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Proposed Rules

This section of the FEDERAL REGISTER contains notices to the public of the proposed issuance of rules and regulations. The purpose of these notices is to give interested persons an opportunity to participate in the rule making prior to the adoption of the final rules.

DEPARTMENT OF ENERGY

10 CFR Part 431

[EERE–2022–BT–STD–0002]

RIN 1904–AF40

Energy Conservation Program: Energy Conservation Standards for Fans and Blowers

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

ACTION: Notification of data availability (''NODA'').

SUMMARY: On February 8, 2022, the U.S. Department of Energy (''DOE'') published a request for information regarding energy conservation standards for fans and blowers. In this NODA, DOE is publishing preliminary inputs and methodology for its technology, screening, engineering, shipments, markups, life cycle cost, and energy use analysis for air circulating fans. Air circulating fans are a subcategory of fans; however, air circulating fans were not included in the Appliance Standards and Rulemaking Federal Advisory (''ASRAC'') negotiations undertaken in 2015 (see Docket No. EERE–2013–BT–STD–0006). The purpose of this NODA is to provide stakeholders with the opportunity to review and provide comment on DOE's preliminary technical and economic evaluation of air circulating fans, prior to DOE's publication of a notice of proposed rulemaking for all fans and blowers. The analysis presented in this NODA is consistent with the air circulating fans scope and definitions that DOE proposed in the July 25, 2022, test procedure notice of proposed rulemaking (''NOPR'') for fans and blowers (''July 2022 TP NOPR''). DOE requests comments, data, and information regarding its analysis.

DATES: Written comments and information will be accepted on or before November 28, 2022.

ADDRESSES: Interested persons are encouraged to submit comments using the Federal eRulemaking Portal at *www.regulations.gov,* under docket number EERE–2022–BT–STD–0002. Follow the instructions for submitting comments. Alternatively, interested persons may submit comments, identified by docket number EERE–2022–BT–STD–0002, by any of the following methods:

Email: FansAndBlowers2022STD0002@ee.doe.gov. Include the docket number EERE–2022–BT–STD–0002 in the subject line of the message.

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

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

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

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

The docket web page can be found at *www.regulations.gov/docket/EERE–2022–BT–STD–0002.* The docket web page contains instructions on how to access all documents, including public comments in the docket. See section III.A of this document for information on how to submit comments through *www.regulations.gov.*

FOR FURTHER INFORMATION CONTACT: Mr. Jeremy Dommu, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies, EE–5B, 1000 Independence Avenue SW, Washington, DC 20585–0121. Telephone: (202) 586–9870. Email: *ApplianceStandardsQuestions@ee.doe.gov.*

Mr. Matthew Schneider, U.S. Department of Energy, Office of the General Counsel, GC–33, 1000 Independence Avenue SW, Washington, DC 20585–0121. Telephone: (240) 597–6265. Email: *matthew.schneider@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.*

SUPPLEMENTARY INFORMATION:

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Introduction

A. Authority

The Energy Policy and Conservation Act, as amended (EPCA),[1] authorizes DOE to regulate the energy efficiency of a number of consumer products and certain industrial equipment. (42 U.S.C. 6291–6317) Title III, Part C [1] of EPCA, added by Public Law 95–619, Title IV, section 441(a) (42 U.S.C. 6311–6317 as codified), established the Energy Conservation Program for Certain Industrial Equipment, which sets forth a variety of provisions designed to improve energy efficiency.

EPCA specifies a list of equipment that constitutes covered equipment (hereafter referred to as ''covered equipment'').[2] EPCA also provides that ''covered equipment'' includes any other type of industrial equipment for which the Secretary of Energy (''Secretary'') determines inclusion is necessary to carry out the purpose of Part A–1. (42 U.S.C. 6311(1)(L), 6312(b)) EPCA specifies the types of industrial equipment that can be classified as covered in addition to the equipment enumerated in 42 U.S.C. 6311(1) This industrial equipment includes fans and blowers. (42 U.S.C. 6311(2)(B)(ii) and (iii)) Additionally, industrial equipment must be of a type that consumes, or is designed to consume, energy in operation; is distributed in commerce for industrial or commercial use[4]; and is not a covered product as defined in 42 U.S.C. 6291(a)(2) other than a component of a covered product with respect to which there is in effect a determination under 42 U.S.C. 6312(c). (42 U.S.C. 6311(2)(A)) On August 19, 2021, DOE published a final determination that the inclusion of fans and blowers as covered equipment was necessary to carry out the purpose of Part A–1 and classified fans and blowers as covered equipment. 86 FR 46579, 46588. Air circulating fans are a class of fans and blowers.

The energy conservation program under EPCA consists essentially of four parts: (1) testing, (2) labeling, (3) energy conservation standards, and (4) certification and enforcement procedures. Relevant provisions of EPCA include definitions (42 U.S.C. 6311), test procedures (42 U.S.C. 6314), labeling provisions (42 U.S.C. 6315), energy conservation standards (42 U.S.C. 6313), and the authority to require information and reports from manufacturers. (42 U.S.C. 6316, 42 U.S.C. 6296)

Federal energy efficiency requirements for covered equipment established under EPCA generally supersede state laws and regulations concerning energy conservation testing, labeling, and standards. (42 U.S.C. 6316(a) and (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 of EPCA. (42 U.S.C. 6316(b)(2)(D))

In proposing new standards, DOE must evaluate a proposal against the criteria detailed in 42 U.S.C. 6295(o), discussed further in section I.C of this document, and follow the rulemaking procedures set out in 42 U.S.C. 6295(p). (42 U.S.C. 6316(a))

DOE is publishing this NODA to collect data and information to inform its decision consistent with its obligations under EPCA.

B. Deviation From Appendix A

In accordance with Section 3(a) of appendix A to subpart C of 10 CFR part 430, DOE notes that it is deviating from that appendix's provision requiring a 75-day comment period for all pre-NOPR standards documents. (Section 6(d)(2) of appendix A to subpart C of 10 CFR part 430) DOE is instead providing a 45-day comment period which DOE believes is appropriate given the substantial stakeholder engagement to date, as discussed in section I.C of this document. The request for information on air circulating fans published on February 8, 2022, provided early notice to interested parties that the Department was interested in evaluating potential energy savings for this equipment. 87 FR 7048. Further, a 45-day comment period will allow DOE to review comments received in response to this NODA and use it to inform the analysis of equipment considered in evaluating potential energy conservation standards.

C. Background

On June 28, 2011, DOE published a notice of proposed coverage determination proposing that fans, blowers, and fume hoods would qualify as covered equipment under EPCA. 76 FR 37678. DOE noted that there were no statutory definitions for ''fan,'' ''blower,'' or ''fume hood,'' and presented definitions for consideration. 76 FR 37678, 37679. DOE subsequently published a framework document on February 1, 2013, detailing the analytical approach for developing potential energy conservation standards for commercial and industrial fans and blowers should the Secretary classify such equipment as covered equipment (''Framework Document''). 78 FR 7306. In the Framework Document, DOE determined that it lacked authority to establish energy conservation standards for fume hoods because fume hoods are not listed as a type of equipment for which DOE could establish standards. (Docket EERE–2013–BT–STD–0006, No. 1 at p. 15) DOE acknowledged that the fan, which provides ventilation for the fume hood, consumes the largest portion of energy within the fume hood system, and that DOE planned to cover all commercial and industrial fan types, which included fans used to ventilate fume hoods. *Id.*

On December 10, 2014, DOE published a NODA presenting an analysis estimating the economic impacts and energy savings from potential energy conservation standards for certain fans and blowers. This analysis did not include air circulating fans. 79 FR 73246.

On April 1, 2015, DOE published a notice of intent to establish an Appliance Standards and Rulemaking Federal Advisory Committee (ASRAC) Working Group for fans (hereafter referred to as the ''Working Group''). 80 FR 17359.

The Working Group [3] commenced negotiations at an open meeting on May

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

[2] ''Covered equipment'' means one of the following types of industrial equipment: Electric motors and pumps; small commercial package air conditioning and heating equipment; large commercial package air conditioning and heating equipment; very large commercial package air conditioning and heating equipment; commercial refrigerators, freezers, and refrigerator-freezers; automatic commercial ice makers; walk-in coolers and walk-in freezers; commercial clothes washers; packaged terminal air-conditioners and packaged terminal heat pumps; warm air furnaces and packaged boilers; and storage water heaters, instantaneous water heaters, and unfired hot water storage tanks. (42 U.S.C. 6311(1)(A)–(K))

[3] The Working Group was comprised of representatives from AAON, Inc.; AcoustiFLO LLC; AGS Consulting LLC; Air Movement and Control Association (AMCA); Air Conditioning, Heating, and Refrigeration Institute (AHRI), Appliance Standards Awareness Project (ASAP); Berner International Corp; Buffalo Air Handling Company;

Continued

18, 2015 and held 16 meetings and three webinars to discuss scope, metrics, test procedures, and standard levels for fans and blowers.[4] The Working Group concluded its negotiations on September 3, 2015, and, by consensus vote,[5] approved a term sheet containing 27 recommendations related to scope, test procedure and energy conservation standards (''term sheet''). (See Docket No. EERE–2013–BT–STD–0006, No. 179) ASRAC approved the term sheet on September 24, 2015. (Docket No. EERE–2013–BT–NOC–0005; Public Meeting Transcript, No. 58, at p. 29) The Working Group term sheet recommended the exclusion of air circulating fans. (See Docket No. EERE–2013–BT–STD–0006, No. 179, Recommendation #2 at p. 2) On November 1, 2016, DOE published a third notification of data availability (''November 2016 NODA'') that presented a revised analysis for fans and blowers other than air circulating fans, consistent with the scope and metric recommendations of the term sheet. 81 FR 75742.

On January 10, 2020, DOE received a petition from the Air Movement and Control Association, International (''AMCA''), Air Conditioning Contractors of America, and Sheet Metal & Air Conditioning Contractors of America requesting that DOE establish a test procedure for certain categories of fans based on an upcoming industry test method, AMCA Standard 214, ''Test Procedure for Calculating Fan Energy Index (FEI) for Commercial and Industrial Fans and Blowers'' DOE published a notice of petition for rulemaking and request for public comment (''April 2020 Notice of Petition for Rulemaking''). 85 FR 22677 (Apr. 23, 2020). AMCA, Air Conditioning Contractors of America, and Sheet Metal & Air Conditioning Contractors have since withdrawn their petition (EERE–2011–BT–DET–0045–00012, at p. 1)

In conjunction with this notice of petition for rulemaking, on May 10, 2021, DOE published a request for information requesting comments on a potential fan or blower definition. 86 FR 24752. On August 19, 2021, DOE published in the **Federal Register** a final coverage determination classifying fans and blowers as covered equipment. 86 FR 46579.

On October 1, 2021, DOE published a request for information pertaining to test procedures for fans and blowers (''October 2021 TP RFI''). 86 FR 54412. As part of the October 2021 TP RFI, DOE discussed the potential scope and definitions for air circulating fans. 86 FR 54412, 54414–54415. DOE is considering including air circulating fans in its analysis of potential energy conservation standards for fans and blowers. As noted previously, air circulating fans were not included in the scope of the term sheet and were not previously analyzed by the Department. DOE published a separate request for information on February 8, 2022, to seek input to aid in the development of the technical and economic analyses regarding whether standards for air circulating fans may be warranted (hereinafter referred to as the ''ECS RFI''). 87 FR 7048. DOE received comments in response to the ECS RFI from the interested parties listed in Table I–1.

TABLE I–1—LIST OF COMMENTERS WITH WRITTEN SUBMISSIONS IN RESPONSE TO THE ECS RFI

Commenter(s)	Reference in this NODA	Comment No. in the Docket	Commenter type
Air Movement and Control Association	AMCA	9,10	Trade Association.
Appliance Standards Awareness Project, American Council for an Energy Efficient Economy, Natural Resources Defense Council, and Northwest Energy Efficiency Alliance.	Joint Commenters	6	Efficiency Organizations.
California Investor-Owned Utilities	CA IOUs	7	Utility.
ebm-papst Inc.	ebm-papst	8	Manufacturer.
Robert Akscyn	Akscyn	2	Individual.
Rubén Guerra	Guerra	3	Individual.

A parenthetical reference at the end of a comment quotation or paraphrase provides the location of the item in the public record.[6] Comments received from the two individuals listed in Table I–1 are not discussed further in because they were either not relevant to the RFI or provide procedural recommendations.[7] [8]

Some of the comments received in response to the ECS RFI were related to the fans and blower test procedure. DOE published a proposed test procedure for fans and blowers on July 25, 2022 (''July 2022 TP NOPR'') in which it addressed the ECS RFI comments related to test procedure issues, including those related to definitions, scope of the test procedure, and metrics. 87 FR 44194.

To date, DOE has not proposed energy conservation standards for fans and

Carnes Company; Daikin/Goodman; ebm-papst; Greenheck; Morrison Products; Natural Resources Defense Council; Newcomb & Boyd; Northwest Energy Efficiency Alliance; CA IOUs; Regal Beloit Corporation; Rheem Manufacturing Company; Smiley Engineering LLC representing Ingersoll Rand/Trane; SPX Cooling Technologies/CTI; The New York Blower Company; Twin City Companies, Ltd; U.S. Department of Energy; and United Technologies/Carrier.

[4] Details of the negotiation sessions can be found in the public meeting transcripts that are posted to the docket for the energy conservation standard rulemaking at: *www.regulations.gov/docket?D=EERE–2013–BT–STD–0006.*

[5] At the beginning of the negotiated rulemaking process, the Working Group defined that before any vote could occur, the Working Group must establish a quorum of at least 20 of the 25 members and defined consensus as an agreement with less than four negative votes. Twenty voting members of the Working Group were present for this vote. Two members (Air Conditioning, Heating, and Refrigeration Institute and Ingersoll Rand/Trane) voted no.

[6] The parenthetical reference provides a reference for information located in the docket of DOE's rulemaking to develop energy conservation standards for fans and blowers. (Docket No. EERE–2022–BT–STD–0002, which is maintained at *www.regulations.gov*) The references are arranged as follows: (commenter name, comment docket ID number, page of that document).

[7] A comment from R. Guerra stated that they own a residential ceiling fan that produces its own energy (Guerra, No. 3 at p. 1). DOE notes that the fans evaluated in this rulemaking exclude both ceiling fans and furnace fans.

[8] R. Akscyn recommended that DOE provide a short RFI summary so stakeholders do not have to review such lengthy documents and that DOE consider presenting the variables included in its analyses in terms of dimensional parameters. (Akscyn, No. 2 at pp. 1–3) DOE appreciates these suggestions. With respect to the structure and length of RFIs, DOE notes that it has certain legal obligations which it must fulfill for every document that is published. In most documents, DOE includes summaries and headings to aid stakeholder review. Additionally, DOE notes that the purpose of an RFI is to collect data and information. The purpose of this document is to present DOE's analyses to support potential energy conservation standards for fans and blowers.

blowers, including air circulating fans. This NODA presents DOE's planned inputs and preliminary analysis to inform the development of potential energy conservation standards for air circulating fans. As previously discussed, DOE previously published and received public comment on three NODAs for fans and blowers, excluding air circulating fans. DOE plans to rely on the existing analysis from the Working Group for fans and blowers other than air circulating fans. This NODA focuses exclusively on air circulating fans and is intended to support DOE as it completes a notice of proposed rulemaking analysis for all fans and blowers, including air circulating fans. While the discussion in this NODA is specific to air circulating fans, DOE welcomes additional comments and data on fans and blowers other than air circulating fans relevant to its analysis of any potential energy conservation standards for all fans and blowers. In addition, DOE may consider conducting a separate rulemaking specific to air circulating fans instead of including air circulating fans as part of the fans and blowers rulemaking.

II. Summary of the Analyses Performed by DOE

This NODA focuses exclusively on air circulating fans and is intended to support DOE as it completes the notice of proposed rulemaking analysis for all fans and blowers, including air circulating fans. This NODA discusses the following for air circulating fans: (1) scope; (2) technology options; (3) engineering analysis; (4) markups analysis; (5) energy use analysis; (6) life cycle cost (''LCC'') and payback period (''PBP'') analyses; and (7) national impacts analysis. The items listed in Table II–1 provide an overview of the information about which DOE is requesting feedback. A supplemental spreadsheet documenting the assumptions and approach to the engineering analysis is included in the docket and accessible via the equipment rulemaking website. (See *https://www1.eere.energy.gov/buildings/appliance_standards/standards.aspx?productid=51&action=viewlive*)

TABLE II–1—OVERVIEW OF DATA PRESENTED IN THIS NODA

Analysis	Data presented
Scope	Scope of equipment considered in the analysis of any potential energy conservation standards and related definitions.
Technology Options	More efficient motors. Improved aerodynamic design (inclusive of blade shape and material selection).
Engineering Analysis	Representative sizes. Determination of baseline fan efficiency. Determination of efficiency levels by applying different technology options. Estimates for manufacturer production cost and manufacturer conversion cost at each efficiency level. Manufacturer markup.
Markups Analysis	Distribution channels. Fraction of sales going through each channel. Distribution channel markups and sales tax.
Energy Use Analysis	Average operating hours per day. Distribution of operating hours. Fraction of time spent in each mode (*i.e.,* speed setting).
Life Cycle Costs and Payback Period Analysis	Review of repair, installation, and repair practices and costs. Energy prices. Lifetimes of air circulating fans. Discount rates. Review of available data to determine efficiency distributions.
National Impact Analysis	Base year shipments. Shipments growth rates and information related to shipments projections. Information related to efficiency trends.

A. Scope

As stated previously, the July 2022 TP NOPR discussed potential scope and definitions for air circulating fans, which include unhoused air circulating fan heads and housed air circulating fan heads. 87 FR 44194. In the July 2022 TP NOPR, DOE proposed that the test procedure would be applicable to all air circulating fans and proposed to define an air circulating fan as a fan that has no provision for connection to ducting or separation of the fan inlet from its outlet using a pressure boundary, operates against zero external static pressure loss, and is not a jet fan. 87 FR 44194, 44215.

DOE is considering including all air circulating fans in its analysis of potential energy conservation standards for fans and blowers. This includes unhoused air circulating fan head and housed air circulating fan head, for which DOE proposed definitions as part of the July 2022 TP NOPR (87 FR 44194, 44216).

In the July 2022 TP NOPR, DOE also provided definitions for subsets of housed air circulating fan heads, specifically air circulating axial panel fans, box fans, cylindrical air circulating fans, and housed centrifugal air circulating fans. 87 FR 44194, 44216.

DOE notes that the definitions used in this NODA are aligned with the proposed definitions in the July 2022 TP NOPR, which in turn were derived from definitions proposed by the AMCA. In response to the ECS RFI, AMCA provided additional comments to the docket on July 7, 2022, summarizing definitions to terms under consideration by the committee revising the ANSI/AMCA 230–15 standard, ''Laboratory Methods of Testing Air Circulating Fans for Rating and Certification'' (''AMCA 230–15''). (AMCA, No. 10, p. 1) AMCA's comments focused on definitions for different categories of air circulating fans and provided context for how air circulating fans might be grouped. (AMCA, No. 10, pp. 1–10) DOE will further address the scope and definitions of air circulating fan categories in the test procedure rulemaking and plans to consider AMCA's comments as part of the test procedure rulemaking.

DOE also notes that in response to the ECS RFI, the Joint Commenters expressed their support for establishing energy conservation standards for air circulating fans, including air circulating fan heads, box fans, personnel coolers, and table fans. (Joint Commenters, No. 6 at p. 1) Additionally, the Joint Commenters agreed that, based on the definition fans and blowers, air circulating fan heads, box fans, personnel coolers, and table fans are within the scope of the fans and blowers equipment category. *Id.* Additionally, ebm-papst supported the inclusion of air circulating fans in the DOE test procedure and energy conservation standards for fans and blowers. (ebm-papst, No. 8 at p. 2) During the public meeting held for the July 2022 TP NOPR, AMCA commented that they believed it would be best to separate air circulating fans into a separate rulemaking from fans and blowers. (Public Meeting Transcript, EERE–2021–BT–TP–0021, No. 18 at pp. 12, 27, 43–44) Morrison Products supported AMCA's position that air circulating fans should be considered in a separate rulemaking. (Public Meeting Transcript, No. 18 at pp. 91–92) DOE has reviewed existing regulatory definitions and market materials and believes that air circulating fans fall within the definition of fans and blowers. DOE will review stakeholder comments and may consider a separate rulemaking for air circulating fans.

B. Technology Options

In the ECS RFI, DOE presented improved aerodynamic design, blade shape, more efficient motors, material selection, and variable-speed drives as potential technology options for air circulating fans and requested comment on: (1) how the specific technologies would impact air circulating fan efficiency; (2) whether the technologies listed apply equally to different categories of air circulating fans; (3) the impact of curved blades and airfoil blades on air circulating fan efficiency; (4) the impact of blade materials on fan efficiency; and (5) the percentage of air circulating fans sold with a motor and with variable-speed drive. 87 FR 7048, 7052.

In response, the Joint Commenters urged DOE to consider more efficient motors and more efficient blade designs in its analysis because of their energy savings potential. (Joint Commenters, No. 6 at p. 2) Specifically, they stated that alternating current (''AC'') direct-drive motors offer better efficiency than belt drives and that direct current (''DC'') motors are more efficient than AC motors. *Id.* They added that more advanced blade designs, such as airfoil blades, can improve the efficiency of a fan relative to traditional single-thickness blades. *Id.* emb-papst commented that to improve fan efficiency, inlet cones or bells and outlet vanes are occasionally included on air circulating fan housings and that winglets and rings are sometimes used on impellers. (ebm-papst, No. 8 at p. 3) Additionally, ebm-papst stated that the most efficient air circulating fans on the market (maximum available technology or ''max-tech'') often include the following features: an electronically commutated motor (''ECM''), injection-molded axial impellers, and outlet guide vanes. (ebm-papst, No. 8 at p. 4) Finally, ebm-papst commented that they are unaware of any air circulating fans that are sold without a motor. (ebm-papst, No. 8 at p. 3)

During manufacturer interviews,[9] many manufacturers stated that they would switch to more efficient motors before redesigning the housing and impeller (*i.e.,* the blade assembly), since fan redesign results in significant conversion costs. However, improving the overall fan aerodynamics with the addition of attachments, such as inlet cones or outlet vanes might be done before moving to higher efficiency and more costly motors.

DOE is not aware of any circulating fans that were distributed in commerce without an electric motor. Based on review of the Bioenvironmental and Structural System Laboratory (''BESS Labs'') database and air circulating fan teardowns, most motors paired with air circulating fans are not currently in the scope of DOE energy conservation standards (because they are split-phase (''SP'') motors and permanent split capacitor (''PSC'') motors).[10] As such, DOE expects that, in many cases, fan manufacturers are using lower efficiency motors. Therefore, in this NODA, DOE's analysis focuses primarily on improving air circulating fan efficiency through the use of more efficient motors, as described in more detail in section II.D.3.c. DOE also evaluates the efficiency gains and relative costs associated with fan aerodynamic redesign. Notably, DOE is conducting a separate energy conservation rulemaking for electric motors in which it is considering standards for certain single-speed SP electric motors, single-speed shaded pole electric motors, and single-speed PSC motors. (See Docket No. EERE–2020–BT–STD–0007) The Department will consider any outcome of the electric motors rulemaking when conducting its analysis of potential energy conservation standards for air circulating fans.

Issue 1: DOE requests comment on its assumption that most motors paired with air circulating fans are lower efficiency induction motors that are not currently regulated by DOE. Additionally, DOE requests data on the percentage of air circulating fans that include a SP, PSC, shaded pole, or electronically commuted motors.

C. Screening Analysis

DOE uses the following five screening criteria to determine which technology options are suitable for further consideration in an energy conservation standards rulemaking: (1) Technological feasibility; (2) Practicability to manufacturer, install, and service; (3) Impacts on product utility or product availability; (4) Adverse impacts on health or safety; and (5) Unique pathway proprietary technologies. 10 CFR part 430, subpart C, appendix A, sections 6(b)(3) and 7(b). If DOE determines that a technology, or a combination of technologies, fails to meet one or more of the listed five criteria, it will be excluded from further consideration in the engineering analysis.

DOE did not conduct a screening analysis for this NODA and instead is presenting analyses for more efficient motors with efficiency and cost estimates for aerodynamic redesign in order to receive stakeholder feedback. In future analysis to support this rulemaking, DOE may screen out some or all of the technologies discussed based on one or more of the screening criteria.

Issue 2: DOE requests comment on if or how the five screening criteria may impact the application of an aerodynamic redesign (including changes to housing, impeller and/or blade design), more efficient motors, or VSDs (''variable-speed drives'') as design options in the current rulemaking analysis.

D. Engineering Analysis

The purpose of the engineering analysis is to determine the incremental manufacturing cost associated with producing products at higher efficiency

[9] DOE conducted manufacturer interviews specific to air circulating fans from May 24 to May 31, 2022, to gather information for its analyses presented in this NODA. Four manufacturers opted to participate in these interviews.

[10] SP and PSC motors are types of single-phase motors that are not currently included in the scope of electric motors at 10 CFR 431.25 because only polyphase motors are included in this scope. SP and PSC motors are not currently included in the scope of small electric motors at 10 CFR 431.441 because they do not meet the statutory definition of ''small electric motor'' as defined at 10 CFR 431.442. In March 2022, DOE published a preliminary analysis for the ongoing energy conservation standards rulemaking for electric motors that included SP and PSC motors in its analysis. 87 FR 11650.

levels. The primary considerations in the engineering analysis are the selection of efficiency levels to analyze (*i.e.,* the ''efficiency analysis'') and the determination of product cost at each efficiency level (*i.e.,* the ''cost analysis'').

DOE conducts the efficiency analysis using either an efficiency-level approach, a design option approach, or a combination of both. Under the efficiency-level approach, the efficiency levels to be considered in the analysis are determined based on the market distribution of existing products (in other words, observing the range of efficiency and efficiency-level ''clusters'' that already exist on the market). This approach typically starts with compiling a comprehensive list of products available on the market, such as from DOE's product certification database. Next, the list of models is ranked by efficiency level from lowest to highest, and DOE typically creates a scatter plot to visualize the distribution of efficiency levels. From these rankings and visual plots, efficiency levels can be identified by examining clusters of models around common efficiency levels. The maximum efficiency level currently available on the market can also be identified.

Under the design option approach, the efficiency levels to be considered in the analysis are determined through detailed engineering calculations and/or computer simulations of the efficiency improvements from implementing specific design options that have been identified in the technology assessment. In an iterative fashion, design options can also be identified during product teardowns, described below. The design option approach is typically used when a comprehensive database of certified models is unavailable (for example, if a product is not yet regulated) and therefore the efficiency-level approach cannot be used.

In certain rulemakings, the efficiency-level approach (based on actual products on the market) will be extended using the design option approach to define ''gap fill'' levels (levels that bridge large gaps between other identified efficiency levels) and/or to extrapolate to the ''max-tech'' level (the level that DOE determines is the maximum achievable efficiency level), particularly in cases where the ''max-tech'' level exceeds the maximum efficiency level currently available on the market.

The cost analysis portion of the engineering analysis is conducted using one or a combination of cost approaches. The selection of the cost approach depends on a variety of factors such as the availability and reliability of information on product features and pricing, the physical characteristics of the regulated product, and the practicability of purchasing the product on the market. DOE generally uses the following cost approaches:

Physical teardown: Under this approach, DOE physically dismantles a commercially available product, component-by-component, to develop a detailed bill of materials (''BOM'') for the product.

Catalog teardown: In lieu of physically deconstructing a product, DOE identifies each component using available parts diagrams (available from manufacturer websites or appliance repair websites, for example) to develop the BOM for the product.

Price surveys: If neither a physical nor catalog teardown is feasible (for example, for tightly integrated products that are infeasible to disassemble and for which parts diagrams are unavailable), DOE conducts retail price surveys by scanning retailer websites and other marketing materials. This approach must be coupled with assumptions regarding distributor markups and retailer markups in order to estimate the actual manufacturing cost of the product.

Manufacturer interviews: DOE may conduct voluntary interviews with manufacturers to gather confidential information that can be used in its analyses. This information can include manufacturing costs, materials prices, and markups that can be used in DOE's cost analysis.

The engineering analysis conducted for this NODA used a design option approach supplemented by an efficiency level approach. The cost analysis relied on physical and catalog tear downs, cost analyses from other rulemakings, and confidential information provided by manufacturers.

1. Methodology

The engineering analysis presented in this NODA is consistent with the scope, definitions, and metric proposed in the July 2022 TP NOPR for all fans (including air circulating fans), except where described below.

a. Metric

In the July 2022 TP NOPR, DOE proposed to use the fan energy index (''FEI'') or weighted average FEI (in the case of multi-speed and variable-speed air circulating fans) as the efficiency metric for fans and blowers, including air circulating fans. (87 FR 44194, 44237–44238) FEI is an index calculated using the fan electrical input power at a given operating point, divided by the electrical input power of a reference fan at the same operating point. The FEI allows for the evaluation of fan or blower efficiency across a range of operating conditions, captures the performance of the motor, transmission, or motor controllers (if present), and enables differentiation of fans with motors, transmissions, and motor controller with different efficiencies. In the July 2022 TP NOPR, DOE proposed that the metric be determined as follows: (1) for single-speed fans, FEI would be evaluated at the single available speed and corresponding duty point; (2) for multi-speed fans and variable-speed fans, a weighted average FEI would be determined using a weighted average of all speeds tested. (87 FR 44194, 44238)

DOE notes that the BESS Labs combined database does not provide performance data for multiple speed fans at all the test speeds proposed in the July 2022 TP NOPR. Therefore, for this NODA, DOE evaluated potential efficiency improvements based only on high-speed test data. Because fans are typically less efficient at their maximum speed, DOE expects that this assumption provides a conservative estimate of potential efficiency gains relative to the baseline. In future analysis, DOE expects to conduct its analysis consistent with the approach adopting in the forthcoming fans and blower test procedure.

In the July 2022 TP NOPR, DOE also proposed FEI reference constants for flow rate, pressure and the efficiency target for air circulating fans. (87 FR 44194, 44230, 44232) Specifically, DOE proposed a flow rate constant (Q_0) of 3,201, and pressure constant (P_0) of 0 and an efficiency target (η_0) of 0.38. *Id.* DOE utilized these proposed constants in its calculations of reference FEI used in the engineering analysis. In the supplemental NODA spreadsheet included in this docket, DOE also provided performance in terms of cubic feet per minute per watt (or CFM/W), since the FEI metric is still relatively new. (See Docket No. EERE–2022–BT–STD–0002, No. 11)

b. Air Circulating Fan Performance Data

AMCA stated that no air circulating fans are currently certified by AMCA. (AMCA, No. 9 at p. 4) Additionally, AMCA commented that air circulating fan product literature may advertise fan performance calculated using multiple versions of the AMCA 230 standard (*e.g.,* AMCA 230–1999, AMCA 230–2007, AMCA 230–2012, AMCA 230–2015 without errata, and AMCA 230–15 with 2021 errata). They stated that all of these versions, except for AMCA 230–15 with 2021 errata, have at least one error with respect to thrust, volumetric flow rate, or input power. AMCA added that this is an issue for the purchaser, either because purchasers are not aware of these errors or because manufacturers are not required to state how air circulating fan performance values were obtained. (*Id.*) AMCA also provided a table in their response to the ECS RFI showing the corrections made between each version of AMCA 230. (AMCA, No. 9 at p. 5, Table 1) The contents of this table are reproduced below in Table II–2.

TABLE II–2—SUMMARY OF ERRORS AND CORRECTIONS IN ANSI/AMCA STANDARD 230

Year	Thrust	Volumetric-flow-rate equation	Input power
1999	No conversion for density	Incorrect—based on actual atmospheric density, but calculation exaggerated by multiplication factor of 1.414 (√2).	No conversion for density.
2007	Conversion to standard air density.	Not calculated	No conversion for density.
2012	Conversion to standard air density.	Incorrect—uses converted thrust but actual air density	No conversion for density.
2015	Conversion to standard air density.	Correct—uses converted thrust and standard air density.	No conversion for density.
2015: 2021 erratum	Conversion to standard air density.	Correct—uses converted thrust and standard air density.	Conversion to standard air density.

During interviews, manufacturers stated that data collected by BESS Labs, associated with the University of Illinois-Champaign, is the best source for air circulating fan data.[11] BESS Labs maintains a database of housed and unhoused air circulating fan heads that are used primarily in the agricultural industry (*i.e.,* poultry houses, greenhouses, dairy barns). DOE notes that these air circulating fans heads are tested by BESS Labs according to AMCA 230–12. DOE used the BESS Labs test data and applied conversion formulas to calculate the performance data of the fans according to AMCA 230–15 with 2021 errata. Details of these performance calculations are available in the supplementary spreadsheet attached to this docket. (EERE–2022–BT–STD–0002, No. 11)

DOE did not receive sufficient air circulating fan performance data from the ECS RFI stakeholder comment responses or from manufacturers during the interview process. Therefore, for this analysis, DOE relied primarily on the BESS Labs circulating fans database (''BESS Labs Database''). The BESS Labs Database categorizes circulating fans into the following categories: basket, box, panel, tube, tube with bell inlet, vented tube, wire basket, and wire tube.

Based on the proposed definitions discussed in section II.A, DOE mapped the categories in the BESS Labs Database as shown in Table II–3.

TABLE II–3—DOE CATEGORIZATION OF BESS LABS DATABASE CIRCULATING FAN CATEGORIES

July 2022 TP NOPR terminology	BESS labs database category
Unhoused air circulating fan head	Basket.
Housed air circulating fan head	
Box fan	Box.
Cylindrical air circulating fan	Tube, Tube with Bell Inlet, Vented Tube.
Air circulating axial panel fan	Panel.

For this initial analysis, DOE evaluated unhoused air circulating fan heads, box fans, and cylindrical air circulating fans.[12] DOE expects that the technology options evaluated in its analysis of these fans would be applicable to air circulating axial panel fans, especially improved motor efficiency. DOE expects that it will conduct additional analysis on air circulating axial panel fans in a subsequent part of this rulemaking.

DOE further notes that the BESS Lab Database did not include any housed centrifugal air circulating fans. DOE expects that it will conduct additional analysis on housed centrifugal air circulating fans in a subsequent part of this rulemaking. In addition, the BESS Labs Database includes very few air circulating fans with input power less than 125 W. DOE expects that it will conduct additional analysis on air circulating fans with input power less than 125 W in a subsequent part of this rulemaking.

To further inform its analysis, DOE completed testing and teardowns on a small sample of housed and unhoused air circulating fan heads.[13] For this analysis, DOE is assuming that the combination of housed and unhoused air circulating fan heads listed in the BESS Labs Database and those additional fans that DOE tested at BESS Labs (''BESS Labs Combined Database'') are representative of the air circulating fan head market. However, the air circulating axial panel fans in the BESS Labs database were excluded from DOE's analysis and housed centrifugal air circulating fans and air circulating fans with input power less than 125 W

[11] BESS Labs is a research, product-testing and educational laboratory. BESS Labs provides engineering data to air in the selection and design of agricultural buildings and assists equipment manufactures in developing better products. Test reports for circulating fans are publicly available at *bess.illinois.edu/current.asp.*

[12] The BESS Labs Database classifies circulating fans as basket, box, panel, tube, tube with bell inlet, vented tube, wire basket, and wire tube fans. DOE evaluated 58 box fans (housed circulating fan heads) and 40 tube fans (housed air circulating fan heads) and 102 basket fans (unhoused air circulating fan heads) in the BESS Labs Database, accessed on June 17, 2022.

[13] DOE tested seven basket fans (unhoused air circulating fan heads) and 11 tube fans (housed air circulating fan heads) and two box fans (housed air circulating fans heads) at BESS Labs. Where DOE has relied on the test data from these fans in addition to the BESS Labs Database, DOE has used the term ''BESS Labs Combined Database''.

were not represented in the BESS Labs Combined Database.

Issue 3: DOE requests comment on its assumption that the BESS Labs Combined Database is representative of the air circulating fan head market, with the exception of housed centrifugal air circulating fans and air circulating fans with input power less than 125 W which are not represented in the BESS Labs Combined Database.

Issue 4: DOE requests additional information for all categories of air circulating fans, including: manufacturer name, model number, fan diameter, blade number, blade shape, blade material, housing type, housing material, spacing between the blade tip and the housing, and housing depth with associated performance data obtained using AMCA 230–15 with 2021 errata (or sufficient information that can be used to correct to AMCA 230–15 with 2021 errata). DOE additionally requests the following information on the motors sold within each fan model: motor type (*i.e.,* SP, PSC, ECM, polyphase, etc.), type of drive (*i.e.,* direct or belt), motor horsepower (''hp''), motor full-load efficiency (if available), motor rotations per minute, number of speeds, motor electric requirements (*i.e.,* volts, amps, frequency, phase, AC/DC), and whether a variable-speed drive is included with the fan.

The minimum and maximum diameter housed and unhoused air circulating fan heads in the BESS Labs Combined Database are 12 inches and 52 inches, respectively. Although DOE did not evaluate fans smaller or larger than these diameters in this NODA, in the absence of additional data, DOE may consider extrapolating BESS Labs data to smaller and larger diameters using fan affinity laws to the extent such extrapolation is representative of the performance of such fans.

Issue 5: DOE requests comment on the potential of using fan affinity laws to extrapolate BESS Labs performance data to air circulating fan heads with diameters less than 12 inches and greater than 52 inches. Additionally, DOE requests model characteristics and performance data obtained using AMCA 230–15 plus 2021 errata (or sufficient information than can be used to correct to AMCA 230–15 plus 2021 errata) for air circulating fans with diameters both smaller than and larger than those listed in the BESS Labs Database.

2. Equipment Classes and Representative Sizes

In the ECS RFI, DOE requested comment on whether it should consider air circulating fan heads, personnel coolers, box fans, and table fans as separate categories (*i.e.,* equipment classes) or whether some or all of these four categories should be grouped together when evaluating potential energy conservation standards for air circulating fan heads. 87 FR 7048, 7051. DOE additionally requested whether these four fan categories have unique features or applications that might warrant separate consideration in the energy standards analysis. *Id.* Finally, DOE requested comment on whether it should consider separate equipment classes for air circulating fan heads based on diameter, operating speed, efficiency, or utility. *Id.*

The Joint Commenters stated that portable blowers may require an equipment class separate from air circulating fans because they provide a unique application (*i.e.,* drying floors), have centrifugal rather than axial construction, and are relatively low in efficiency. (Joint Commenters, No. 6 at p. 2) In the July 2022 TP NOPR, DOE proposed a definition for ''housed centrifugal air circulating fan'', which it believes is the same fan type that the Joint Commenters describe as a portable blower. 87 FR 44194, 44216. As discussed in section II.D.2.a, however, DOE has not yet finalized equipment classes for air circulating fans. DOE is requesting additional information and data on the utility of different fan categories to further inform its analysis.

AMCA commented that air circulating fan heads, box fans, personnel coolers, and table fans all provide directional airflow. (AMCA, No. 9 at p. 2) ebm-papst indicated that designing an air circulating fan for high outlet velocity may be an impediment to achieving greater fan efficiency. (ebm-papst, No. 8 at p. 3) DOE interprets this comment to mean that the utility of an air circulating fan (*i.e.,* a fan designed for high outlet velocity vs. more diffuse flow) may impact its efficiency.

a. Equipment Classes

When evaluating and establishing energy efficiency standards, DOE often divides covered equipment into separate classes by the type of energy used, equipment capacity, or some other performance-related features that justify differing standards. In deciding whether a performance-related feature justifies a different standard, DOE generally considers such factors as the utility of the feature to the consumer and other factors DOE determines are appropriate. (42 U.S.C. 6295(q) and 6316(a))

DOE has not yet identified equipment classes for air circulating fans, but is considering the following performance-related features that may justify separate equipment classes:

(1) Presence or absence of a safety guard;

(2) Presence or absence of housing;

(3) Housing design (*i.e.,* box, panel, cylindrical, bladeless, thermal, etc.);

(4) Blade type (axial, centrifugal);

(5) Drive type (belt, direct);

(6) Number of discrete speed settings (single-speed, two-speed, three-speed, etc.);

(7) Power requirements (input power, phase, voltage, etc.); and

(8) Air velocity or throw.

For the purposes of this NODA, DOE grouped all air circulating fans analyzed into a single equipment class.

Issue 6: DOE requests comment on whether, and if so how, each of the following performance-related features may impact utility of air circulating fans: presence or absence of a safety guard, presence or absence of housing, housing design, blade type, drive type, number of discrete speed settings, power requirements, and air velocity or throw. DOE requests additional feedback and data or information on other air circulating fan features that may impact utility for the end user and might form the basis for classification.

Issue 7: DOE requests comment with supporting data on whether the following performance-related features provide substantially different utility, or are expected to have a significant impact on efficiency because of how they are used: (1) housed vs. unhoused air circulating fan heads; (2) direct-driven vs. belt-driven air circulating fan heads; and (3) single-phase vs. polyphase air circulating fan heads. DOE also requests information on any additional features that may impact air circulating fan head utility.

b. Representative Sizes

The minimum and maximum diameters reported in the BESS Labs Database for housed and unhoused air circulating fan heads are 12 inches and 52 inches, respectively. DOE notes that diameter has been used to define representative units for ceiling fans and for previous analyses conducted on fans and blowers that are not air circulating fans.[14] Therefore, DOE developed a diameter histogram using the BESS Labs Combined Database to determine

[14] On November 1, 2016, DOE published a notification of data availability (''November 2016 NODA'') that presented an analysis for fans and blowers other than air circulating fans. 81 FR 75742. The engineering analysis evaluated manufacturer production cost as a function of efficiency level for 10-inch, 20-inch and 30-inch diameter fans and blowers that are not air circulating fans. See *www.regulations.gov/document/EERE–2013–BT–STD–0006–0189.*

representative diameters for analysis. Based on this distribution, DOE chose the following representative diameters for its analysis in this NODA: 12 inches, 20 inches, 24 inches, 36 inches and 50 inches. More details on the diameter distribution can be found in the supplementary spreadsheet included in the docket. (See Docket No. EERE–2022–BT–STD–0002, No. 11)

Issue 8: DOE requests comment on whether the diameters chosen for representative units in this analysis (*i.e.,* 12 inches, 20 inches, 24 inches, 36 inches, and 50 inches) accurately represent the diameters with the highest sales volume available in the air circulating fan market. DOE also requests comment on whether diameter is an appropriate representative metric for air circulating fans.

For each representative diameter, DOE used the most common motor shaft output power value in the BESS Labs Combined Database as the representative motor hp. Table II–4 summarizes the motor hp associated with each representative diameter in DOE's NODA analysis. More details on the motor hp distribution can be found in the supplementary spreadsheet included in the docket. (See Docket No. EERE–2022–BT–STD–0002, No. 11)

TABLE II–4—REPRESENTATIVE DIAMETERS AND ASSOCIATED REPRESENTATIVE MOTOR INPUT POWER USE IN THIS ANALYSIS

Representative diameter (inches)	Representative motor input power (hp)
12	0.1
20	0.33
24	0.5
36	0.5
50	1

Issue 9: DOE requests comment on whether the motor hp it has associated with each representative diameter (*i.e.,* 0.1 hp for 12 inches, 0.33 hp for 20 inches, 0.5 hp for 24 inches and 36 inches, and 1 hp for 50 inches) appropriately represent the motor hp for fans sold with those corresponding diameters.

To simplify the discussion in this NODA, the efficiency model and the cost model are discussed using a 24-inch representative unit. DOE's analysis for other representative units is included in the supplemental spreadsheet included in the docket. (See Docket No. EERE–2022–BT–STD–0002, No. 11)

3. Efficiency Model

The efficiency model is a key analytical tool used to construct cost-efficiency curves. This model is used to estimate efficiencies at different efficiency levels using a design option approach supplemented with a performance approach.

a. BESS Combined Database

DOE calculated FEI for all fans in the BESS Labs Combined Database by correcting the BESS data for air density, consistent with AMCA 230–15 (with 2021 errata) and using the FEI equation proposed in the July 2022 TP NOPR. 87 FR 44194, 44230, 44232. A plot of average FEI as a function of representative diameter and number of representative units analyzed in the BESS Labs Combined Database is shown in Figure 1.

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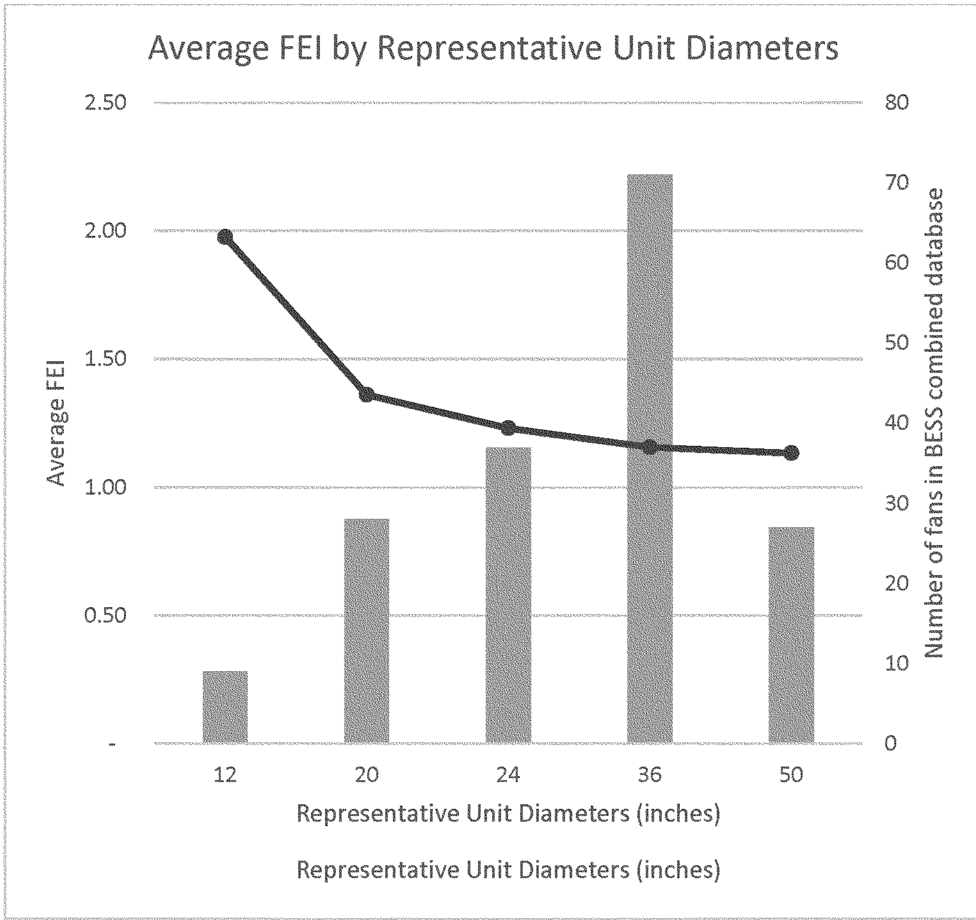

Figure 1: Average FEI and Number of Fans in the BESS Combined Database as a Function of Representative Diameter.

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As shown in Figure 1, FEI ranges from 0.39 to 2.74. A plot showing FEI for all fans in the BESS Labs Combined Database as a function of diameter can be found in the supplemental spreadsheet attached to this docket. (See Docket No. EERE–2022–BT–STD–0002, No. 11) FEI has minimal variance between 20-inch and 50-inch diameter fans; however, FEI increases sharply at diameters less than 20 inches. DOE expects this is because the reference fan used in the FEI calculation assumes a belt-drive. Table II–5 shows the number of direct-drive and the number of belt-drive air circulating fans in the BESS Labs Combined Database for each representative diameter. Relative to DOE's representative diameters, belt-driven fans are observed only at 36 inches and 50 inches. Only at 50 inches do belt-driven fans become more prevalent in the BESS Labs Combined Database than direct-drive fans.

TABLE II–5—DISTRIBUTION OF DIRECT-DRIVE AND BELT-DRIVE FANS IN THE BESS LABS COMBINED DATABASE BY DIAMETER

Diameter (inches)	Number of direct-drive	Number of belt-driven	Grand total
12	9	0	9
20	28	0	28
24	37	0	37
36	62	9	71
50	5	22	27

DOE also reviewed the BESS Labs Combined Database to understand the types of motors sold with air circulating fans. DOE evaluated motor type, model, and corresponding product literature for the 20 fans in the BESS Labs Combined Database that DOE tested, in addition to the 10 most efficient and least efficient fans in the database. DOE found that every fan evaluated as part of this exercise used either a single-phase PSC motor, a polyphase motor,[15] or an ECM. There was only one ECM fan in the BESS Labs Combined Database. Details of this analysis can be found in the supplemental spreadsheet attached to this docket. (See Docket No. EERE–2022–BT–STD–0002, No. 11)

DOE also compared the FEI values of fans that use single-phase and fans that use polyphase motors in the BESS Labs Combined Database and did not find a significant difference between the two. However, as discussed in a notice of proposed rulemaking for dedicated purpose pool pump motors published on June 21, 2021, DOE has previously found that polyphase motors are generally more efficient than single-phase motors due to differences in their construction. 87 FR 37122, 37136. For both the efficiency and cost analyses here, DOE opted to evaluate single-phase motor technologies only. Given that polyphase motors are generally more efficient than single-phase motors, DOE believes this is a more conservative approach. While DOE evaluated only single-phase motor technologies, it utilized the FEI data of both single-phase and polyphase motor fans in the BESS Labs Combined Database when determining FEI values. DOE did this since this approach provided more FEI data, and, despite the expectation that polyphase motors are generally more efficient than single-phase motors, there was not a significant difference in FEI between single-phase and polyphase fans in the database.

Although the BESS Labs Combined Database lists only PSC motors and one ECM, DOE's review of the air circulating fan market indicated that SP motors are also used in air circulating fans. In general, SP motors are the least efficient, ECMs are the most efficient, and PSC motor efficiency falls between SP motors and ECMs. The efficiency of each motor type can be improved by using higher quality steel and magnets, or by using more magnetic material. For this analysis, DOE assumed that the least efficient fans on the market (baseline) used SP motors and therefore evaluated potential air circulating fan efficiency improvements by replacing an SP motor with a PSC motor (''PSC 1''), replacing a PSC 1 motor with a more efficient PSC motor (''PSC 2''), and replacing a PSC 2 motor with an ECM.

Issue 10: DOE requests comment on its use of SP motors as the baseline for air circulating fans. Additionally, DOE seeks feedback on its choice of motor technologies (SP motor to PSC 1 motor, PSC 1 motor to PSC 2 motor, and PSC 2 motor to ECM) to estimate air circulating fan efficiency increases from one efficiency level to the next.

Additionally, DOE considered the efficiency gains that might be obtained from improving the aerodynamic design of an air circulating fan. DOE's analysis of the BESS Labs Combined Database did not indicate that any particular aerodynamic features, including blade design or housing/guard design, had a significant impact on air circulating fan efficiency. However, feedback received during manufacturer interviews indicated that blade design and housing/guard design can impact fan efficiency. For blade design, manufacturers generally responded that decreasing the number of fan blades, optimizing the blade shape for efficiency, and, for housed fans, decreasing the clearance between the blade tip and the housing can all improve the efficiency of air circulating fans. However, manufacturers added that decreasing the blade tip clearance can also increase the noise generated by the fan. For unhoused air circulating fans, manufacturers stated that increasing the spacing between wire guard wires and redesigning the motor hub supports more efficient airflow. For housed air circulating fans, manufacturers discussed the potential for improving fan efficiency by adjusting the inlet and outlet geometries to improve airflow.

Table II–6 summarizes the technology options DOE analyzed for each efficiency level.

TABLE II–6: TECHNOLOGY OPTIONS ASSOCIATED WITH EACH EFFICIENCY LEVEL

EL0 (baseline)	EL1	EL2	EL3	EL4
SP motor	PSC 1	PSC 2	ECM	ECM and Aerodynamic redesign.

DOE discusses its analysis of baseline efficiency and the efficiencies that it used in its analysis for each EL in the following sections.

b. Baseline Fan Efficiencies

The baseline configuration represents the lowest efficiency level commonly available in the market. Because energy conservation standards do not currently exist for air circulating fans, DOE must establish a baseline configuration using available information, as opposed to an existing energy conservation standard. The baseline configuration defines the energy consumption and associated cost for the lowest efficiency fan analyzed in each equipment class.

DOE assumed that baseline air circulating fans use SP motors because they are the least expensive type of air circulating fan motor on the market. As stated in the previous section, SP motors are less efficient than other electric motors available. Since DOE does not have test data for air circulating fans sold with a SP motor, DOE defined EL1 as a fan in the BESS Labs Combined Database with a PSC 1 motor. Using data from an electric motors database compiled by the Department (''Motors Database''), DOE established the loss in efficiency by replacing a PSC 1 motor (EL 1) with an SP motor (EL 0 or baseline).

Data in the Motors Database include information on motor topology (*i.e.,* whether the motor is SP, PSC, or another type), motor enclosure (*i.e.,* whether the motor is enclosed[16] or not or whether it is air-over[17] or not), motor hp, and motor efficiency. DOE notes that the motors in its Motors Database are not currently subject to DOE standards. Given that motor manufacturers are not required to certify motor performance values to DOE, it is possible that the nominal efficiency values presented in the catalog data are not accurate. During its review of air circulating fan motor literature, DOE found that every fan for which the motor enclosure type was divulged used

[15] Single-phase motors have a single conductor through which the alternating current input signal is sent to the motor. Polyphase motors have multiple conductors through which alternating current input signals that are phase-shifted from each other are sent to the motor.

[16] ''Enclosed'' motors are dust-tight, meaning that they prevent the free exchange of air to the point that particulates cannot enter the motor enclosure. ''Open'' motors allow the free exchange of air through the motor enclosure via openings designed for ventilation.

[17] ''Air-over'' motors are used specifically for fans and blowers, are placed in the pathway of the airflow, and are cooled by the airflow.

an air-over motor. Therefore, in this analysis, DOE assumed that all motors used for air circulating fans are air-over motors, and it considered only data for air-over SP motors and for air-over PSC motors in the Motors Database. ECMs were not included in the Motors Database.

To determine the differences in efficiency between SP motors and PSC motors, DOE used SP motor and PSC motor data from the motor database. DOE calculated the average efficiencies of SP motors and PSC motors for each motor output value in the database, then applied best fit curves to the average efficiency values as a function of horsepower. DOE used these equations to estimate SP motor and PSC 1 motor efficiencies and to calculate the decrease in efficiency from PSC 1 motors to SP motors for each representative unit horsepower. Using this approach, the efficiency decrease for the 24-inch diameter fan, correlating to the 0.5 hp unit, is 8.3 percent. Further details of how the efficiency difference between SP motors and PSC 1 motors was determined and applied to the fan FEI values can be found in Section II.D.3.c of this NODA and the supplementary spreadsheet attached to this docket. (See Docket No. EERE–2022–BT–STD–0002, No. 11)

Issue 11: DOE requests comment on its assumption that motors used in air circulating fans are exclusively air-over motors. If this is not the case, DOE requests information on the other types of motors that are sold with air circulating fans and data on the percentage of air circulating fans that are sold with motors other than air-over motors. Additionally, DOE requests information on whether or not the type of motor supplied with an air circulating fan is a function of air circulating fan category (*e.g.,* unhoused air circulating fan head, box fan, cylindrical air circulating fan, etc.).

To determine FEI values at EL 1, DOE established a separate FEI value at EL1 for fans less than 20 inches in diameter and for fans greater than or equal to 20 inches in diameter, consistent with the average FEI values shown in Figure 1, where FEI increases significantly below a diameter of 20 inches. Using the BESS Labs Combined Database, DOE defined EL1 as the 5th percentile of FEI values calculated for the 12-inch representative unit (FEI = 1.70) and the 5th percentile of FEI values calculated for all representative units with diameters at or above 20 inches (FEI = 0.79). The 5th percentile was chosen to conservatively capture the efficiencies of the least efficient air circulating fans in the database, which DOE assumed also used the least efficient PSC 1 motors, while excluding potential outliers with very low FEI values. Further details of this analysis can be found in the supplementary spreadsheet attached to this docket. (See Docket No. EERE–2022–BT–STD–0002, No. 11) Since DOE estimated SP motors to be 8.3 percent less efficient than PSC 1 motors for the 24-inch, 0.5 hp representative unit, DOE defined the baseline (EL 0) for this representative unit at FEI = 0.73. FEI values calculated for the 24-inch representative unit are shown in Table II–7 at the end of this section. Further details of this analysis can be found in the supplementary spreadsheet attached to this docket (see Docket No. EERE–2022–BT–STD–0002, No. 11).

Issue 12: DOE requests feedback on whether catalog performance data on SP motors and PSC motors is generally representative of the performance of the SP and PSC motors included with air circulating fans.

Issue 13: DOE requests feedback on the methodology used to determine the baseline efficiency values for the representative units, including its method of first establishing the EL1 efficiency and then determining the baseline efficiency by reducing the EL1 efficiency by the difference in efficiency between a PSC motor and a SP motor. Additionally, DOE requests data on the expected average improvement in air circulating fan efficiency when a SP motor is replaced by a PSC 1 motor.

c. Improving Efficiency With More Efficient Motors

This section describes how DOE estimated improvements in air circulating fan efficiency by using more efficient motors.

When substituting a more efficient motor for a less efficient motor, DOE assumed that the duty point of the fan (*i.e.,* the fan's airflow and pressure) remained the same, and that the only change in motor performance was a decrease in input power. Factors such as motor speed and inrush current were assumed to remain constant with the change in motor. This assumption enabled DOE to assume that a percent change in FEI is equal to a percent change in motor efficiency using the equations defined in ANSI/AMCA Standard 214–21, ''Test Procedure for Calculating Fan Energy Index (FEI) for Commercial and Industrial Fans and Blowers.'' This aligns with the July 2022 TP NOPR approach for calculating FEI. 87 FR 44194, 44230, 44232. A description of how DOE derived this relationship is provided in the supplementary spreadsheet attached to this docket. (See Docket No. EERE–2022–BT–STD–0002, No. 11) Throughout the remainder of this NODA, DOE will therefore discuss efficiency increases in terms of FEI and not in terms of motor efficiency increases. In the future, DOE may consider performing this analysis in terms of motor losses and shaft power, consistent with other rulemakings. See the ceiling fans preliminary analysis published February 9, 2022 (''Ceiling Fan Preliminary Analysis''). 87 FR 7758. See also the electric motors preliminary analysis published March 2, 2022 (''Electric Motors Preliminary Analysis''). 87 FR 11650.

Issue 14: DOE requests feedback on its assumption that airflow, pressure, and motor performance (for example, speed and inrush current) remain constant when replacing a less efficient motor with a more efficient motor in an air circulating fan. If airflow, pressure, or motor performance are not maintained when using a more efficient motor, DOE requests feedback and data on how it should conduct this analysis.

To determine the PSC 2 motor efficiencies, DOE again used PSC motor data from the motor database. Rather than fitting a curve to the average PSC motor efficiency values at each motor output power value, as it did for the PSC 1 motor curve, DOE instead fit a curve to the 95th percentile PSC motor efficiency values. The 95th percentile was chosen so that the efficiency values for PSC 2 motors were close to the maximum possible PSC motor efficiencies. DOE then used this curve to estimate PSC 2 motor efficiencies for the representative unit motor output power values.

For the representative units in this NODA that used 0.5 hp motors, replacing a 0.5 hp PSC 1 motor with a 0.5 hp PSC 2 motor increases the air circulating fan FEI by 11.2 percent. The resulting FEI for the 24-inch, 0.5 hp representative unit with a PSC 2 motor is therefore 0.88. (See Table II–7 at the end of this section) The supplementary spreadsheet attached to this docket provides more details on how efficiency increases from PSC 1 motors to PSC 2 motors were determined. (See Docket No. EERE–2022–BT–STD–0002, No. 11)

Issue 15: DOE requests feedback on whether the efficiency gains shown in the supplementary spreadsheet are realistic efficiency gains when replacing a lower efficiency PSC motor (*i.e.,* PSC 1 motor) with a higher efficiency PSC motor (*i.e.,* PSC 2 motor). If these assumptions are not realistic, DOE requests data demonstrating air circulating fan motor efficiency as a function of hp, as well as data for motor hp as a function of fan diameter.

To evaluate the efficiency increase when changing to an ECM, DOE used a 2018 pool pump motor database containing information on ECMs that was compiled by DOE in support of its dedicated purpose pool pump rulemaking (''DPPP Motor Database''). Most motors in the DPPP Motor Database were 1 hp and higher; therefore, DOE fit a curve to the ECM data at each motor hp and used this curve to extrapolate the data and estimate motor efficiencies at fractional hp for ECMs. The resulting ECM efficiency for the 24-inch, 0.5 hp representative unit is 83.2 percent, an efficiency increase of 23.9 percent from a PSC 1 motor to an ECM and a FEI of 0.98 at EL 3 (see Table II–7 at the end of this section). Further details of this analysis can be found in the supplementary spreadsheet attached to this docket. (See Docket No. EERE–2022–BT–STD–0002, No. 11)

Issue 16: DOE requests feedback on its use of dedicated purpose pool pump motors as a source for comparing PSC motor and ECM efficiency. Additionally, DOE requests information on whether motors used for this purpose are comparable to air circulating fan motors. DOE further requests feedback on whether the efficiency increases from PSC 1 motors to ECM that DOE presents are realistic. If dedicated purpose pool pump motors are not representative of air circulating fans motors, or DOE's estimated efficiency increases are not realistic, DOE requests data on the difference between PSC 1 motor efficiency and ECM efficiency and the difference between PSC 2 motor efficiency and ECM efficiency for air circulating fans. DOE also requests comment on its use of extrapolation of these data to obtain efficiency values at fractional hp.

d. Improving Efficiency Through Aerodynamic Redesign

This section describes how DOE evaluated increasing the energy efficiency of air circulating fans by improving fan component aerodynamic design.

While EL3 assumes that air circulating fan efficiency is increased through the use of an ECM, EL4 evaluates the efficiency impact from adding an ECM and improving the aerodynamic design of the fan. This ''max-tech'' level represents the highest efficiency available on the market. The fans in the BESS Labs Combined Database used almost exclusively PSC motors, so DOE assumed that the maximum efficiencies in the database corresponded to the use of a PSC 2 motor with a highly efficient aerodynamic design. Presumably, the maximum efficiencies achieved by a fan with a PSC motor and no aerodynamic redesign would be captured by the FEI values determined for EL 2 for each representative unit. The efficiency gain due to improvements in aerodynamic design can therefore be quantified by determining the difference between the maximum FEI values in the database and the efficiency levels determined for EL 2. DOE used the maximum FEI values in the BESS Labs Combined Database for each representative unit to develop a curve for the PSC 2 plus aerodynamic redesign FEI values as a function of diameter. The resulting FEI value for the 24-inch, 0.5 hp representative unit is 1.89. DOE then determined the percent increase from the EL 2 FEI values to the FEI values determined from the curve fit to establish the increase in efficiency due to aerodynamic redesign for each representative unit. This percent increase for the 24-inch, 0.5 hp representative unit was 114.39 percent. DOE then applied the percent increases in FEI due to aerodynamic redesign to the EL 3 FEI values to determine the EL 4 FEI values. The resulting EL 4 FEI value for the 24-inch, 0.5 hp representative unit was 2.10. Further details of this analysis can be found in the supplementary spreadsheet attached to this docket. (See Docket No. EERE–2022–BT–STD–0002, No. 11)

Issue 17: DOE requests feedback on the FEI values that it determined and its approach for estimating FEI values for an air circulating fan that includes both an ECM and improved aerodynamic design.

e. Results for a 24-inch, 0.5 hp Representative Unit

FEI values calculated for each efficiency level for the 24-inch, 0.5 hp representative unit are shown in Table II–7 . Information on the FEI values calculated for other representative units can be found in the supplementary spreadsheet attached to this docket. (See Docket No. EERE–2022–BT–STD–0002, No. 11)

TABLE II–7—FEI VALUES FOR 24-INCH, 0.5 hp REPRESENTATIVE UNIT

EL0 (baseline)	EL1	EL2	EL3	EL4
0.73	0.79	0.88	0.98	2.10

4. Cost Model

The cost model is a key analytical tool used to construct cost-efficiency curves. This model is used to estimate manufacturing production costs at various efficiency levels using a design option approach.

a. Cost Model Structure and Process

This section describes the process by which the cost model converts the physical information in each product's BOM into manufacturing cost estimates. The cost model is based on production activities and divides factory costs into materials, labor, depreciation, and overhead. The material costs include both raw materials and purchased part costs. The labor costs include fabrication, assembly, and indirect and overhead (burdened) labor rates. The depreciation costs include manufacturing equipment depreciation, tooling depreciation, and building depreciation. The overhead costs include indirect process costs, utilities, equipment and building maintenance, and rework. DOE lists the cost inputs of these categories in Table II–8.

TABLE II–8—COST MODEL CATEGORIES AND DESCRIPTIONS

Major category	Subcategory	Description
Material Costs	Direct	Raw materials (*e.g.,* coils of sheet metal) and purchased parts (*e.g.,* fan motors, compressors).

TABLE II–8—COST MODEL CATEGORIES AND DESCRIPTIONS—Continued

Major category	Subcategory	Description
	Indirect	Material used during manufacturing (*e.g.,* welding rods, die oil, release media).
Manufacturing Labor	Assembly	Part/unit assembly on manufacturing line.
	Fabrication	Conversion of raw material into parts ready for assembly.
	Indirect	Fraction of overall labor not associated directly with product manufacturing (*e.g.,* forklift drivers, quality control).
	Supervisory	Fraction of indirect labor that is paid a higher wage.
Depreciation	Equipment, Conveyor, Building	Straight line depreciation over expected life.
	Tooling	Cost is allocated on a per-use basis or obsolescence, whichever is shorter.
Other Overhead	Utilities	A fixed fraction of all material costs meant to cover electricity and other utility costs.
	Maintenance	Based on installed equipment and tooling investment.
	Property Tax and Insurance	A fixed fraction based on total unit costs.

To determine material costs, DOE followed one of two different paths, depending on whether a subassembly was purchased (outsourced) or produced in-house. For purchased parts, DOE gathered price quotations from major suppliers at different production volumes. For parts produced in-house, DOE reconstructed manufacturing processes for each part using modeling software based on internal expertise. For the raw materials being converted to ready-to-assemble parts, DOE estimated manufacturing process parameters (manufacturing equipment use and time for each item, the required initial material quantity, scrap, etc.) to determine the value of each component.

Using this process, DOE was able to assign manufacturing labor time, equipment utilization, and other important factors to each subassembly for each unit considered in this analysis. The last step was to convert the information into dollar values. To perform this task, DOE collected information on such factors as labor rates, tooling depreciation, and costs of purchased raw materials. DOE assumed values for these parameters using internal expertise and confidential information available to its contractors.

In sum, DOE assigned costs of labor, materials, and overhead to each part, whether purchased or produced in-house. DOE then aggregated single-part costs into major assemblies (*e.g.,* for air circulating fans this would include packaging, housing, impeller, controls and wiring, motor, guard, and mounting gear) and summarized these costs in a spreadsheet. All parameters related to manufacture and assembly were then aggregated to determine facility requirements at various manufacturing scales. The final cost obtained by the cost model is the manufacturer production cost (''MPC''), representing the total cost to the manufacturer of producing the component.

b. Cost Model Assumptions

Assumptions about manufacturer practices and cost structure play an important role in estimating the MPC of the products. DOE based assumptions about the sourcing of parts and in-house fabrication on industry experience, information in trade publications, and discussions with manufacturers. DOE used assumptions regarding the manufacturing process parameters, (*e.g.,* equipment use, labor rates, tooling depreciation, and cost of purchased raw materials) to determine the value of each component. The following sections describe the cost model assumptions related to material prices, purchased parts and factory parameters.

Raw Material Prices

For parts fabricated in-house, the prices of the underlying ''raw'' metals (*e.g.,* tube, sheet metal) are estimated on the basis of 5-year averages to smooth out spikes in demand. Other ''raw'' materials such as plastic resins, insulation materials, etc. are estimated on a current-market basis. The costs of raw materials are based on manufacturer interviews, quotes from suppliers, and secondary research. Past results are updated periodically and/or inflated to present-day prices using indices from resources such as MEPS International,[18] PolymerUpdate,[19] the U.S. geologic survey (''USGS''),[20] and the Bureau of Labor Statistics (''BLS'').[21]

Fabricated Parts and Purchased Parts

DOE characterized parts based on whether manufacturers fabricated them in-house or purchased them from outside suppliers. For fabricated parts, DOE estimated the price of intermediate materials (*e.g.,* tube, sheet metal) and the cost of forming them into finished parts. DOE estimated initial raw material dimensions to account for scrap. For scrap materials that are recyclable, DOE assigned a scrap credit that is a fraction of the base material cost. Non-recyclable materials incur a disposal cost for all scrap. For purchased parts, DOE estimated the purchase price for original equipment manufacturers based on its confidential parts database and industry expertise. For the purpose of this analysis, DOE assumed that all components of the fan were purchased from outside suppliers. This assumption was made because of the relatively low volume of manufacturing for air circulating fans compared to other products, which increases the likelihood that parts are purchased rather than manufactured in-house.

As previously stated, variability in the costs of purchased parts can account for large changes in the overall MPC values calculated. Purchased part costs can vary significantly based on the quantities desired and the component suppliers chosen. The purchased part prices used in this study were typical values based on estimated production volume and other factors. However,

[18] More information on MEPS International may be found at: *www.meps.co.uk/.*

[19] More information on PolymerUpdate may be found at: *www.polymerupdate.com.*

[20] More information on the USGS metal price statistics may be found at: *www.usgs.gov/centers/nmic/commondity-statistics-and-information.*

[21] More information on the BLS producer price indices may be found at: *www.bls.gov/ppi/.*

variability in these prices may exist on a case-by-case basis.

Due to the great diversity of manufacturing scale in the fans industry, DOE estimates that the purchased parts costs could vary significantly by manufacturer. Some parts like motors, and impellers may be produced in-house by some manufacturers and purchased by others, changing likely overall system costs and investment requirements.

Factory Parameters

Certain factory parameters, such as fabrication rates, labor rates, and wages, also affect the cost of each unit produced. DOE factory parameter assumptions were based on internal expertise and may be updated based on manufacturer feedback. Table II–9 lists the factory parameter assumptions used in the cost models. These assumptions are generalized to represent typical production and are not intended to model a specific factory.

TABLE II–9—FACTORY PARAMETER ASSUMPTIONS FOR AIR CIRCULATING FANS

Parameter	Estimate
Actual Annual Production Volume	25,000
Work Days Per Year (days)	250
Fabrication Shifts Per Day (shifts)	1
Assembly Shifts Per Day (shifts)	1
Fabrication Labor Wages ($/hr)	16
Assembly Labor Wages ($/hr)	16
Burdened Fabrication Labor Wage ($/hr)	24
Burdened Assembly Labor Wage ($/hr)	24
Fabrication Worker Hours Per Year	250
Assembly Worker Hours Per Year	250
Supervisor Span (workers/supervisor)	25
Supervisor Wage Premium (over fabrication and assembly wage)	30%
Fringe Benefits Ratio	50%
Indirect to Direct Labor Ratio	33%
Length of Shift (hr)	8
Worker Downtime	10%
Actual units per day	100
Average Equipment Installation Cost (% of purchase price)	10%
Average Scrap Credit (relative to base material cost)	30%
Non-recyclable Trash Cost ($/lb)	$0

Issue 18: DOE requests comment on its factory parameter assumptions for typical air circulating fan production.

c. Determination of Air Circulating Fan MPC

DOE conducted teardowns on four housed and five unhoused air circulating fan heads ranging in diameter from 18 inches to 30 inches and created a BOM for each fan. For this NODA, DOE used the BOM for what DOE considered to be a representative baseline 24-inch unhoused fan without a motor and one representative baseline 24-inch housed fan without a motor. The baseline unhoused air circulating fan material and production costs were scaled to each of the unhoused representative diameters (*i.e.,* 12, 20, 36, and 50 inches) by the ratio of the representative diameters to 24 inches. For housed air circulating fans, DOE determined material and production costs for the 24-inch housed fan, then used the ratio between the 24-inch housed and unhoused costs to estimate housed fan costs at each representative diameter. DOE's cost data for diameters other than 24 inches is included in the supplement spreadsheet included in the docket. (See Docket No. EERE–2022–BT–STD–0002, No. 11) Table II–10 summarizes the characteristics assumed for 24-inch housed and unhoused baseline fans. DOE assumed that these fans were manufactured in China, and that material and parts were also sourced from China.

TABLE II–10—MATERIAL AND PRODUCTION CHARACTERISTICS FOR BASELINE 24-INCH HOUSED AND UNHOUSED AIR CIRCULATING FAN

	Unhoused	Housed
Blade Type	Propeller	Propeller.
Blade Shape	Rectangular	Rectangular.
Blade Material	Galvanized Cold Rolled Steel (“CRS”)	Galvanized CRS.
Hub Material	Aluminum CRS	Aluminum CRS.
Type of Housing	Basket	Tube.
Housing Material	CRS-Wire	CRS-Wire and polypropylene.

Issue 19: DOE requests comment on whether or not its baseline material assumptions are representative of baseline fans distributed into commerce. If DOE's baseline material assumptions are not representative, DOE requests information and data on materials typically used in the air circulating fans currently on the market.

Housed and unhoused baseline 24-inch air circulating fan cost estimates are summarized in Table II–11.

TABLE II–11—ESTIMATED MPCS FOR AIR CIRCULATING FANS WITH NO MOTORS

	Fan cost (no motor)
24-inch Unhoused	$26.06

TABLE II–11—ESTIMATED MPCS FOR AIR CIRCULATING FANS WITH NO MOTORS—Continued

	Fan cost (no motor)
24-inch Housed	69.89

Issue 20: DOE requests comment on its estimated base MPC for air circulating fans with no motors at each of the representative diameters evaluated. (See supplemental spreadsheet included in Docket No. EERE–2022–BT–STD–0002, No. 11)

As discussed previously, DOE used a design option approach to structure its engineering analysis. DOE assumed that baseline fans with fractional motor hp would be equipped with a SP motor. For each efficiency level analyzed (*i.e.,* EL1, EL2, and EL 3), DOE assumed that a more efficient motor is substituted into the same fan. At EL 4, DOE assumed the most efficient motor was paired with improved aerodynamic design of the fan.

To estimate manufacturer costs for SP motors, PSC motors, and ECMs, DOE used motor costs from its internal parts database and assumed a motor to fan manufacturer markup of 1.37.[22] DOE did not have specific cost data for SP motors, and therefore used costs for shaded-pole motors as a proxy for SP motor costs. See 2009 CR Report. To estimate motor costs for the motor hp used in the representative units evaluated for this analysis, DOE determined the equation of the best fit line for hp as a function of motor cost and calculated motor cost at 0.1, 0.33, 0.5, and 1 hp for SP motors, PSC motors and ECMs.

DOE's parts database does not differentiate between motor efficiency. DOE therefore estimated PSC 1 motor cost using a best fit line for cost as a function of hp. For PSC 2 motor costs, DOE determined a best fit line identified the 95th cost percentile for each representative unit/motor hp, and then determined the best fit line through these points. Table II–12 summarizes estimated motor costs for the 24-inch air circulating fan at each EL evaluated.

TABLE II–12—ESTIMATED MOTOR COSTS AT EACH EL FOR 24-INCH DIAMETER AIR CIRCULATING FANS

Motor hp	EL0	EL1	EL2	EL3
0.5	$26.05	$64.32	$79.78	$114.45

Issue 21: DOE requests comment on whether replacing a given fan motor with a more efficient fan motor will result in similar efficiency and cost impacts for housed and unhoused air circulating fan heads.

Issue 22: DOE requests comment on its estimated motor costs SP motors (EL0), PSC motors (EL1), higher efficiency PSC motors (EL2), and ESMs (EL3) at each hp associated with the representative diameters evaluated. (See supplemental spreadsheet included in Docket No. EERE–2022–BT–STD–0002, No. 11)

Table II–13 summarizes the total estimated cost of the fan assembly, including the motor, for 24-inch unhoused and housed fans.

TABLE II–13—TOTAL AIR CIRCULATING FAN COST FOR A 24-INCH HOUSED AND UNHOUSED FAN AT EL0, EL1, EL2, AND EL3

Type	Motor hp	EL 0	EL 1	EL 2	EL 3
Unhoused	0.5	$52.12	$90.38	$105.84	$140.51
Housed	0.5	95.94	134.21	149.67	184.34

Issue 23: DOE requests comment on its estimated housed and unhoused air circulating fan costs at each EL and for each representative unit. (See supplemental spreadsheet included in Docket No. EERE–2022–BT–STD–0002, No. 11)

As mentioned previously, DOE is assuming that a max-tech air circulating fan (*i.e.,* EL4) would undergo aerodynamic redesign and contain an ECM. Aerodynamic redesign includes modifications to a fan's housing, blade/impeller, and/or guard that would include fan model redesign, re-engineering, and upgraded/new tooling equipment. These modifications result in a one-time cost that is not captured by MPC but may be represented by capital conversion costs. DOE used the conversion costs for axial cylindrical housed fans, presented in the November 2016 NODA,[23] as a proxy for estimating air circulating fan conversion costs. After adjusting for inflation, DOE estimates an air circulating fan redesign cost of $720,300 per fan. Additional information on DOE's assumptions and analysis may be found in the supplemental spreadsheet associated with this docket (see Docket No. EERE–2022–BT–STD–0002, No. 11).

Issue 24: DOE requests comment on and additional data to support its estimated air circulating fan conversion costs to undergo aerodynamic redesign.

[22] A markup of 1.37 for motors at or below 5 hp was used in the Electric Motors Preliminary Analysis Technical Support Document (TSD) (see section 5.4.8.4, Docket No. EERE–2020–BT–STD–0007–0010 at *regulations.gov*).

[23] See EERE–2013–BT–STD–0006–0189 at *regulations.gov.*

5. Manufacturer Selling Price

The manufacturer selling price (''MSP'') is the price of the equipment when it is sold by the manufacturer to the first party in the distribution chain. It includes all direct and indirect production costs, other costs such as research and development, and the manufacturer's profit.

When developing cost-efficiency curves during its engineering analysis, DOE typically uses MSP as a function of efficiency. For simplicity, DOE is presenting the results of its cost model for this NODA in terms of MPC.

The MSP is expressed as the product of the MPC and the manufacturer markup. Based on information obtained during interviews with manufacturers, DOE is assuming that the average manufacturer markup for a baseline fan is 1.5.50 percent, meaning the MSP is During interviews, manufacturers stated that they expected to be able to maintain their profit margin if DOE were to set energy efficiency standards for air circulating fans; therefore, DOE is assuming that the average MSP in a market with standards would also be 1.5.

Issue 25: DOE requests comment on whether or not an average MSP of 1.5 is representative for the air circulating fan market. If an average MSP of 1.5 is not representative, DOE requests information of what a more representative MSP would be. Additionally, DOE requests comment on whether or not MSP for air circulating fans will remain constant in the case of new energy conservation standards. If not, DOE seeks information on the magnitude by which MSP might change under potential energy efficiency standards.

E. Markups Analysis

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

DOE developed baseline and incremental markups for each actor in the distribution chain. Baseline markups are applied to the price of products with baseline efficiency, while incremental markups are applied to the difference in price between baseline and higher efficiency models (the incremental cost increase). The incremental markup is typically less than the baseline markup and is designed to maintain similar per-unit operating profit before and after new or amended standards.[24]

In the ECS RFI, DOE requested information to help characterize distribution channels for air circulating fans. DOE also requested data on the fraction of sales that go through these channels. 87 FR 7048, 7054. DOE did not receive any input on this topic.

DOE identified two distribution channels for air circulating fans, depending on the input power of the fan at maximum speed. Air circulating fans with input power less than 125 Watts (W) are primarily used in residential applications.[25] Data from the Association of Home Appliance Manufacturers (''AHAM'') indicate that an majority of residential appliances are sold through retail outlets.[26] Because DOE is not aware of any other distribution channel that plays a significant role for air circulating fans with input power less than 125 W, DOE estimates that such air circulating fans are purchased by consumers from retail outlets (including online retailers).

For air circulating fans with input power greater than or equal to 125 W, DOE estimates that the primary distribution channel is that the manufacturer sells the equipment to a distributor, who in turn sells it to the customer. DOE is also aware of another direct sale channel for air circulating fans greater than or equal to 125 W where the manufacturer sells the equipment directly to a customer through their in-house distributor. In addition, DOE considered additional channels that included a contractor based on input from manufacturer interviews. Further, DOE estimated the fraction of shipments of air circulating fans with input power greater than or equal to 125 W going through each channel based on feedback from manufacturer interviews. Information from the manufacturer interviews also indicated that some fraction of shipments (10–15 percent) are sold to consumers via an original equipment manufacturer (''OEM'') and a distributor. However, DOE is not aware of any OEM equipment that would incorporate an air circulating fan and therefore did not consider this channel.

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

[25] DOE notes that distribution for residential use does not preclude coverage as covered equipment, so long as the equipment is of a type that is also distributed in commerce for industrial and commercial use.

[26] Association of Home Appliance Manufacturers. *Fact Book 2009.* 2009. AHAM: Washington, DC.

Table II–14 summarizes the air circulating fan distribution channels identified by DOE.

TABLE II–14—DISTRIBUTION CHANNELS FOR AIR CIRCULATING FANS

Air circulating fan input power at maximum speed (W)	Distribution channel	Fraction of shipments (%)
Less than 125 W	Manufacturer → Retailer → Consumer	100
Greater than or equal to 125 W	Manufacturer → Distributor → Consumer	40
	Manufacturer → Distributor → Contractor → Consumer	20
	Manufacturer → In-house Distributor → Consumer	30
	Manufacturer → In-house Distributor → Contractor → Consumer	10

To estimate average baseline and incremental markups for each actor in the distribution channels, DOE relied on data from the 2017 Annual Retail Trade Survey,[27] the 2017 Annual Wholesale Trade Survey,[28] and RS Means.[29] In addition to the markups, DOE obtained state and local taxes from data provided by the Sales Tax Clearinghouse.[30] Table II–15 and Table II–16 and show the resulting baseline markups, incremental markups, and sales tax.

TABLE II–15—DISTRIBUTION CHANNEL MARKUPS FOR AIR CIRCULATING FANS WITH INPUT POWER LESS THAN 125 W

Distribution channel	Manufacturer → retailer → consumer (100% shipments)	
	Baseline	Incremental
Retailer	1.486	1.238
Sales Tax	1.073	1.073
Overall Markup	1.594	1.328

TABLE II–16—DISTRIBUTION CHANNEL MARKUPS FOR AIR CIRCULATING FANS WITH INPUT POWER GREATER THAN OR EQUAL TO 125 W

	Manufacturer → distributor → consumer (40% shipments)		Manufacturer → distributor → contractor → consumer (20% shipments)		Manufacturer → in-house distributor → consumer (30% shipments)		Manufacturer → in-house distributor → contractor → consumer (10% shipments)	
	Base.*	Inc.*	Base.	Inc.	Base.	Inc.	Base.	Inc.
(In-house) Distributor	1.412	1.194	1.412	1.194	1.412	1.194	1.412	1.194
Contractor			1.100	1.100			1.100	1.100
Sales Tax	1.073	1.073	1.073	1.073	1.073	1.073	1.073	1.073
Overall Markup	1.516	1.281	1.667	1.409	1.516	1.281	1.667	1.409

* Base. = baseline, Inc. = Incremental.

Issue 26: DOE requests feedback and information on the distribution channels identified for air circulating fans, and on any other distribution channel that DOE should consider. DOE also requests data on the fraction of sales that go through these channels.

F. Energy Use Analysis

The purpose of the energy use analysis is to determine the annual energy consumption of air circulating fans at different efficiencies for a representative sample of consumers, and to assess the energy savings potential of increased air circulating fan efficiency. The energy use analysis estimates the range of energy use of air circulating fans in the field (*i.e.,* as they are actually used by consumers). The energy use analysis provides the basis for other analyses DOE performs, particularly assessments of the energy savings and the savings in consumer operating costs that could result from adoption of amended or new standards.

In any future analysis, DOE may consider calculating the energy use by combining air circulating fan input power consumption in each mode (*e.g.,* high speed, medium speed, low speed) from the engineering analysis with operating hours spent in each mode. To characterize variability and uncertainty, the energy use is calculated for a representative sample of air circulating fan consumers. This method of analysis, referred to as a Monte Carlo method, is explained in more detail in section II.G of this document. Results of the energy use analysis for each representative air circulating fan will be derived from a sample of 10,000 consumers. DOE then plans on using the range of energy use results in the LCC and PBP analyses and the average of the energy use results in the National Impact Analysis (''NIA'') analysis. This section presents DOE's approach to develop consumer samples and the operating hour inputs that DOE is considering using in any future energy use analysis. For each consumer in the sample, DOE will associate a value of air circulating fan operating

[27] Available at *www.census.gov/data/tables/2017/econ/arts/annual-report.html;* NAICS 443—Electronics and Appliance Stores.

[28] Available at: *www.census.gov/programs-surveys/awts.html;* NAICS 4238—Machinery, equipment, and supplies merchant wholesalers.

[29] RS Means Electrical Cost Data 2021. Available at: *www.rsmeans.com.*

[30] Sales Tax Clearinghouse Inc., State Sales Tax Rates Along with Combined Average City and County Rates (2022), available at *https://thestc.com/STrates.stm* (last accessed June 6, 2022).

hours drawn from a statistical distribution as described in the remainder of this section.

1. Fans With Input Power Less Than 125 W

a. Sample of Consumers

DOE is considering including only residential applications in the energy use analysis of air circulating fans with input power below 125 W. Although some of these air circulating fans are used in commercial or industrial settings, DOE believes that they represent a very small portion of the total market for such air circulating fans. To develop a representative sample of consumers, DOE is considering using the Energy Information Administration (''EIA'') 2020 Residential Energy Consumption Survey (''RECS'') [31] to choose a random sample of households in which new air circulating fans could be installed. RECS is a national survey of housing units that collects statistical information on the consumption of, and expenditures for, energy in housing units, along with data on energy-related characteristics of the housing units and occupants. RECS collects data on thousands of housing units, and was constructed by EIA to be a national representation of the household population in the United States. Although RECS contains information on operation for many appliances, it contains no information on the operation of air circulating fans within each household. RECS reports only the number of floor or window fans in the household which is the category of appliance closest to air circulating fans.

In creating the sample of RECS households, DOE is planning on using the subset of RECS records that met the criterion that the household had at least one ''floor or window fan''. DOE is planning on choosing a sample of 10,000 households from RECS to estimate annual energy use for air circulating fans with input power less than 125 W. Because RECS provides no means of determining the subset of air circulating fans in a given household, DOE will use the same sample for all equipment classes.

[31] Department of Energy, Energy Information Administration. *2020 Residential Energy Consumption Survey (RECS).* 2020. (Last accessed July 6, 2022) *www.eia.gov/consumption/residential/data/2020/.*

b. Operating Hours

In the ECS RFI, DOE requested information to characterize the annual operating hours of air circulating fans and time spent in each operating mode, if applicable, by sector of application, and geographical region. 87 FR 7048, 7054. In response, ebm-papst commented that the use of agricultural fans, residential fans, commercial fans, and basket fans used for distribution transformers are all very different (ebm-papst, No. 8 at p. 4). ebm-papst did not provide additional information to characterize operating conditions. DOE did not receive other comments on this topic.

DOE reviewed existing studies on air circulating fans used in residential applications and found that these are often studied in combination with ceiling fans, indicating that they likely operate similarly.[32] In the absence of existing data indicating the daily hours of operation specific to air circulating fans with input power less than 125 W, DOE used the same annual operating hours as developed for standard, hugger, and very small diameter ceiling fans in the Ceiling Fans Preliminary Analysis to characterize the operating hours of air circulating fans with input power less than 125 W.[33] The ceiling fan preliminary analysis relied on a distribution of operating hours, with an average of 6.45 hours of operation per day with 33 percent at high speed, 38 percent at medium speed, and 29 percent at low speed. DOE assumes this is also representative of air circulating fan usage with input power less than 125W and plans on applying this load profile in any future energy use calculation. DOE notes that some air circulating fans may not have three available speeds, in which case DOE plans on adjusting the time spent in each mode according to the fan's speed capability (*e.g.,* assuming 100 percent of operation at the one available speed for single-speed air circulating fans).

[32] Ecodesign Lot 10 Comfort Fans Study, Preparatory Study on Environmental Performance of Residential Room Conditioning Appliances (airco and ventilation) Study on comfort fans—final report October 2008, after SH comments *www.eceee.org/static/media/uploads/site-2/ecodesign/products/airco-ventilation/finalreport-cf.zip.*

[33] See Section 7.3.2. of Chapter 7 of the ceiling fan preliminary analysis Technical Support Document, *www.regulations.gov/document/EERE-2021-BT-STD-0011-0015.*

2. Fans With Input Power Greater Than or Equal to 125 W

a. Sample of Consumers

DOE is considering including only commercial, industrial, and agricultural applications in the energy use analysis of air circulating fans with input power greater than or equal to 125 W. Although some air circulating fans with input power greater than or equal to 125 W are used in residential applications, DOE believes that they represent a very small portion of the total market for such fans. DOE plans on creating a sample of 10,000 consumers for each equipment class to represent the range of air circulating fan energy use in the commercial, industrial, and agricultural sectors.

b. Operating Hours

As noted previously, DOE did not receive any information related to the operating hours of air circulating fans. In the absence of data indicating the daily hours of operation specific to air circulating fans, DOE estimated that air circulating fans with input power greater than or equal to 125 W operate, on average, 12 hours per day, consistent with the hours of use estimated for large-diameter ceiling fans in the Ceiling Fan Preliminary Analysis.[34] To represent a range of possible operating hours around this representative value, DOE will be drawing 10,000 samples from a uniform distribution between 6 hours per day and 18 hours per day (assuming a uniform distribution of operating hours due to the limited availability of information).

In the July 2022 TP NOPR, the efficiency metric is calculated assuming that the performance at each of the five tested speeds is weighted equally, as there are not available data to suggest a different distribution of time spent at each speed. 87 FR 44194, 44238. For this NODA, DOE assumed an equal amount of time would be spent at each speed, in alignment with the approach in the July 2022 TP NOPR.

Table II–17 summarizes the inputs to the energy use calculation identified by DOE. For each consumer in the samples, DOE will associate a value of air circulating fan operating hours drawn from a statistical distribution as described in Table II–17.

[34] See Section 7.4.2 of Chapter 7 of the Ceiling Fan Preliminary Analysis Technical Support Document, *www.regulations.gov/document/EERE-2021-BT-STD-0011-0015.*

TABLE II–17—INPUTS TO THE ENERGY USE CALCULATION

Input to the energy use calculation	Air circulating fan with input power at maximum speed less than 125 W	Air circulating fan with input power at maximum speed greater than or equal to 125 W
Average Operating Hours per Day	6.45 hours per day	12 hours per day.
Statistical Distribution	Based on Consumer Survey	Uniform Distribution between 6 hours per day and 18 hours per day.
Fraction of time spent in each mode	33% on high speed, 38% on medium speed, 29% on low speed.	Equal amount of time at each tested speed.

Issue 27: DOE seeks comment on the estimated average number of operating hours per year, distribution of operating hours, and the estimated fraction of time spent at each speed setting for air circulating fans with input power less than 125 W and those with input power greater than or equal to 125 W. In addition, if DOE should consider different operating hours for specific applications (*e.g.,* air circulating fans used in agricultural applications, thermal mixing fans) DOE requests data on how to best characterize operating hours for these various applications.

G. Life Cycle Cost and Payback Period Analyses

The effect of new or amended energy conservation standards on individual consumers usually involves a reduction in operating cost and an increase in purchase cost. DOE uses the following two metrics to measure consumer impacts:

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

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

For any given efficiency level, DOE measures the change in LCC relative to the LCC in the no-new-standards case, which reflects the estimated efficiency distribution of air circulating fans in the absence of new energy conservation standards. In contrast, the PBP for a given efficiency level is measured relative to the baseline product. For each considered efficiency level in each equipment class, DOE plans on calculating the LCC and PBP for a nationally representative sample of consumers.

In addition, the computer model that DOE plans on using to calculate the LCC and PBP relies on a Monte Carlo simulation to incorporate uncertainty and variability into the analysis. The Monte Carlo simulations randomly sample input values from the probability distributions and air circulating fan consumer samples. The model calculates the LCC and PBP for equipment at each efficiency level for 10,000 consumers per simulation run. The analytical results include a distribution of 10,000 data points showing the range of LCC savings for a given efficiency level relative to the no-new-standards case efficiency distribution. In performing an iteration of the Monte Carlo simulation for a given consumer, equipment efficiency is chosen based on its probability. If the chosen equipment efficiency is greater than or equal to the efficiency of the standard level under consideration, the LCC and PBP calculation reveals that a consumer is not impacted by the standard level. By accounting for consumers who already purchase more efficient equipment, DOE avoids overstating the potential benefits from increasing equipment efficiency.

This section presents the approach and data DOE used to derive inputs to the LCC and PBP analysis not previously described in this document. All inputs to the LCC and PBP analyses are summarized in Table II–18.

TABLE II–18—SUMMARY OF INPUTS AND METHODS FOR THE LCC AND PBP ANALYSIS

Inputs	Source/method
Equipment Cost	Will be derived by multiplying MSPs by distribution channel markups and sales tax, as appropriate. DOE uses historical data to derive a constant price index to project equipment costs.
Installation Costs	Assumed installation costs do not vary by efficiency level.
Annual Energy Use	*Annual energy use:* Based on the time spent in each model multiplied by the input power in each mode. *Variability:* Based on discrete and uniform probability distributions.
Energy Prices	*Electricity:* Average and marginal prices based on Edison Electric Institute (“EEI”) data for 2021. *Variability:* Based on sector and geographical region.
Energy Price Trends	Based on 2022 Annual Energy Outlook (“*AEO2022*”) price projections (or most recent version available at the time of the analysis).
Repair and Maintenance Costs	Assumed maintenance costs do not vary by efficiency level. Assumed no repair costs for air circulating fans with input power less than 125 W. Assumed one motor repair for air circulating fans with input power greater than or equal to 125 W, with a lifetime that exceeds the average lifetime.

TABLE II–18—SUMMARY OF INPUTS AND METHODS FOR THE LCC AND PBP ANALYSIS—Continued

Inputs	Source/method
Equipment Lifetime	*Average:* 10 years for air circulating fans with input power less than 125 W. And 30 years for air circulating fans with input power greater than or equal to 125 W. *Variability:* Based on Weibull distribution.
Discount Rates	*Residential:* approach involves identifying all possible debt or asset classes that might be used to purchase the considered appliances, or might be affected indirectly. Primary data source was the Federal Reserve Board's Survey of Consumer Finances. *Commercial/Industrial/Agricultural:* Calculated as the weighted average cost of capital for entities purchasing pool pumps. Primary data source was Damodaran Online.
Compliance Date	5 years after publication of any final rule.

Issue 28: DOE requests feedback on the inputs and considered methods used for the LCC and PBP analyses.

1. Equipment Price

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

To project equipment costs in the projected compliance year, DOE plans on developing an equipment price trend. Because the motor is the most costly component of the air circulating fan, DOE believes that historic prices of electric motors provide a reasonable basis for considering trends in the price of air circulating fans.

DOE is planning on obtaining historical Producer Price Index (''PPI'') data for integral hp motors and generators manufacturing spanning the time period from 1969 to 2021 and for fractional hp motors and generators manufacturing between 1967 and 2021 from the BLS.[35] The PPI data reflect nominal prices, adjusted for product quality changes. An inflation-adjusted (deflated) price index for fractional hp motors and generators manufacturing was calculated by dividing the PPI series by the Gross Domestic Product Chained Price Index. Previous DOE analysis that relied on the same approach and data sources resulted in a constant price trend assumption to project future electric motor prices.[36] Similarly, DOE expects to rely on a constant price trend for air circulating fans.

2. Installation, Repair and Maintenance Costs

DOE reviewed available air circulating fan installation, maintenance, and repair cost information.

For air circulating fans with input power less than 125 W, which DOE is assuming are primarily used in residential applications, a previous study focused on air circulating fans used in residential settings estimated no installation, repair, or maintenance costs for these fans.[37] DOE believes this is a representative characterization of these costs as these air circulating fans are plug-in equipment that do not require any maintenance and are unlikely to be repaired due to the relatively low equipment price.

For air circulating fans with input power greater than 125 W, which DOE assumes are primarily used in commercial, industrial, and agricultural applications, DOE did not find any information supporting changes in installation and maintenance costs as a function of efficiency. Therefore, because DOE expresses results in terms of LCC savings, DOE is not planning to account for installation costs in the LCC (the difference in installation costs between a baseline and more efficient air circulating fan would be zero and would have no impact on the calculated LCC savings). In terms of repairs, DOE has identified the motor replacement as a potential repair. Depending on the design options considered, DOE may include different repair costs by EL to reflect differences in motor replacement costs. DOE did not find any information related to motor repair frequency in air circulating fans. For air circulating fans greater than or equal to 125 W, DOE is considering accounting for one motor replacement for consumers that have an air circulating fan with a sampled lifetime exceeding the average lifetime.

Issue 29: DOE requests information on its assumptions related to installation, maintenance, and repair practices of air circulating fans. Specifically, DOE requests feedback and data on whether installation, maintenance, and repair costs of air circulating fans are expected to be different at higher efficiency levels in comparison to the baseline installation, maintenance, and repair costs. To the extent that these costs differ, DOE seeks supporting data and the reasons for those differences.

Issue 30: DOE requests information on the repair frequency of air circulating fans (*i.e.,* how many repairs in a lifetime) by category (*i.e.,* unhoused air circulating fan heads, air circulating axial panel fan, box fan, cylindrical air circulating fan, and housed centrifugal air circulating fan) and on its approach to consider a single repair for certain air circulating fans with input power greater than or equal to 125 W.

3. Energy Prices

DOE is planning on using average and marginal electricity prices in 2021 for each census division using data from the EEI Typical Bills and Average Rates reports[38] and the methodology described in two Lawrence Berkeley National Laboratory reports.[39 40] DOE's

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

[36] See Electric Motors Energy Conservation Standards Preliminary Analysis Technical Support Document, Chapter 8: Life Cycle Cost and Payback Period Analysis (p. 269). Available at: *www.regulations.gov/document/EERE-2020-BT-STD-0007-0010.*

[37] Ecodesign Lot 10 Comfort Fans Study, Preparatory Study on Environmental Performance of Residential Room Conditioning Appliances (airco and ventilation) Study on comfort fans—final report October 2008, after SH comments (p. 44; p. 71–73) *www.eceee.org/static/media/uploads/site-2/ecodesign/products/airco-ventilation/finalreport-cf.zip.*

[38] Edison Electric Institute, EEI Typical Bills and Average Rates Report (2021). Washington, DC.

[39] Katie Coughlin and Berket Beraki, ''Non-Residential Electricity Prices: A Review of Data Sources and Estimation Methods,'' April 15, 2019, *doi.org/10.2172/1515782.*

methodology allows electricity prices to vary by sector, region, and season. In the analysis, variability in electricity prices is chosen to be consistent with the way the consumer economic and energy use characteristics are defined in the LCC and PBP analyses. Table II–19 shows the average and marginal prices for each sector of application.

TABLE II–19—ELECTRICITY PRICES IN 2021

Sector	Average price *2021$/kWh*	Marginal price *2021$/kWh*
Residential	0.157	0.151
Commercial (small)	0.123	0.117
Commercial (large)	0.097	0.083
Industrial	0.081	0.069

To estimate electricity prices in future years, DOE is planning on multiplying the 2021 electricity prices by the sector-specific forecasts of annual national average price changes from EIA's Reference case in the AEO 2022. The reference case is a business-as-usual estimate, given known market, demographic, and technological trends. AEO2022 has an end year of 2050. DOE assumes a flat rate of change in prices from 2050. The values for the industrial sector are used for the agricultural sector as well.

4. Lifetime

The equipment lifetime is the age at which given equipment is retired from service. DOE typically develops survival probabilities using on a Weibull function to characterize variability in lifetimes. In preparation for this NODA, DOE reviewed data available for air circulating fan lifetime.

For air circulating fans with input power less than 125 W, which are primarily used in residential applications, a previous study focused on air circulating fans used in residential settings estimated air circulating fan lifetimes at 10 years on average.[41]

For air circulating fans with input power greater than or equal to 125 W, DOE did not find data specific to such fans and instead is considering an average lifetime of 30 years across all sectors, as used to characterize fan and blower lifetimes in a previous DOE analysis.[42]

Issue 31: DOE requests comment on the estimated average equipment lifetimes for air circulating fans. DOE also requests information related to minimum and maximum equipment lifetimes (in years or total mechanical hours).

5. Discount Rates

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

DOE applies weighted average discount rates calculated from consumer debt and asset data, rather than marginal or implicit discount rates.[43] The LCC analysis estimates net present value over the lifetime of the equipment, so the appropriate discount rate will reflect the general opportunity cost of household funds, taking this time scale into account. Given the long time horizon modeled in the LCC analysis, the application of a marginal interest rate associated with an initial source of funds is inaccurate. Regardless of the method of purchase, consumers are expected to continue to rebalance their debt and asset holdings over the LCC analysis period, based on the restrictions consumers face in their debt payment requirements and the relative size of the interest rates available on debts and assets. DOE estimates the aggregate impact of this rebalancing using the historical distribution of debts and assets.

To establish residential discount rates for the LCC analysis, DOE identified all relevant household debt or asset classes in order to approximate a consumer's opportunity cost of funds related to appliance energy cost savings. It estimated the average percentage shares of the various types of debt and equity by household income group using data from the Federal Reserve Board's Survey of Consumer Finances[44] (''SCF'') for 1995, 1998, 2001, 2004, 2007, 2010, 2013, 2016, and 2019. Using the SCF and other sources, DOE developed a distribution of rates for each type of debt and asset by income group to represent the rates that may apply in the year in which amended standards would take effect. In the LCC calculation, to account for variation among households, DOE will assign each RECS household a specific discount rate drawn the distributions for the appropriate income group (RECS provides household income data). The average discount rate in 2021 across all types of household debt and equity and income groups, weighted by the shares of each type, is 4.3 percent.

DOE applies weighted average discount rates calculated from consumer debt and asset data, rather than marginal or implicit discount rates. DOE notes that the LCC does not analyze the appliance purchase decision, so the implicit discount rate is not relevant in this model. The LCC estimates net present value over the lifetime of the

[40] Katie Coughlin and Bereket Beraki, ''Residential Electricity Prices: A Review of Data Sources and Estimation Methods,'' 2018.

[41] Ecodesign Lot 10 Comfort Fans Study, Preparatory Study on Environmental Performance of Residential Room Conditioning Appliances (airco and ventilation) Study on comfort fans—final report October 2008, after SH comments (p. 44) *www.eceee.org/static/media/uploads/site-2/ecodesign/products/airco-ventilation/finalreport-cf.zip.*

[42] On November 1, 2016, DOE published a notification of data availability (''November 2016 NODA'') that presented an analysis for fans and blowers other than air circulating fans. 81 FR 75742. The lifetime assumptions and data source supporting the life cycle cost calculation of the November 2016 NODA are available online at *www.regulations.gov/document/EERE-2013-BT-STD-0006-0190* (see ''Lifetime'' worksheet). The average lifetime estimate was based on input from a subject matter expert John Murphy. ''Commercial and Industrial Fans Life-cycle Cost Informational Interview.'' Telephone interview. 13 May 2014.

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

[44] U.S. Board of Governors of the Federal Reserve System. *Survey of Consumer Finances.* 1995, 1998, 2001, 2004, 2007, 2010, 2013, 2016, and 2019. (Last accessed June 15, 2022) *www.federalreserve.gov/econresdata/scf/scfindex.htm.*

product, so the appropriate discount rate will reflect the general opportunity cost of household funds, taking this time scale into account. Given the long time horizon modeled in the LCC, the application of a marginal interest rate associated with an initial source of funds is inaccurate. Regardless of the method of purchase, consumers are expected to continue to rebalance their debt and asset holdings over the LCC analysis period, based on the restrictions consumers face in their debt payment requirements and the relative size of the interest rates available on debts and assets. DOE estimates the aggregate impact of this rebalancing using the historical distribution of debts and assets.

To establish commercial, industrial, and agricultural discount rates, DOE estimated the weighted average cost of capital using data from Damodaran Online.[45] The weighted average cost of capital is commonly used to estimate the present value of cash flows to be derived from a typical company project or investment. Most companies use both debt and equity capital to fund investments, so their cost of capital is the weighted average of the cost to the firm of equity and debt financing. DOE estimated the cost of equity using the capital asset pricing model, which assumes that the cost of equity for a particular company is proportional to the systematic risk faced by that company. The average commercial, industrial, and agricultural discount rates in 2021 are 6.77 percent, 7.25 percent, and 7.15 percent respectively.

6. Efficiency Distribution in the No-New Standards Case

To accurately estimate the share of consumers that would be affected by a potential energy conservation standard at a particular efficiency level, DOE's LCC analysis considers the projected distribution (market shares) of equipment efficiencies in the no-new-standards case (*i.e.,* the case without new energy conservation standards) in the anticipated compliance year of any future energy conservations standards.

For air circulating fans with input power less than 125 W, DOE did not find any data regarding the distributions of equipment efficiencies in the no-new-standards case. In the absence of any data, DOE is conservatively considering assuming all shipments are at the baseline level (EL 0).

For air circulating fans with input power greater than or equal to 125 W, DOE is planning on using the distributions based on model counts at each efficiency level analyzed from the BESS Labs Database to develop 2021 distributions of equipment efficiencies in the no-new-standards case. DOE notes that the BESS Labs Database only publishes performance at limited operating points for a given model, allowing DOE to calculate the FEI at a single operating point (and not as a weighted average). In the absence of other data, DOE will use this as a proxy for determining the weighted average FEI of air circulating fans with variable and multi-speed capability. In addition, DOE will apply equipment efficiency trends (see section II.H.3 of this document) to project the efficiency distribution for the no-new-standards case in the compliance year.

Using the projected distribution of efficiencies for air circulating fans, DOE plans on randomly assigning an equipment efficiency to each household and commercial, industrial, or agricultural consumer drawn from the consumer samples. If a consumer is assigned an equipment efficiency that is greater than or equal to the efficiency under consideration, the consumer would not be affected by a standard at that efficiency level.

Issue 32: DOE requests comment on its approach to derive efficiency distribution in the no-new standards case for each air circulating fan category and input regarding 2021 (or most recent year available) equipment efficiency distributions. Additionally, DOE seeks data that would support changes in efficiency distributions over time in the no-new standards case. To the extent any of the efficiency distributions in the no-new standards case differ by size or other consumer or design characteristic, DOE requests information to characterize these variations.

H. National Impact Analysis

The NIA estimates the national energy savings (''NES'') and the net present value (''NPV'') of total consumer costs and savings expected to result from new standards at specific efficiency levels (referred to as candidate standard levels).[46] DOE calculates the NES and NPV for the potential standard levels considered based on projections of annual equipment shipments, along with the annual energy consumption and total installed cost data from the energy use and LCC analyses. For the present analysis, DOE projected the energy savings, operating cost savings, equipment costs, and NPV of consumer benefits over the lifetime of air circulating fans sold over a 30-year period starting in the compliance year.

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

The NIA calculations use typical values (as opposed to probability distributions) as inputs. Critical inputs to this analysis include shipments projections, estimated product lifetimes, product installed costs and operating costs, product annual energy consumption, the base case efficiency projection, and discount rates. In this section, DOE discusses specific inputs to the NIA, not previously discussed in this document, for which it requests comment and feedback.

1. Base Year Shipments

DOE develops shipments forecasts to calculate the national impacts of potential energy conservation standards on energy consumption, NPV, and future manufacturer cash flows. DOE shipments projections are typically based on available historical data broken out by equipment class, capacity, and efficiency. Current sales estimates allow for a more accurate model that captures recent trends in the market.

For air circulating fans with input power less than 125 W, DOE reviewed shipments data from the Appliance Magazine market research,[47] which provides 1981–1994 shipments estimates of air circulating fans used in residential settings and of ceiling fans. On average during the period 1981–1994, the data showed that shipments of such air circulating fans represented 91 percent of ceiling fan shipments. DOE

[45] Damodaran Online, *Data Page: Costs of Capital by Industry Sector* (2020). (Last accessed February 1, 2021) *pages.stern.nyu.edu/~adamodar/*.

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

[47] Appliance Magazine market research, Appliance Historical Statistical review, 1954–2012, January 2014.

assumed that this ratio is still representative of the market in 2020 and calculated shipments of air circulating fans with input power less than 125 W by multiplying the 2020 ceiling fan shipments data published in a previous DOE study [48] by 0.91, which resulted in 19.2 million units in 2020. DOE did not find data to characterize shipments by equipment classes in that input power range.

For air circulating fans with input power greater than or equal to 125 W, DOE obtained 2021 shipments estimates from manufacturer interviews for unhoused air circulating fan heads and cylindrical air circulating fans.[49] DOE then used model counts from the BESS Labs Database to estimate market shares by air circulating fan category. Table II–20 shows the estimated market shares by category based on model counts from the BESS Labs Database. Based on this data, DOE estimated that unhoused air circulating fan headsand cylindrical air circulating fans represent a combined 30 percent of the total market of air circulating fans with input power greater than or equal to 125 W. In addition, DOE adjusted the market shares of unhoused air circulating fan heads (22 percent) and cylindrical air circulating fans (8 percent) from the BESS Labs database to account for the market shares from the shipments estimates provided in manufacturer interviews (*i.e.,* 20 percent and 10 percent, respectively). DOE then used unadjusted market shares by category as presented in Table II–20 to calculate shipments of air circulating fans for which manufacturer interviews did not provide estimates. The BESS Labs Database does not include any housed centrifugal air circulating fans. DOE did not find any data to estimate the shipments of housed centrifugal air circulating fans.

TABLE II–20—AIR CIRCULATING FANS WITH INPUT POWER GREATER THAN OR EQUAL TO 125 W—MARKET SHARE BY EQUIPMENT CLASS (EXCLUDING HOUSED CENTRIFUGAL AIR CIRCULATING FANS)

DOE terminology	BESS category	Market share based on model counts (%)	Calculated market share (%) *	Estimated 2021 shipments (units)
Unhoused Air Circulating Fan Head	Basket fan	22	20	494,950
Box fan	Box fan	11	11	275,018
Air circulating axial panel fan	Panel fan	59	59	1,475,098
Cylindrical air circulating fan	Tube fan	8	10	255,100
Housed centrifugal air circulating fan	N/A	N/A	N/A	N/A
Total		100	100	2,500,167

* Adjusted market shares of Unhoused Air Circulating Fan Head and Cylindrical air circulating fan based on shipments estimates from manufacturer interviews.

Finally for air circulating fans with input power greater than or equal to 125 W, based on information from manufacturer interviews, DOE estimated that while some fans are used in commercial and industrial settings, the majority of these fans are used in agricultural applications. In the absence of any quantitative data to characterize the fraction of shipments by sector, DOE assumed 75 percent of shipments are used in agricultural settings,[50] 12.5 percent in commercial settings, and 12.5 percent in industrial applications.

2. Shipments Projections

In response to the February 2022 ECS RFI, ebm-papst suggested that the growth of indoor horticulture, a need for farm animal cooling due to climate change, and a need for auxiliary cooling on distribution transformers due to electrification of climate change could all be reasons for possible growth in the air circulating fan market. (ebm-papst, No. 8 at p. 4)

To project shipments of air circulating fans with input power less than 125 W, DOE is considering using an annual growth rate of 5 percent based on the Appliance Magazine market research data,[51] which provides 1981–1994 shipments estimates for air circulating fans used in residential settings.

For air circulating fans with input power greater than or equal to 125 W, DOE estimates that shipments of such fans follow similar trends as shipments of large-diameter ceiling fans. Therefore, DOE is considering projecting shipments of air circulating fans with input power greater than or equal to 125 W based on the growth rates projected for shipments of large-diameter ceiling fans.[52] DOE notes that this corresponds to a compound annual growth rate of 8.3 percent for the period 2020–2030.

DOE may consider alternative approaches to project shipments depending on stakeholder comment and any additional data that may become available.

Issue 33: DOE requests comment on the estimated 2020 shipments of air circulating fans for each market segment considered (*i.e.,* below 125 W, and at or above 125 W) and seeks input on the fraction of shipments by air circulating fan category (*i.e.,* unhoused air circulating fan heads, air circulating axial panel fan, box fan, cylindrical air circulating fan, and housed centrifugal air circulating fan). In addition, DOE requests 2021 annual sales data (or the most recent year available)—*i.e.,* number of shipments—for air circulating fans and annual historical shipments data for 2016–2020 (or most recent years available). If disaggregated data of annual sales are not available for different air circulating fan categories, DOE requests more aggregated data of annual sales as available.

Issue 34: DOE requests comment on the estimated market share by sector. DOE requests 2016–2021 data (or the most recent years available) on the fraction of shipments in the industrial, commercial, and residential sectors for

[48] See Chapter 9 of the ceiling fan preliminary analysis Technical Support Document *www.regulations.gov/document/EERE-2021-BT-STD-0011-0015.*

[49] Information from manufacturer interviews indicated shipments estimates of 494,950 units of unhoused air circulating fan heads and 255,100 units of cylindrical air circulating fans.

[50] DOE assumed the mid-point between 50 and 100 percent of shipments (75 percent) go to agriculture. Distributed the remaining shipments equally across the commercial and industrial sectors.

[51] Appliance Magazine market research, Appliance Historical Statistical review, 1954–2012, January 2014.

[52] See Chapter 9 of the ceiling fan preliminary analysis Technical Support Document (TSD) *https://www.regulations.gov/document/EERE-2021-BT-STD-0011-0015.*

air circulating fans. In each sector, DOE requests 2016–2021 data (or the most recent years available) on the fraction of shipments that represent replacement versus new installations.

Issue 35: DOE requests comments on its approach to project shipments of air circulating fans. DOE requests information on the rate at which annual sales (*i.e.,* number of shipments) of air circulating fans is expected to change in the next 5–10 years. If possible, DOE requests this information for each air circulating fan category (*i.e.,* unhoused air circulating fan heads, air circulating axial panel fan, box fan, cylindrical air circulating fan, and housed centrifugal air circulating fan). If disaggregated data of annual sales are not available for each air circulating fan category, DOE requests more aggregated data of annual sales.

3. Equipment Efficiency Trends

A key component of the NIA is the trend in energy efficiency projected for the no-new-standards case and each of the standards cases over the entire 30-year analysis period. To project the trend in efficiency absent amended standards for air circulating fans, DOE did not find any historical equipment efficiency data. Instead, in order to incorporate any efficiency trends, DOE may consider an approach that shifts a fraction of the market share in the single-speed levels (*e.g.,* 1 percent) to the variable-speed efficiency levels to reflect the growing market share of variable-speed air circulating fans. DOE may consider alternative approaches to project equipment efficiency depending on stakeholder comment and any additional data that may become available.

For standards cases, DOE is considering a ''roll up'' scenario to establish the shipment-weighted efficiency for the year that standards are assumed to become effective. In this scenario, the market share of products in the no-new-standards case that do not meet the standard under consideration would ''roll up'' to meet the new standard level, and the market share of products above the standard would remain unchanged. To project the trend in efficiency in the various standard case considered, DOE would then apply the same shift towards variable-speed efficiency levels as in the no-new-standard case for the standards cases.

Issue 36: DOE requests comments on its approach to project equipment efficiency for air circulating fans. DOE requests data and information on any trends in the fans market that could be used to forecast expected trends in market share by efficiency levels for air circulating fans. If disaggregated data are not available for each air circulating fan category, DOE requests more aggregated data.

III. Public Participation

A. Submission of Comments

DOE will accept comments, data, and information regarding this notification of data availability no later than the date provided in the **DATES** section at the beginning of this document. Interested parties may submit comments, data, and other information using any of the methods described in the **ADDRESSES** section at the beginning of this document.

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

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

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

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

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

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

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

B. Issues on Which DOE Seeks Comment

As indicated in the analyses previously, DOE is seeking further comment and/or data on certain issues. For reference, these issues from the above analyses include the following:

Issue 1: DOE requests comment on its assumption that most motors paired with air circulating fans are lower efficiency induction motors that are not currently regulated by DOE. Additionally, DOE requests data on the percentage of air circulating fans that include a SP, PSC, shaded pole, or electronically commuted motors.

Issue 2: DOE requests comment on if or how the five screening criteria may impact the application of an aerodynamic redesign (including changes to housing, impeller and/or blade design), more efficient motors, or VSDs (''variable-speed drives'') as design options in the current rulemaking analysis.

Issue 3: DOE requests comment on its assumption that the BESS Labs Combined Database is representative of the air circulating fan head market, with the exception of housed centrifugal air circulating fans and air circulating fans with input power less than 125 W which are not represented in the BESS Labs Combined Database.

Issue 4: DOE requests additional information for all categories of air circulating fans, including: manufacturer name, model number, fan diameter, blade number, blade shape, blade material, housing type, housing material, spacing between the blade tip and the housing, and housing depth with associated performance data obtained using AMCA 230–15 with 2021 errata (or sufficient information that can be used to correct to AMCA 230–15 with 2021 errata). DOE additionally requests the following information on the motors sold within each fan model: motor type (*i.e.,* SP, PSC, ECM, polyphase, etc.), type of drive (*i.e.,* direct or belt), motor horsepower (''hp''), motor full-load efficiency (if available), motor rotations per minute, number of speeds, motor electric requirements (*i.e.,* volts, amps, frequency, phase, AC/DC), and whether a variable-speed drive is included with the fan.

Issue 5: DOE requests comment on the potential of using fan affinity laws to extrapolate BESS Labs performance data to air circulating fan heads with diameters less than 12 inches and greater than 52 inches. Additionally, DOE requests model characteristics and performance data obtained using AMCA 230–15 plus 2021 errata (or sufficient information than can be used to correct to AMCA 230–15 plus 2021 errata) for air circulating fans with diameters both smaller than and larger than those listed in the BESS Labs Database.

Issue 6: DOE requests comment on whether, and if so how, each of the following performance-related features may impact utility of air circulating fans: presence or absence of a safety guard, presence or absence of housing, housing design, blade type, drive type, number of discrete speed settings, power requirements, and air velocity or throw. DOE requests additional feedback and data or information on other air circulating fan features that may impact utility for the end user and might form the basis for classification.

Issue 7: DOE requests comment with supporting data on whether the following performance-related features provide substantially different utility, or are expected to have a significant impact on efficiency because of how they are used: (1) housed vs. unhoused air circulating fan heads; (2) direct-driven vs. belt-driven air circulating fan heads; and (3) single-phase vs. polyphase air circulating fan heads. DOE also requests information on any additional features that may impact air circulating fan head utility.

Issue 8: DOE requests comment on whether the diameters chosen for representative units in this analysis (*i.e.,* 12 inches, 20 inches, 24 inches, 36 inches, and 50 inches) accurately represent the diameters with the highest sales volume available in the air circulating fan market. DOE also requests comment on whether diameter is an appropriate representative metric for air circulating fans.

Issue 9: DOE requests comment on whether the motor hp it has associated with each representative diameter (*i.e.,* 0.1 hp for 12 inches, 0.33 hp for 20 inches, 0.5 hp for 24 inches and 36 inches, and 1 hp for 50 inches) appropriately represent the motor hp for fans sold with those corresponding diameters.

Issue 10: DOE requests comment on its use of SP motors as the baseline for air circulating fans. Additionally, DOE seeks feedback on its choice of motor technologies (SP motor to PSC 1 motor, PSC 1 motor to PSC 2 motor, and PSC 2 motor to ECM) to estimate air circulating fan efficiency increases from one efficiency level to the next.

Issue 11: DOE requests comment on its assumption that motors used in air circulating fans are exclusively air-over motors. If this is not the case, DOE requests information on the other types of motors that are sold with air circulating fans and data on the percentage of air circulating fans that are sold with motors other than air-over motors. Additionally, DOE requests information on whether or not the type of motor supplied with an air circulating fan is a function of air circulating fan category (*e.g.,* unhoused air circulating fan head, box fan, cylindrical air circulating fan, etc.).

Issue 12: DOE requests feedback on whether catalog performance data on SP motors and PSC motors is generally representative of the performance of the SP and PSC motors included with air circulating fans.

Issue 13: DOE requests feedback on the methodology used to determine the baseline efficiency values for the representative units, including its method of first establishing the EL1 efficiency and then determining the baseline efficiency by reducing the EL1 efficiency by the difference in efficiency between a PSC motor and a SP motor. Additionally, DOE requests data on the expected average improvement in air circulating fan efficiency when a SP motor is replaced by a PSC 1 motor.

Issue 14: DOE requests feedback on its assumption that airflow, pressure, and motor performance (for example, speed and inrush current) remain constant when replacing a less efficient motor with a more efficient motor in an air circulating fan. If airflow, pressure, or motor performance are not maintained when using a more efficient motor, DOE requests feedback and data on how it should conduct this analysis.

Issue 15: DOE requests feedback on whether the efficiency gains shown in the supplementary spreadsheet are realistic efficiency gains when replacing a lower efficiency PSC motor (*i.e.,* PSC 1 motor) with a higher efficiency PSC motor (*i.e.,* PSC 2 motor). If these assumptions are not realistic, DOE requests data demonstrating air circulating fan motor efficiency as a function of hp, as well as data for motor hp as a function of fan diameter.

Issue 16: DOE requests feedback on its use of dedicated purpose pool pump motors as a source for comparing PSC motor and ECM efficiency. Additionally, DOE requests information on whether motors used for this purpose are comparable to air circulating fan motors. DOE further requests feedback on whether the efficiency increases from

PSC 1 motors to ECM that DOE presents are realistic. If dedicated purpose pool pump motors are not representative of air circulating fans motors, or DOE's estimated efficiency increases are not realistic, DOE requests data on the difference between PSC 1 motor efficiency and ECM efficiency and the difference between PSC 2 motor efficiency and ECM efficiency for air circulating fans. DOE also requests comment on its use of extrapolation of these data to obtain efficiency values at fractional hp.

Issue 17: DOE requests feedback on the FEI values that it determined and its approach for estimating FEI values for an air circulating fan that includes both an ECM and improved aerodynamic design.

Issue 18: DOE requests comment on its factory parameter assumptions for typical air circulating fan production.

Issue 19: DOE requests comment on whether or not its baseline material assumptions are representative of baseline fans distributed into commerce. If DOE's baseline material assumptions are not representative, DOE requests information and data on materials typicaly used in the air circulating fans currently on the market.

Issue 20: DOE requests comment on its estimated base MPC for air circulating fans with no motors at each of the representative diameters evaluated. (See supplemental spreadsheet included in Docket No. EERE–2022–BT–STD–0002, No. 11)

Issue 21: DOE requests comment on whether replacing a given fan motor with a more efficient fan motor will result in similar efficiency and cost impacts for housed and unhoused air circulating fan heads.

Issue 22: DOE requests comment on its estimated motor costs SP motors (EL0), PSC motors (EL1), higher efficiency PSC motors (EL2), and ESMs (EL3) at each hp associated with the representative diameters evaluated. (See supplemental spreadsheet included in Docket No. EERE–2022–BT–STD–0002, No. 11)

Issue 23: DOE requests comment on its estimated housed and unhoused air circulating fan costs at each EL and for each representative unit. (See supplemental spreadsheet included in Docket No. EERE–2022–BT–STD–0002, No. 11)

Issue 24: DOE requests comment on and additional data to support its estimated air circulating fan conversion costs to undergo aerodynamic redesign.

Issue 25: DOE requests comment on whether or not an average MSP of 1.5 is representative for the air circulating fan market. If an average MSP of 1.5 is not representative, DOE requests information of what a more representative MSP would be. Additionally, DOE requests comment on whether or not MSP for air circulating fans will remain constant in the case of new energy conservation standards. If not, DOE seeks information on the magnitude by which MSP might change under potential energy efficiency standards.

Issue 26: DOE requests feedback and information on the distribution channels identified for air circulating fans, and on any other distribution channel that DOE should consider. DOE also requests data on the fraction of sales that go through these channels.

Issue 27: DOE seeks comment on the estimated average number of operating hours per year, distribution of operating hours, and the estimated fraction of time spent at each speed setting for air circulating fans with input power less than 125 W and those with input ower greater than or equal to 125 W. In addition, if DOE should consider different operating hours for specific applications (*e.g.,* air circulating fans used in agricultural applications, thermal mixing fans) DOE requests data on how to best characterize operating hours for these various applications.

Issue 28: DOE requests feedback on the inputs and considered methods used for the LCC and PBP analyses.

Issue 29: DOE requests information on its assumptions related to installation, maintenance, and repair practices of air circulating fans. Specifically, DOE requests feedback and data on whether installation, maintenance, and repair costs of air circulating fans are expected to be different at higher efficiency levels in comparison to the baseline installation, maintenance, and repair costs. To the extent that these costs differ, DOE seeks supporting data and the reasons for those differences.

Issue 30: DOE requests information on the repair frequency of air circulating fans (*i.e.,* how many repairs in a lifetime) by category (*i.e.,* unhoused air circulating fan heads, air circulating axial panel fan, box fan, cylindrical air circulating fan, and housed centrifugal air circulating fan) and on its approach to consider a single repair for certain air circulating fans with input power greater than or equal to 125 W.

Issue 31: DOE requests comment on the estimated average equipment lifetimes for air circulating fans. DOE also requests information related to minimum and maximum equipment lifetimes (in years or total mechanical hours).

Issue 32: DOE requests comment on its approach to derive efficiency distribution in the no-new standards case for each air circulating fan category and input regarding 2021 (or most recent year available) equipment efficiency distributions. Additionally, DOE seeks data that would support changes in efficiency distributions over time in the no-new standards case. To the extent any of the efficiency distributions in the no-new standards case differ by size or other consumer or design characteristic, DOE requests information to characterize these variations.

Issue 33: DOE requests comment on the estimated 2020 shipments of air circulating fans for each market segment considered (*i.e.,* below 125 W, and at or above 125 W) and seeks input on the fraction of shipments by air circulating fan category (*i.e.,* unhoused air circulating fan heads, air circulating axial panel fan, box fan, cylindrical air circulating fan, and housed centrifugal air circulating fan). In addition, DOE requests 2021 annual sales data (or the most recent year available)—*i.e.,* number of shipments—for air circulating fans and annual historical shipments data for 2016–2020 (or most recent years available). If disaggregated data of annual sales are not available for different air circulating fan categories, DOE requests more aggregated data of annual sales as available.

Issue 34: DOE requests comment on the estimated market share by sector. DOE requests 2016–2021 data (or the most recent years available) on the fraction of shipments in the industrial, commercial, and residential sectors for air circulating fans. In each sector, DOE requests 2016–2021 data (or the most recent years available) on the fraction of shipments that represent replacement versus new installations.

Issue 35: DOE requests comments on its approach to project shipments of air circulating fans. DOE requests information on the rate at which annual sales (*i.e.,* number of shipments) of air circulating fans is expected to change in the next 5–10 years. If possible, DOE requests this information for each air circulating fan category (*i.e.,* unhoused air circulating fan heads, air circulating axial panel fan, box fan, cylindrical air circulating fan, and housed centrifugal air circulating fan). If disaggregated data of annual sales are not available for each air circulating fan category, DOE requests more aggregated data of annual sales.

Issue 36: DOE requests comments on its approach to project equipment efficiency for air circulating fans. DOE requests data and information on any trends in the fans market that could be used to forecast expected trends in market share by efficiency levels for air circulating fans. If disaggregated data are not available for each air circulating fan category, DOE requests more aggregated data.

IV. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of this notification of the availability of the preliminary technical support document and request for comment.

Signing Authority

This document of the Department of Energy was signed on October 5, 2022, by Francisco Alejandro Moreno, Acting Assistant Secretary for Energy Efficiency and Renewable Energy, pursuant to delegated authority from the Secretary of Energy. That document with the original signature and date is maintained by DOE. For administrative purposes only, and in compliance with requirements of the Office of the Federal Register, the undersigned DOE Federal Register Liaison Officer has been authorized to sign and submit the document in electronic format for publication, as an official document of the Department of Energy. This administrative process in no way alters the legal effect of this document upon publication in the **Federal Register**.

Signed in Washington, DC, on October 6, 2022.

Treena V. Garrett,

Federal Register Liaison Officer, U.S. Department of Energy.

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