Conservation Standards for Small, Large, and Very Large Air-Cooled Commercial Package Air Conditioning and Heating Equipment, National Impact Analysis spreadsheet (Available at: *https://www.regulations.gov/document?D=EERE-2013-BT-STD-0007-0107*).

CRAC Issue 14: DOE requests any data or information regarding whether 15 years is an appropriate average value for CRAC equipment lifetime and whether equipment lifetime varies based on equipment class and/or efficiency level.

DOE does not have any data on the lifetime of DOASes; however, DOE did develop a lifetime model for commercial package air conditioners in the January 2016 CUAC–CUHP–CWAF DFR.[38] As DOASes are also package, DX equipment, DOE used the lifetimes it developed for 15-ton commercial package air conditioners to estimate the lifetime of DOASes. DOE calculated a mean lifetime of 22.6 years from the annual failure rates developed for 15-ton CUACs from the life-cycle model of the January 2016 CUAC–CUHP–CWAF DFR.[39] DOE used this mean lifetime of 22.6 years in its DOAS analysis.

DOAS Issue 10: DOE requests any data or information about the lifetime of DOASes and whether the equipment lifetime varies based on equipment class, condenser type, capacity, and efficiency level. In the absence of data about the lifetime of DOASes, DOE requests comment on the appropriateness of applying the lifetime developed for the January 2016 CUAC–CUHP CWAF DFR.

2. Compliance Dates and Analysis Period

If DOE were to prescribe energy conservation standards at the efficiency levels contained in ASHRAE Standard 90.1–2016, EPCA states that any such standard shall become effective on or after a date that is two or three years (depending on the equipment type or size) after the effective date of the applicable minimum energy efficiency requirement in the amended ASHRAE standard. (42 U.S.C. 6313(a)(6)(D)) If DOE were to prescribe standards more stringent than the efficiency levels contained in ASHRAE Standard 90.1–2016, EPCA dictates that any such standard will become effective for equipment manufactured on or after a date which is four years after the date of publication of a final rule in the **Federal Register**. (42 U.S.C. 6313(a)(6)(D)) For equipment classes where DOE is acting under its 6-year-lookback authority, if DOE were to adopt more-stringent standards, EPCA states that any such standard shall apply to equipment manufactured after a date that is the latter of the date three years after publication of the final rule establishing such standard or six years after the effective date for the current standard. (42 U.S.C. 6313(a)(6)(C)(iv))

For purposes of calculating the NES for the equipment in this evaluation, DOE used a 30-year analysis period starting with the assumed year of compliance listed in Table III.14 for each equipment class. This is the standard analysis period of 30 years that DOE typically uses in its NES analysis. For equipment classes with a compliance date in the last six months of the year, DOE starts its analysis period in the first full year after compliance. For example, if CRACs greater than 65,000 Btu/h and less than 240,000 Btu/h were to have a compliance date of October 26, 2019, the analysis period for calculating NES would begin in 2020 and extend to 2049.

While the analysis periods remain the same for assessing the energy savings of efficiency levels higher than the ASHRAE levels, those energy savings would not begin accumulating until 2023 (the assumed compliance date if DOE were to determine that standard levels more stringent than the ASHRAE levels are justified).

TABLE III.14—APPROXIMATE COMPLIANCE DATE OF AN AMENDED ENERGY CONSERVATION STANDARD FOR EACH EQUIPMENT CLASS

Equipment class	Approximate compliance date for adopting the efficiency levels in ASHRAE standard 90.1–2016	Approximate compliance date for adopting more-stringent efficiency levels than those in ASHRAE standard 90.1–2016
Computer Room Air Conditioners		
CRAC, Glycol-Cooled, ≥65,000 and <240,000 Btu/h, Upflow Non-ducted	10/26/2019	4/26/2023
CRAC, Glycol-Cooled, ≥240,000 Btu/h and <760,000 Btu/h, Upflow Non-ducted	10/26/2019	4/26/2023
CRAC, Glycol-Cooled with fluid economizer, <65,000 Btu/h, Upflow Non-ducted	10/26/2018	4/26/2023
CRAC, Glycol-Cooled with fluid economizer, ≥65,000 and <240,000 Btu/h, Upflow Non-ducted	10/26/2019	4/26/2023
CRAC, Glycol-Cooled with fluid economizer, ≥240,000 Btu/h and <760,000 Btu/h, Upflow Non-Ducted	10/26/2019	4/26/2023
Dedicated Outdoor Air Systems		
All Equipment Classes	10/26/2019	4/26/2023

E. Other Energy Conservation Standards Topics

1. Market Failures

In the field of economics, a market failure is a situation in which the market outcome does not maximize societal welfare. Such an outcome would result in unrealized potential welfare. DOE welcomes comment on any aspect of market failures, especially those in the context of amended energy conservation standards for CRACs and DOASes.

2. Network Mode/''Smart'' Equipment

DOE recently published an RFI on the emerging smart technology appliance and equipment market. 83 FR 46886 (Sept. 17, 2018). In that RFI, DOE sought information to better understand market trends and issues in the emerging market for appliances and commercial

[38] Direct Final Rule Life-Cycle-Cost Analysis Spreadsheet (Available at: *https://www.regulations.gov/document?D=EERE-2013-BT-STD-0007-0106*).

[39] Direct Final Rule Life-Cycle-Cost Analysis Spreadsheet (Available at: *https://www.regulations.gov/document?D=EERE-2013-BT-STD-0007-0106*).

equipment that incorporate smart technology. DOE's intent in issuing the RFI was to ensure that DOE did not inadvertently impede such innovation in fulfilling its statutory obligations in setting efficiency standards for covered products and equipment. DOE seeks comments, data, and information on the issues presented in the RFI as they may be applicable to CRACs and DOASes.

3. Other

In addition to the issues identified earlier in this document, DOE welcomes comment on any other aspect of energy conservation standards for CRACs and DOASes not already addressed by the specific areas identified in this document.

F. Estimates of Potential Energy Savings

DOE estimated the potential primary and full-fuel cycle (FFC) energy savings in quads (*i.e.,* 10^{15} Btu) for each efficiency level considered within each equipment class analyzed. The potential energy savings for efficiency levels more stringent than those specified by ASHRAE Standard 90.1–2016 were calculated relative to the efficiency levels that would result if ASHRAE Standard 90.1–2016 standards were adopted. Table III.15 through Table III.17 show the potential energy savings resulting from the analyses conducted. The reported energy savings are cumulative over the period in which equipment shipped in the 30-year analysis continues to operate.

TABLE III.15—POTENTIAL ENERGY SAVINGS FOR CRACS, GLYCOL-COOLED, UPFLOW, NON-DUCTED

	≥65,000 Btu/h and <240,000 Btu/h †		≥240,000 Btu/h and <760,000 Btu/h †	
	NSenCOP	quads	NSenCOP	quads
Site Energy Savings Estimate (quads)				
Level 0	1.85	0.000	1.75	0.000
Level 1	1.87	0.000	1.78	0.000
Level 2	1.89	0.000	1.81	0.000
Level 3	1.99	0.000	1.94	0.000
Level 4	2.14	0.001	2.01	0.000
Level 5—"Max Tech"	2.29	0.002	2.04	0.000
Primary Energy Savings Estimate (quads)				
Level 0	1.85	0.000	1.75	0.000
Level 1	1.87	0.000	1.78	0.000
Level 2	1.89	0.000	1.81	0.000
Level 3	1.99	0.001	1.94	0.001
Level 4	2.14	0.003	2.01	0.001
Level 5—"Max Tech"	2.29	0.004	2.04	0.001
FFC Energy Savings Estimate (quads)				
Level 0	1.85	0.000	1.75	0.000
Level 1	1.87	0.000	1.78	0.000
Level 2	1.89	0.000	1.81	0.000
Level 3	1.99	0.001	1.94	0.001
Level 4	2.14	0.003	2.01	0.001
Level 5—"Max Tech"	2.29	0.005	2.04	0.001

† The potential energy savings for Level 0 (the ASHRAE Standard 90.1–2016 level) were calculated relative to the Federal standard. The potential energy savings for efficiency Levels 1–5 were calculated relative to Level 0.

TABLE III.16—POTENTIAL ENERGY SAVINGS FOR CRACS, GLYCOL-COOLED WITH A FLUID ECONOMIZER, UPFLOW, NON-DUCTED

	<65,000 Btu/h †		≥65,000 Btu/h and <240,000 Btu/h †		≥240,000 Btu/h and <760,000 Btu/h †	
	NSenCOP	quads	NSenCOP	quads	NSenCOP	quads
Site Energy Savings Estimate (quads)						
Level 0	2.00	0.000	1.75	0.000	1.70	0.000
Level 1	2.04	0.000	1.77	0.000	1.72	0.000
Level 2	2.07	0.000	1.88	0.000	1.77	0.000
Level 3	2.14	0.000	1.94	0.001	1.87	0.000
Level 4	2.20	0.000	2.08	0.002	1.90	0.000
Level 5—"Max Tech"	2.24	0.000	2.22	0.002	1.97	0.001
Primary Energy Savings Estimate (quads)						
Level 0	2.00	0.000	1.75	0.000	1.70	0.000
Level 1	2.04	0.000	1.77	0.000	1.72	0.000
Level 2	2.07	0.000	1.88	0.001	1.77	0.000
Level 3	2.14	0.000	1.94	0.002	1.87	0.001
Level 4	2.20	0.000	2.08	0.004	1.90	0.001

TABLE III.16—POTENTIAL ENERGY SAVINGS FOR CRACS, GLYCOL-COOLED WITH A FLUID ECONOMIZER, UPFLOW, NON-DUCTED—Continued

	<65,000 Btu/h †		≥65,000 Btu/h and <240,000 Btu/h †		≥240,000 Btu/h and <760,000 Btu/h †	
	NSenCOP	quads	NSenCOP	quads	NSenCOP	quads
Level 5—"Max Tech"	2.24	0.001	2.22	0.006	1.97	0.001
FFC Energy Savings Estimate (quads)						
Level 0	2.00	0.000	1.75	0.000	1.70	0.000
Level 1	2.04	0.000	1.77	0.000	1.72	0.000
Level 2	2.07	0.000	1.88	0.001	1.77	0.000
Level 3	2.14	0.000	1.94	0.002	1.87	0.001
Level 4	2.20	0.000	2.08	0.004	1.90	0.001
Level 5—"Max Tech"	2.24	0.001	2.22	0.006	1.97	0.001

† The potential energy savings for Level 0 (the ASHRAE Standard 90.1–2016 level) were calculated relative to the Federal standard. The potential energy savings for efficiency Levels 1–5 were calculated relative to Level 0.

TABLE III.17—POTENTIAL ENERGY SAVINGS FOR AIR-COOLED DOASES

Efficiency Level	Without energy recovery		With energy recovery	
	ISMRE	quads	ISMRE	quads
Site Energy Savings Estimate				
Level 0—ASHRAE	4.0		5.2	
Level 1	5.0	0.155	6.2	0.067
Level 2 = "Max Tech"	6.0	0.362	7.2	0.164
Primary Energy Savings Estimate				
Level 0—ASHRAE	4.0		5.2	
Level 1	5.0	0.408	6.2	0.176
Level 2 = "Max Tech"	6.0	0.951	7.2	0.431
FFC Energy Savings Estimate				
Level 0—ASHRAE	4.0		5.2	
Level 1	5.0	0.426	6.2	0.184
Level 2 = "Max Tech"	6.0	0.994	7.2	0.450

IV. Review Under Six-Year Lookback Provisions: Requested Information

As discussed, DOE is 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)) Accordingly, DOE is also evaluating the remaining 40 CRAC equipment classes for which ASHRAE Standard 90.1–2016 did not increase the stringency of the standards. In making a determination of whether standards for such equipment need to be amended, DOE must also follow specific statutory criteria. Similar to the consideration of whether to adopt a standard more stringent than an amended ASHRAE Standard 90.1 level, DOE must evaluate whether amended Federal standards would result in significant additional conservation of energy and are technologically feasible and economically justified. (42 U.S.C. 6313(a)(6)(C)(i)(I) (*referencing* 42 U.S.C. 6313(a)(6)(A)(ii)(II)) A determination of whether more-stringent standards are economically justified in the context of the six-year look-back provision requires an analysis under the same seven factors EPCA established for determining whether standards more stringent than an amended ASHRAE standard are required. (42 U.S.C. 6313(a)(6)(C)(i)(II) (*referencing* 42 U.S.C. 6313(a)(6)(B)(i)(I)–(VII)) (See section III)

As the analysis of more-stringent standards for those equipment classes of CRACs for which ASHRAE 90.1–2016 did not increase stringency of efficiency levels is similar to the analysis for those equipment classes for which ASHRAE 90.1–2016 did increase stringency of efficiency levels, the issues identified in section III apply to both sets of equipment classes. Specifically, for the 40 equipment classes of CRACs for which ASHRAE Standard 90.1–2016 does not specify energy efficiency levels more stringent than the currently applicable Federal standards, DOE requests comment and information on the following issues:

Annual Energy Use

CRAC Issue 15: DOE seeks comment on the appropriateness of using UECs derived for the May 2012 final rule, specifically whether energy use has changed significantly since the 2012 analysis due to changes in operational behavior. DOE also requests feedback on scaling UECs using NSenCOP values for higher efficiency levels.

CRAC Issue 16: DOE seeks comment on its approach to determining the UEC of upflow units using the fractional increase or decrease in NSenCOP relative to the baseline downflow unit in a given equipment class grouping of condenser system and capacity.

Shipments

CRAC Issue 17: DOE assumed that buildings that do not identify the presence of a data center, but contain more than 10 servers would require a CRAC in the absence of a central chiller or district chilled water system. DOE requests comment on the appropriateness of using 10 servers as a threshold for assigning a CRAC unit for cooling.

CRAC Issue 18: DOE requests input and data on the typical amount of oversizing employed by CRAC customers. DOE specifically requests comment on its decision to use an oversize factor of 30 percent in its energy use analysis. Additionally, DOE requests comment and supporting data indicating whether the oversize factor would change with equipment capacity or equipment class. DOE also requests comment on whether it is appropriate to apply its cooling calculation to data centers of all sizes.

CRAC Issue 19: DOE requests comment on its server power consumption estimates and any information or data on expectations of future server stock and energy use in small data centers.

CRAC Issue 20: DOE's approach to estimating energy savings relies on estimates for annual shipments for the total CRAC market. DOE seeks historical shipments data for CRACs and projections for growth of the market based on trends stakeholders have observed. Specifically, DOE requests as many years of historical shipments as can be provided with an example table requested in Table IV.1.

TABLE IV.1—REQUEST FOR HISTORICAL SHIPMENTS

	2012	2013	2014	2015	2016	2017	2018
Annual CRAC Shipments	....	....	....	....	....	....	....

CRAC Issue 21: In order to accurately disaggregate energy savings by equipment class, DOE is interested in market data by equipment class, efficiency level, and climatic region.

CRAC Issue 22: DOE requests data and feedback on its methodology for determining market share by equipment class.

CRAC Issue 23: DOE requests data and feedback on its stock calculation, particularly data about the number of small data centers that use CRACs, the assumption that buildings with chiller or chilled water system will not use CRACs, and any data or information about the current stock of CRACs.

No-New-Standards-Case Efficiency Distribution

CRAC Issue 24: DOE seeks input on its determination of the no-new-standards case distribution of efficiencies for CRACs and its projection of how amended standards would affect the distribution of efficiencies in each standards case.

Equipment Lifetime

CRAC Issue 25: DOE requests any data or information regarding whether 15 years is an appropriate average value for CRAC equipment lifetime and whether equipment lifetime varies based on equipment class and/or efficiency level.

V. Public Participation

A. Submission of Comments

DOE invites all interested parties to submit in writing by the date specified previously in the **DATES** section of this document, comments, data, and information on matters addressed in this document and on other matters relevant to DOE's consideration of amended energy conservation standards for CRACs and DOASes. Interested parties may submit comments, data, and other information using any of the methods described in the **ADDRESSES** section at the beginning of this document.

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

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

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

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

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

Include contact information each time you submit comments, data, documents, and other information to DOE. If you submit via postal mail or hand delivery/courier, please provide all items on a CD, if feasible, in which case it is not necessary to submit printed copies.

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

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

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

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

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

DOE considers public participation to be a very important part of the process for developing energy conservation standards. DOE actively encourages the participation and interaction of the public during the comment period in each stage of the rulemaking process. Interactions with and between members of the public provide a balanced discussion of the issues and assist DOE in the rulemaking process. Anyone who wishes to be added to the DOE mailing list to receive future notices and information about this process or would like to request a public meeting should contact Appliance and Equipment Standards Program staff at (202) 287–1445 or via email at *ApplianceStandardsQuestions@ee.doe.gov*.

B. Issues on Which DOE Seeks Comment

DOE welcomes comments on any aspect of this document for CRAC and DOAS equipment classes where ASHRAE Standard 90.1–2016 increased stringency (thereby triggering DOE's review of amended standards) and for CRAC and DOAS equipment classes undergoing 6-year-lookback review. DOE is particularly interested in receiving comments and views of interested parties concerning the following issues, listed by equipment category:

CRAC Issue 1: DOE seeks comment on whether, in the context of its consideration of more-stringent standards, there have been sufficient technological or market changes for CRACs since the most recent standards update that may justify a new rulemaking to consider more-stringent standards. Specifically, DOE seeks data and information that could enable the agency to determine whether DOE should propose a ''no new standard'' determination because a more-stringent standard: (1) Would not result in significant additional savings of energy; (2) is not technologically feasible; (3) is not economically justified; or (4) any combination of the foregoing.

CRAC Issue 2: DOE requests comment on the methodology and results for the crosswalk analysis.

CRAC Issue 3: DOE seeks comment on the appropriateness of using UECs derived for the May 2012 final rule, specifically whether energy use has changed significantly since the 2012 analysis due to changes in operational behavior. DOE also requests feedback on scaling UECs using NSenCOP values for higher efficiency levels.

CRAC Issue 4: DOE seeks comment on its approach to determining the UEC of upflow units using the fractional increase or decrease in NSenCOP relative to the baseline downflow unit in a given equipment class grouping of condenser system and capacity.

CRAC Issue 5: DOE assumed that buildings that do not identify the presence of a data center, but contain more than 10 servers would require a CRAC in the absence of a central chiller or district chilled water system. DOE requests comment on the appropriateness of using 10 servers as a threshold for assigning a CRAC unit for cooling.

CRAC Issue 6: DOE requests input and data on the typical amount of oversizing employed by CRAC customers. DOE specifically requests comment on its decision to use an oversize factor of 30 percent in its energy use analysis. Additionally, DOE requests comment and supporting data indicating whether the oversize factor would change with equipment capacity or equipment class. DOE also requests comment on whether it is appropriate to apply its cooling calculation to data centers of all sizes.

CRAC Issue 7: DOE requests comment on its server power consumption estimates and any information or data on expectations of future server stock and energy use in small data centers.

CRAC Issue 8: DOE seeks information and comment on the ratio of redundant to active equipment. DOE requests comment on whether installed redundancy practices differ by customer type (*i.e.,* private business versus government) or by CRAC capacity. If so, DOE seeks information and comment on factors that would affect the ratio of equipment redundancy for different consumers.

CRAC Issue 9: DOE's approach to estimating energy savings relies on estimates for annual shipments for the total CRAC market. DOE seeks historical shipments data for CRACs and projections for growth of the market based on trends stakeholders have observed. Specifically, DOE requests as many years of historical shipments as can be provided, consistent with the example table in Table III.12.

CRAC Issue 10: In order to accurately disaggregate energy savings by equipment class, DOE is interested in market data by equipment class, efficiency level, and climatic region.

CRAC Issue 11: DOE requests data and feedback on its methodology for determining market share by equipment class. DOE also requests data on the breakdown of upflow units between upflow ducted and upflow non-ducted and data on shipments for horizontal-flow equipment classes.

CRAC Issue 12: DOE requests data and feedback on its stock calculation, particularly data about the number of small data centers that use CRACs, the assumption that buildings with a chiller or chilled water system will not use CRACs, and any data or information about the current stock of CRACs.

CRAC Issue 13: DOE seeks input on its determination of the no-new-standards case distribution of efficiencies for CRACs and its projection of how amended energy conservation standards would affect the distribution of efficiencies in each standards case.

CRAC Issue 14: DOE requests any data or information regarding whether 15 years is an appropriate average value for CRAC equipment lifetime and whether equipment lifetime varies based on equipment class and/or efficiency level.

CRAC Issue 15: DOE seeks comment on the appropriateness of using UECs derived for the May 2012 final rule, specifically whether energy use has changed significantly since the 2012 analysis due to changes in operational behavior. DOE also requests feedback on scaling UECs using NSenCOP values for higher efficiency levels.

CRAC Issue 16: DOE seeks comment on its approach to determining the UEC of upflow units using the fractional increase or decrease in NSenCOP relative to the baseline downflow unit in a given equipment class grouping of condenser system and capacity.

CRAC Issue 17: DOE assumed that buildings that do not identify the presence of a data center, but contain more than 10 servers would require a CRAC in the absence of a central chiller or district chilled water system. DOE requests comment on the appropriateness of using 10 servers as a threshold for assigning a CRAC unit for cooling.

CRAC Issue 18: DOE requests input and data on the typical amount of oversizing employed by CRAC customers. DOE specifically requests comment on its decision to use an oversize factor of 30 percent in its energy use analysis. Additionally, DOE requests comment and supporting data indicating whether the oversize factor would change with equipment capacity or equipment class. DOE also requests comment on whether it is appropriate to apply its cooling calculation to data centers of all sizes.

CRAC Issue 19: DOE requests comment on its server power consumption estimates and any information or data on expectations of future server stock and energy use in small data centers.

CRAC Issue 20: DOE's approach to estimating energy savings relies on estimates for annual shipments for the total CRAC market. DOE seeks historical shipments data for CRACs and projections for growth of the market based on trends stakeholders have observed. Specifically, DOE requests as many years of historical shipments as can be provided with an example table requested in Table IV.1.

CRAC Issue 21: In order to accurately disaggregate energy savings by equipment class, DOE is interested in market data by equipment class, efficiency level, and climatic region.

CRAC Issue 22: DOE requests data and feedback on its methodology for determining market share by equipment class.

CRAC Issue 23: DOE requests data and feedback on its stock calculation, particularly data about the number of small data centers that use CRACs, the assumption that buildings with chiller or chilled water system will not use CRACs, and any data or information about the current stock of CRACs.

CRAC Issue 24: DOE seeks input on its determination of the no-new-standards case distribution of efficiencies for CRACs and its projection of how amended standards would affect the distribution of efficiencies in each standards case.

CRAC Issue 25: DOE requests any data or information regarding whether 15 years is an appropriate average value for CRAC equipment lifetime and whether equipment lifetime varies based on equipment class and/or efficiency level.

DOAS Issue 1: DOE requests comment on the approach of evaluating water-cooled DOASes as a single category (with classes still disaggregated by those models with energy recovery and those models without energy recovery) using the specified cooling tower condenser water entering temperature conditions, and evaluating water-source heat pump DOASes as a single category (with classes still disaggregated by those models with energy recovery and those models without energy recovery) using the specified water-source (rather than ground-source) inlet fluid temperature conditions.

DOAS Issue 2: DOE requests comment and data on developing a potential crosswalk from the efficiency levels in ASHRAE 90.1–2016 based on ANSI/AHRI 920–2015 to efficiency levels based on the revisions to AHRI 920.

DOAS Issue 3: DOE requests information about the ranges of ISMRE and ISCOP levels that are available on the market by equipment class and capacity, in order to assist with selection of efficiency levels, including the market baseline.

DOAS Issue 4: DOE requests comment on the appropriateness of using the above approach to develop UECs for DOASes, whether alternative assumptions should be made in the calculations, or whether an alternate source of DOAS unit energy consumption values is available. If DOE receives performance data for DOASes, then it will derive UECs by matching building loads to DOAS performance.

DOAS Issue 5: DOE requests data from field studies and laboratory testing which show system performance curves and how capacity and efficiency vary with outdoor air temperature, heating/cooling load, ventilation load, and any other factors that impact capacity and efficiency.

DOAS Issue 6: DOE seeks historical data on DOAS shipments and forecasted growth of DOAS shipments by efficiency level, equipment class, and capacity.

DOAS Issue 7: DOE seeks information about the most common kinds of local, in-space cooling system with which a DOAS is paired. DOE seeks comment on the assumption that DOAS shipments will grow in line with VRF multi-split systems and water-source heat pumps in future years.

DOAS Issue 8: DOE also seeks input on how best to determine the no-standards-case efficiency distribution for DOASes.

DOAS Issue 9: DOE seeks historical shipment-weighted efficiency data for DOASes by equipment class.

DOAS Issue 10: DOE requests any data or information about the lifetime of DOASes and whether the equipment lifetime varies based on equipment class, condenser type, capacity, and efficiency level. In the absence of data about the lifetime of DOASes, DOE requests comment on the appropriateness of applying the lifetime developed for the January 2016 CUAC–CUHP CWAF DFR.

VI. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of this notice of data availability and request for information.

Signed in Washington, DC, on August 16, 2019.

Alexander N. Fitzsimmons,

Acting Deputy Assistant Secretary for Energy Efficiency, Energy Efficiency and Renewable Energy.

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