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Commercial & Industrial Stand-Alone Fans Market Research

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1 EXECUTIVE SUMMARY

NEEA contracted DNV (formerly ERS) to conduct primary research in order to characterize the commercial and industrial (C&I) stand-alone fan market to inform future program designs. NEEA defines a stand-alone fan as a fan that is not distributed in commerce for incorporation in unitary packaged HVAC systems or built-up HVAC systems. The research conducted during this study leveraged NEEA's definition and focused on fans of up to 50 horsepower for C&I applications.

1.1 Research approach

The research team conducted 27 in-depth interviews with the key market actors that manufacture, sell, select, and install stand-alone fans: manufacturers, manufacturing representatives, design engineers, fan installers, and service providers serving NEEA's region.

1.2 Key findings

The following key findings emerged from this research:

1. **Specifiers are the critical actors in selecting and influencing the stand-alone fan selection for both new construction and renovation projects**. Specifiers primarily include design engineers and manufacturers' representatives. Manufacturers also specify fan equipment for large C&I customers. Interviewees also reported that end-users are typically not familiar with fans and what makes an efficient fan.
2. **Stand-alone fans, especially for exhaust applications, are commonplace in C&I buildings, but interviewed design engineers report spending most of their design time on other aspects of HVAC systems.** Design engineers reported that stand-alone fans are typically not large contributors to HVAC load, and that they primarily leverage manufacturers' fan selection software and their own engineering expertise to select stand-alone fans for their projects.
3. **Stand-alone fans are primarily sold through manufacturers and their representatives.** Fans are commonly custom ordered and are typically not carried in stock by manufacturers' representatives or available from distributors.
4. **Most manufacturers have developed their own proprietary fan selection software to assist in fan selection.** These software products are used ubiquitously in the market by design professionals and manufacturers' representatives to facilitate fan selection. They typically include some measures of efficiency but the software solutions do not consistently use efficiency as the primary criterion for fan selection recommendations.
5. **Existing fan efficiency metrics such as Fan Energy Index (FEI), though familiar to many market actors, are not currently used as decision-making or sales tools**. Design engineers report typically relying on their engineering expertise to select fans, and while their selection process often leverages similar underlying calculations to those used for FEI, the industry would require significant awareness building in order for FEI to be widely adopted as a key fan selection tool.
6. **Energy codes can help drive FEI awareness**. ASHRAE 90.1-2019 includes a minimum FEI for fans, which has contributed to market actor awareness of this metric. As these codes become more widely adopted, FEI will likely receive more attention as a measure of fan efficiency and performance.
7. **Cost, and specifically first cost, is the primary influence on fan selection, particularly for mechanical contractors (installers).** While design engineers and manufacturers' representatives commonly select specific fans to be included in project requirements, mechanical contractors typically purchase and install the equipment and have opportunities to substitute equivalent fans. Mechanical contractor interviewees indicated that they most commonly substitute based on price.

1.3 Intervention opportunities

DNV identified several intervention opportunities for NEEA to consider to influence the stand-alone fan market.

1. **Work with manufacturers to increase the visibility of efficiency features in their selection software offerings.** These software programs are used throughout the industry, and efforts to promote efficiency, whether explicitly via the FEI metric or based on key fan parameters or total cost of ownership, could influence all parties involved in fan specification. There are multiple stand-alone fan manufacturers, so intervention would need to occur across platforms to enable comparisons of stand-alone fans across brands.
2. **Consider a midstream intervention targeted at manufacturers' representatives to promote sales of efficient stand-alone fans**. Manufacturers' representatives are responsible for most fan sales across applications and are engaged in fan specification. Targeting this group could have broad influence on the market. For example, NEEA could investigate offering an incentive to increase profit margins for qualifying efficient stand-alone fans. NEEA could also provide financial motivation for representatives to include and identify efficient stand-alone fan options alongside standard options in their quotes, which accompanied by appropriate efficiency and total cost of ownership estimates, could increase sales of these products.
3. **Work with utilities and any other groups administering existing energy efficiency programs in NEEA's region to investigate whether existing programs targeting new construction design professionals could be expanded to serve the stand-alone fan market.** Existing programs targeting the design community may provide an efficient and effective platform for communicating and incentivizing the value of high efficiency stand-alone fans as an integral part of good design in lieu of establishing an altogether new program for stand-alone fans. This intervention could be particularly effective for design engineers who are typically responsible for choosing all HVAC equipment for a project. Integrated programs could provide one-stop shopping to help identify all available program offerings to encourage efficient equipment selection.

2 METHODOLOGY AND RESEARCH APPROACH

This section contains the methodology and research approach to gather market insights for the commercial and industrial (C&I) stand-alone fan market to support NEEA program development.

2.1 Background

NEEA contracted DNV (formerly ERS) to conduct primary research in order to characterize the commercial and industrial (C&I) stand-alone fan market to inform future program designs. NEEA defines a stand-alone fan as a fan that is not distributed in commerce for incorporation in unitary packaged HVAC systems and built-up HVAC systems. The research conducted during this study leveraged NEEA's definition and focused on fans up to 50 horsepower for C&I applications.

This research was originally designed to explore the possibility of adding stand-alone fans to NEEA's Motor-Driven System Product Group's existing Extended Motor Products (XMP) program. However, during the research period, NEEA staff determined that stand-alone fans were unlikely to be included in the XMP program. Thus, DNV and NEEA adjusted the focus of the analysis to identify fan market characteristics to support future program development not necessarily tied to the XMP program.

2.2 Research objectives

NEEA and DNV defined research objectives to support data collection that would characterize the stand-alone fans market. Table 2-1 includes the key research questions organized by topic and explored in the results section below.

Table 2-1. NEEA Fans Market Research Questions

Research Topic	Key Questions
Fan applications	1. What are the primary applications and sectors for stand-alone fans? 2. Is there any overlap with pumps in the agricultural sector?
Market dynamics	1. What is the product distribution flow from manufacturing to end user? 2. What are the roles of market supply actors in purchase decisions? Are distributors involved? 3. What are the key decision factors?
Barriers to fans	1. What are the market barriers for adopting efficient C&I stand-alone fans? 2. How do the market barriers compare to the Extended Motor Products (XMP) Pumps logic model barriers?
Role of fan efficiency	1. What is the awareness of FEI in the market? 2. How do market actors think about energy efficiency? Is it a differentiator?

2.3 Research approach

The primary research method for this study was conducting in-depth interviews with the key market actors that manufacture, sell, select, and install stand-alone fans. DNV used several methods to identify these market actors, including purchasing contact lists, industry research, and incorporating specific recommendations from NEEA to leverage existing industry relationships. These sources are summarized in Table 2-2. DNV aggregated the industry contacts developed from these sources to develop contact lists for each market actor to track recruitment and interview progress.

Table 2-2. Sources used to identify stand-alone fans market actors

Contact source	Description of source	Market actor(s) identified
Thomas directory	The Thomas Directory is a marketing platform for industrial buyers, engineers, and maintenance, repair, and overhaul (MRO) professionals. It lists over 500,000 North American manufacturers and suppliers. DNV identified around 300 industrial fan manufacturers in the U.S. and Canada. Not all of the fan manufacturers sell stand-alone fans.	Manufacturers; manufacturers' representatives
Dunhill purchased lists	DNV purchased list of companies from Dunhill and identified Standard Industrial Classification (SIC) codes most likely to apply to stand-alone fan market.	Manufacturers; manufacturers' representatives; design engineers; mechanical contractors
Industry research	DNV conducted industry research, reviewing manufacturer websites to identify their representatives within NEEA's region, as well as reviewing industry reports that identified companies within US fan and blower market.	Manufacturers; manufacturers' representatives
AMCA member and FEI labeled fan company lists	DNV reviewed AMCA membership and FEI suppliers to identify market participants.	Manufacturers; manufacturers' representatives
NEEA recommendations	Recommendations and discussion with NEEA to inform all market actor groups	Manufacturers; manufacturers' representatives; design engineers; mechanical contractors

DNV confirmed that each interviewee works in and/or has experience in NEEA's region (Oregon, Washington, Montana, and Idaho), and directed interviewees to focus their responses on their experiences with stand-alone fans up to 50 horsepower. Table 2-3 summarizes the interviews completed to inform this study.[1]

Table 2-3. Stand-Alone Fans Interview Summary

Market Actor	Interviews Completed
Manufacturers	8
Manufacturers' Representatives	10
Design Engineers[2]	7
Fan Installers and Service Providers	2
Total completes	**27**

3 RESULTS AND FINDINGS

This section presents the results and findings from the market research, organized to align with the research objectives.

3.1 Fan applications

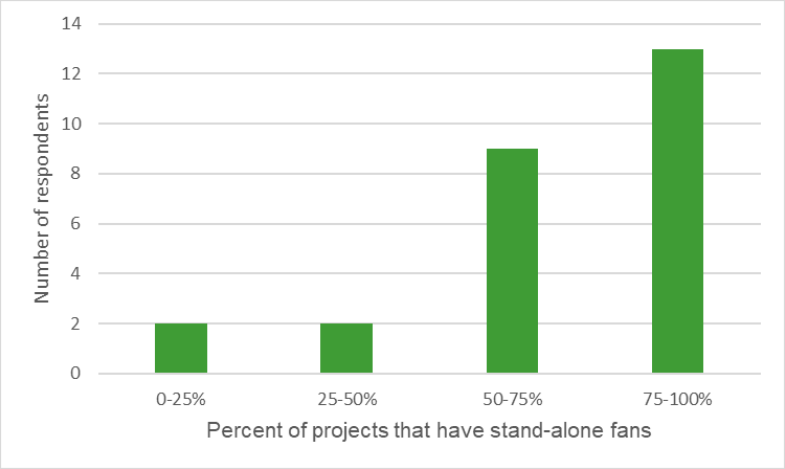
DNV asked all interviewees to identify the most common applications and building sectors for stand-alone fans, and how often stand-alone fans are included in C&I projects. Here are the key insights regarding fan applications:

- **Stand-alone fans are found in most C&I projects, though their contribution to overall HVAC load varies widely**. DNV asked interviewees to estimate the percent of their commercial and industrial (C&I) projects in the past year that included stand-alone fans and how the percentage of projects varies across new construction and retrofit. As shown in Figure 3-1, stand-alone fans are commonplace across responses from all market actors, with nine interviewees (out of 27) indicating that stand-alone fans are present in more than 90% of projects. The specifiers highlighted that while these fans are commonplace, design teams for commercial projects typically spend more time on the design of a building's packaged HVAC systems, since they commonly consume more of the building HVAC load.

[1] The DNV team originally included distributors as an interview target, but the team pivoted away from distributor interviews based on initial findings from the early manufacturer and manufacturers' representative interviews indicating that distributors are not key market actors for stand-alone fans.

[2] DNV encountered interview recruitment challenges when reaching out to design engineers; out of 990 unique organizations, only 118 responded to DNV's interview invitation, and of those, 62 noted they do not engage in stand-alone fan selection for C&I applications and were not viable interview candidates.

Figure 3-1. Estimated Percentage of Projects that Include Stand-Alone Fans



- **Stand-alone fans are common in both new construction and retrofit applications**. Interviewees consistently indicated that their project volume is fairly evenly split between new construction and retrofit projects. Retrofit applications include both planned and emergency replacements, as well as fan repair in some cases.
- **Exhaust is the primary application for stand-alone fans**. The market actors agreed that exhaust is the primary application for stand-alone fans. The specific exhaust applications vary, and include kitchen, bathroom, and general building exhaust. Supply-side fans, while occasionally stand-alone, are more likely to be embedded in packaged systems that enable conditioning of the air prior to supplying it to the facility.
- **Other common commercial applications include ventilation and air movement**. Interviewees mentioned general ventilation and air movement as additional stand-alone applications, often achieved by high volume low speed fans and panel fans or fan grids. These types of applications are more common in warehouses and open areas, as well as parking garages and tunnels.
- **Industrial applications include process and agricultural production needs**. For industrial facilities, market actors identified process exhaust, product drying, and dust collection as common stand-alone fan applications, as well as additional custom applications. Market actors identified a variety of industrial applications using stand-alone fans, including general manufacturing, paint booths, and welding. Interviewees also identified agricultural applications in response to questions about industrial applications, including cannabis, dairy, and other crop drying.

3.2 Market dynamics

A key objective of this research was to identify the primary market actors involved in stand-alone fan transactions, and to document the typical stand-alone fan product flow from manufacture to installation. This section outlines the primary market actors and typical product flow(s) for stand-alone fans.

Stand-alone fan terminology. DNV observed during the interviews that the term “stand-alone fans” is not a well-known or commonly used term in the industry. Many market actors work with all types of fans, and they differentiate stand-alone fans based on their application. DNV found that differentiating between “fans embedded within packaged equipment” and “fans not embedded within packaged equipment” was the most effective approach to focus the discussion on stand-alone fans.

3.2.1 Primary market actors for stand-alone fans

While specific roles and responsibilities can vary across individual projects, interviewees identified the following typical market actors within the stand-alone fan market:

- **Manufacturers**. There are many manufacturers producing stand-alone fans for C&I applications. Manufacturers produce full product specifications that are typically included as supporting documentation for construction drawings. Most manufacturers have developed in-house fan selection software to assist specifiers and manufacturers' representatives in selecting fans that are appropriate for the desired applications.
- **Manufacturers' Representatives**. The majority of stand-alone fans are purchased through manufacturers' representatives. Typically, manufacturers' representatives have geographically exclusive relationships with manufacturers for fan sales in each jurisdiction, and these firms generally do not represent multiple brands in the same product line. The manufacturers' representatives' roles vary based on the expertise of the other parties involved in fan selection, which typically include design engineers and occasionally end users and mechanical contractors. Common roles for manufacturers' representatives include full fan selection on behalf of design engineers and/or end users, review of design engineer selections, and providing consulting advice and guidance to assist in product selection. Several manufacturers' representatives indicated that the manufacturer software they use typically provides two to four suitable fans for most applications, though they often provide a single recommendation in their quote to customers that reflects their understanding of project needs.
- **Design engineers** commonly specify fans for C&I projects, consulting fan selection software and directly with manufacturers' representatives. Typically, engineers select a single fan for an application to include in the construction documentation. Design engineers indicated that they typically spend more of their time on the larger HVAC systems and less on the selection of stand-alone fans, which typically serve exhaust and constitute a smaller part of the energy and capital budget.
- **Mechanical contractors** are typically responsible for fan purchase and installation. They generally do not specify fans but are responsible for acquiring the fans needed for a project. Some mechanical contractors and designers reported that contractors often shop around with various manufacturers' representatives to get price quotes for different brands, sometimes making substitutions for the fan specified in the basis of design. Typically, these substitutions require approval from the design teams to ensure they provide equivalent performance.
- **Building service providers** maintain stand-alone fans in existing buildings. They are more likely to be engaged in fan repair and replacements, and they indicated in interviews that they commonly seek guidance from manufacturers' representatives regarding repair versus replacement decisions and in selecting appropriate replacement fans where needed.
- **Building owners/end users** are typically not very knowledgeable regarding stand-alone fan needs and specifications and thus they rely on contractors, representatives, and design teams to select appropriate fans for their applications. Several representatives noted some exceptions for large organizations and industrial applications where the end users are likely to have specialized expertise in-house; in these instances, it is common for manufacturers' representatives to work directly with building owners/users to select fans.
- **Distributors** are not actively engaged in the stand-alone fan markets. While some stand-alone fans are sold through distributor warehouses for residential and small commercial applications, most of the stand-alone fans are sold through manufacturers' representatives. DNV pivoted the research away from distributors based on this early finding from interviews with manufacturers and manufacturers' representatives.

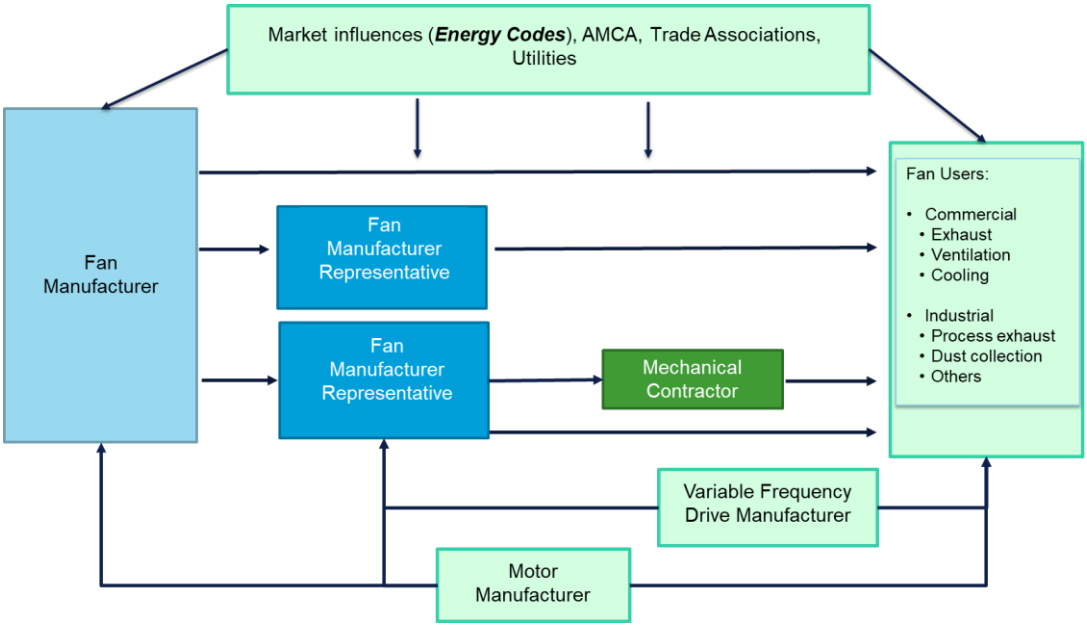
3.2.2 Stand-alone fan typical product flows

Figure 3-2 below summarizes the typical product flows for stand-alone fans based on the market research conducted in this study. There are several pathways for fans to go from manufacturer to end user. Direct sales are typically only seen for large and/or sophisticated customers, while most end users leverage manufacturer representatives and/or mechanical contractors to acquire and install fans. DNV's research focused on manufacturers, manufacturers' representatives, and mechanical contractors serving in the roles of fan manufacture, sales, selection, and installation/servicing.

There are a variety of market influences that can affect the fans selected for projects. These influences include statutory requirements such as energy codes, equipment-specific organizations such as the Air Movement and Control Association (AMCA) that set efficiency standards and best practices, and trade associations, as well as utility programs that can encourage selection of efficient equipment to receive rebates and/or incentives.

This research did not focus on motors and drives, which are generally added to stand-alone fans either at the factory or during installation. These are shown in Figure 3-2 for reference.

Figure 3-2. Stand-Alone Fan Product Flow[3]



3.2.3 Fan repair/replacement considerations

DNV spoke with several manufacturers, manufacturers' representatives, specifiers, mechanical contractors, and service providers that work on renovation projects where they are either repairing or replacing fans. This research found that:

- **Fans are relatively simple equipment with few moving parts.** Interviewees reported that most fans have few moving parts, and thus there are opportunities to repair broken fans, as replacing bearings, cones, and wheels is commonly much less expensive than full fan replacement.
- **Fan repair may present opportunities for motor upgrades**. DNV asked service providers and others engaged in fan repair about repairing or replacing motors within the fan assembly. Interviewees indicated that price and existing fan condition are biggest factors in this decision. In some cases, they will replace and/or upgrade motors (adding an electronically commutated motor (ECM) is most common), while in others the fan condition or motor replacement costs warrant full fan replacement. Interviewees noted that ECMs are becoming more common and are being included in increasingly larger fans. Interviewees also indicated that they encourage the addition of variable frequency drives (VFDs) where possible but are similarly restricted by price and existing conditions.
- **Physical space constraints influence replacement options**. Interviewees reported that fan replacement options are commonly restricted by the space allotted to the fan they are replacing. Like-for-like replacements typically will fit in the same enclosure, but when upselling for higher efficiency products, designers and manufacturers' representatives need to ensure that there is enough physical space for a new fan while also reviewing any existing ductwork for suitability.

[3] Design engineers are not included in the figure, as this figure shows the product flow from manufacturer to end user. Design engineers commonly select fans, but are not part of the product flow.

- **Timing of design team and fan expert engagement varies**. Interviewees involved in fan repair and replacement indicated that the timing of when they are engaged varies based on customer awareness and sophistication. Some customers have in-house or contracted mechanical service providers that examine broken or malfunctioning equipment to assess the need for repair or replacement prior to contacting fan professionals, while others contact manufacturers' representatives directly for assistance when fans require repair or replacement. Mechanical contractors reported occasionally seeking guidance from manufacturers' representatives regarding the decision to repair versus replace fans but indicated that on-site facilities staff most often make this decision without engagement of manufacturers or their representatives.

3.3 Influences on the selection and adoption of efficient fans

This section summarizes the interviewees' perspectives regarding factors that influence the specific fans recommended for selection, as well as the barriers to adopting efficient stand-alone fans in the C&I market. Section 3.3.1 summarizes the interviewee perspectives on the primary influences affecting the specific fans they recommend, and Section 3.3.2 integrates these factors to summarize the primary barriers, using the XMP-pumps logic model barriers for context.

3.3.1 Factors influencing fan selection

DNV asked interviewees about the key factors influencing the specific fans they select and/or recommend for C&I projects. The key factors include:

- **Application and design requirements.** Across all market actors interviewed, ensuring the fans under consideration meet the design requirements of the intended application and design characteristics is the primary factor influencing the fans recommended for selection. Where there are typically several options that satisfy these criteria, the factors discussed below were the primary influences on selection.
- **Cost, and specifically first cost**. The commercial construction market is driven by cost mitigation; mechanical contractors commonly seek the lowest cost option when purchasing equipment. First cost is commonly used in the industry, as contractors are typically not responsible for operational and maintenance costs of equipment.
  - ***Opportunities for total cost of ownership***: Several manufacturers reported efforts to focus on total cost of ownership (the cost of the equipment plus the cost to operate it over its useful life), but face hurdles when working directly with contractors. However, interviewees reported that some project/design approaches are more likely to promote total cost of ownership:
    - Design/build projects – Several specifiers reported that design/build projects, where the design and construction teams collaborate throughout the design and construction, typically present greater opportunities to incorporate total cost of ownership.
    - Industrial and institutional projects – Manufacturers' representatives and specifiers noted that industrial and institutional projects often present opportunities to promote lifetime equipment costs, as end users are more likely to have equipment expertise in-house and, if they are working directly with the design/selection teams, they can represent the ongoing operational and maintenance costs of fans. Industrial end users often are selecting fans for specialized applications, while institutional customers (such as universities) like to standardize their equipment and vendors and are responsible for maintenance and replacement of their equipment.
- **Lead time is critical when purchasing fans**. Since the majority of stand-alone fans are not purchased from distributors who carry stand-alone fans in stock, custom orders are commonplace, and fans can take weeks and/or months for manufacture and delivery. Most manufacturers reported that the COVID-19 pandemic has extended delivery

times on fans due to supply chain disruptions, and mechanical contractors reported shopping around with multiple manufacturers' representatives to compare both price and delivery timing before making purchases.

- **Code requirements,** specifically energy code requirements, are another factor that interviewees reported has had an influence on fan selection. Fan efficiency metrics were introduced in ASHRAE 90.1-2013, with a requirement for most fans to meet certain Fan Efficiency Grade (FEG) levels. More recently, the ASHRAE 90.1-2019 edition replaced the FEG requirement with a Fan Efficiency Index (FEI) requirement. Both specifiers and manufacturers' representatives cited these energy codes as influences on fan selection, as they need to design their projects to meet the code. As more states adopt the latest versions of codes, they expect to see these requirements more frequently.
- **Sound and vibration** concerns were cited by specifiers and manufacturers' representatives as an additional decision factor for specific customers and applications, especially for fans operating within occupied spaces.
- **Efficiency** is a factor in fan decision-making, primarily in the context of fan sizing and selecting the most efficient fan for the job to minimize costs to the customer. Additional details on efficiency are provided in Section 3.4 below.

3.3.2 Barriers to adoption of efficient stand-alone fans

This section highlights the primary barriers to selecting energy efficient stand-alone fans; DNV explored these barriers in the context of the barriers outlined in the XMP Pumps program logic model. The bullets below reflect the XMP Pumps logic model language but customized to stand-alone fans where appropriate.

- **Specifiers and buyers primarily select fans based on first cost and lack access to data needed for return-on-investment calculations**. Fan selection is most commonly driven by first cost. Manufacturer software contains varying levels of detail regarding total cost of ownership, though several manufacturers identified this as an area of opportunity for improving fan selection software.
- **Stand-alone fans are typically a small and relatively simple component of larger HVAC equipment specification processes.** Design engineers reported that stand-alone fans are typically not large contributors to HVAC load and thus they spend the majority of their equipment specification effort on larger, more complex HVAC systems.
- **End users lack familiarity with efficient products and do not know how to identify or request efficient fans.** For stand-alone fans, aside from large institutional and industrial customers, end users typically cannot identify efficient products and thus require design engineers and/or manufacturers' representatives to help them select the appropriate fans for their projects. Interviewees reported that end users do care about costs, reliability, and other factors such as sound and vibration, but are dependent on fan specifiers to satisfy these concerns.
- **Specifiers do not prioritize efficiency when specifying stand-alone fans.** Design engineers and manufacturers' representatives commonly leverage manufacturers' selection software and their own engineering expertise to select appropriate fans for an application. They typically consider efficiency as one of the criteria influencing the fan specification process (for example, identifying fans that meet a specific efficiency threshold), but reported that they do not often compare efficiency metrics across options when choosing between multiple fans.
- **Suppliers prefer familiar, customized solutions and like-for-like replacements**. Most of the design engineers indicated that they have preferences for specific fan manufacturers and/or manufacturers' fan selection software. This influences the fans they commonly specify as the basis of design, though substitutions do occur from mechanical contractors. Manufacturers and their representatives most commonly highlighted brand loyalty and company longevity as the key differentiators for them in the marketplace.
  - For replacements, 10 out of 12 interviewees (among design engineers and manufacturers' representatives) indicated that customers often or always ask for like-for-like replacements. For fans, space constraints are an important factor in selecting replacements, though there may be opportunities for upselling.

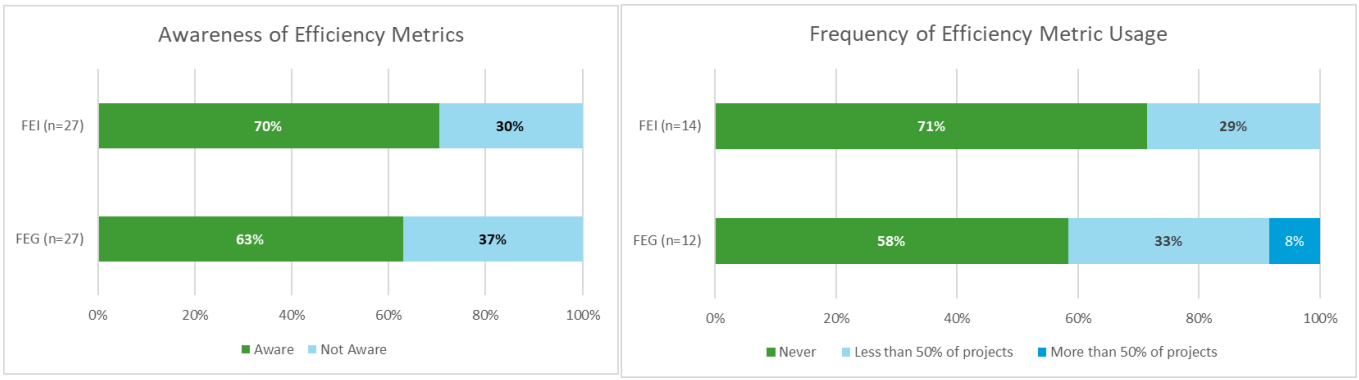
- **There is a lack of full category data that could hinder the ability to understand the market**. DNV asked all manufacturers and manufacturers' representatives whether they were aware of any fan shipment data that exists across manufacturers. No interviewees were aware of this information. Some manufacturers indicated that they would potentially be willing to share their data, and others suggested that AMCA partner in consolidating this information, but they were fairly certain that such a resource does not currently exist.

3.4 Fan efficiency

DNV asked the market actors a series of questions regarding fan efficiency to gather information about customer and market actor awareness, interest in fan efficiency, familiarity with existing fan efficiency metrics and their use in fan decision-making. Specifically, NEEA asked DNV to explore awareness and use of the Fan Energy Index (FEI) metric, a recently developed metric to assess fan efficiency, as well as whether continued awareness and/or use of the previous metric, Fan Efficiency Grade (FEG), could create barriers to adoption of FEI.

- **FEI and FEG are not commonly used in fan selection.** DNV asked all interviewees whether they were aware of each metric, and if so, how often they use the metrics in selecting fans. Most of the interviewee awareness was driven by inclusion of these metrics in energy codes; FEG was introduced in older versions of ASHRAE 90.1, and was replaced by FEI in ASHRAE 90.1-2019. Figure 3-3 compares interviewee awareness of FEI and FEG, as well as the percentage of interviewees aware of the metrics that use them in fan selection. While there is similar awareness of each metric in the market, neither are commonly used to select fans.

Figure 3-3. Awareness and Usage of FEI and FEG in Fan Selection



- **Fan specifiers understand the key components of fan efficiency and what data to collect to select appropriate fans**. While they are not using efficiency metrics explicitly to select fans, they use many of the same fan performance criteria that feed the metrics. Specifiers identified using fan curves to help with fan selection, and when comparing individual fans, common criteria examined include brake horsepower, fan size (CFM), and system pressure.
- **Fan selection software incorporates efficiency measures, though the FEI and FEG metrics are not always explicitly communicated**. Each manufacturer's selection software contains efficiency information about its products to assist in selection. Some manufacturers explicitly include FEI and/or FEG in their software as a variable for filtering and sorting, while others do not explicitly show these metrics.
- **Customers and end users are not familiar with fan efficiency or how to ask for efficient fans**. Across the board, interviewees reported that most customers are not well-versed in how to measure fan efficiency, and they instead rely on specifiers and manufacturers' representatives to select the appropriate fans. Several interviewees

indicated that occasionally a customer will request “the most efficient fan” for an application, but that they typically are not familiar with the underlying performance characteristics that make a fan efficient.

- **Energy codes are a driver for awareness and potential future use of the FEI metric**. Specifiers and manufacturers’ representatives indicated that the inclusion of fan efficiency metrics (FEG in ASHRAE 90.1-2013, replaced with FEI in ASHRAE 90.1-2019) in energy codes is the primary driver for customers asking for these metrics. Future adoption of these codes could be an opportunity to promote the FEI metric.

4 CONCLUSIONS AND INTERVENTION OPPORTUNITIES

DNV developed the following key conclusions and intervention opportunities based on the analysis completed.

4.1 Key conclusions

1. **Specifiers are the critical actors in selecting and influencing the stand-alone fans selected for both new construction and renovation projects**. Specifiers primarily include design engineers and manufacturers’ representatives. Manufacturers also specify fan equipment for large C&I customers. While mechanical contractors may substitute less expensive fans, the specifier selects the fan based on design criteria and typically must approve any changes to specified products. Interviewees also reported that end-users are typically not familiar with stand-alone fans and what makes an efficient fan.
2. **Stand-alone fans, especially for exhaust applications, are commonplace in C&I buildings, but interviewed design engineers report spending most of their design time on other aspects of HVAC systems.** Design engineers reported that stand-alone fans are typically not large contributors to HVAC load, and that they primarily leverage manufacturers’ fan selection software and their own engineering expertise to select stand-alone fans for their projects.
3. **Stand-alone fans are primarily sold through manufacturers and their representatives.** Fans are not commonly carried in stock by manufacturers’ representatives or available from distributors.
4. **Most manufacturers have developed their own proprietary fan selection software to assist in fan selection.** These software products are used ubiquitously in the market by design professionals and manufacturers’ representatives to facilitate fan selection. They typically include some measures of efficiency but the software solutions do not consistently use efficiency as the primary criterion for prioritizing fan selection recommendations.
5. **Existing fan efficiency metrics such as Fan Energy Index (FEI), though familiar to many market actors, are not currently used as decision-making or sales tools**. Design engineers report typically relying on their engineering expertise to select fans, and while their selection process often leverages similar underlying calculations to those used for FEI, the industry would require significant awareness building in order for FEI to be widely adopted as a key fan selection tool.
6. **Energy codes can help drive FEI awareness**. ASHRAE 90.1-2019 includes a minimum FEI for fans, which has contributed to market actor awareness of this metric. As these codes become more widely adopted, FEI will likely receive more attention as a measure of fan efficiency and performance.
7. **Cost, and specifically first cost, is the primary influence on fan selection, particularly for mechanical contractors (installers)**. While design engineers and manufacturers’ representatives commonly select specific fans to be included in project requirements, mechanical contractors typically purchase and install the equipment and have opportunities to substitute equivalent fans. Mechanical contractor interviewees indicated that they most commonly substitute based on price.

4.2 Intervention opportunities

DNV identified several intervention opportunities for NEEA to consider to influence the stand-alone fan market.

1. **Work with manufacturers to increase the visibility of efficiency features in their selection software offerings.** These software programs are used throughout the industry, and efforts to promote efficiency, whether explicitly via the FEI metric or based on key fan parameters or total cost of ownership, could influence all parties involved in fan specification. There are multiple stand-alone fan manufacturers, so intervention would need to be across platforms to enable comparisons of stand-alone fans across brands.
2. **Consider a midstream intervention targeted at manufacturers' representatives to promote sales of efficient stand-alone fans**. Manufacturers' representatives are responsible for most fan sales across applications and are engaged in fan specification. Targeting this group could have broad influence on the market. For example, NEEA could investigate offering an incentive to increase profit margins for qualifying efficient stand-alone fans. NEEA could also provide financial motivation for representatives to include and identify efficient stand-alone fan options alongside standard options in their quotes, which accompanied by appropriate efficiency and total cost of ownership estimates, could increase sales of these products.
3. **Work with utilities and any other groups administering existing energy efficiency programs in NEEA's region to investigate whether existing programs targeting new construction design professionals could be expanded to serve the stand-alone fan market.** Existing programs targeting the design community may provide an efficient and effective platform for communicating and incentivizing the value of high efficiency stand-alone fans as an integral part of good design in lieu of establishing an altogether new program for stand-alone fans. This intervention could be particularly effective for design engineers who are typically responsible for choosing all HVAC equipment for a project. Integrated programs could provide one-stop shopping to help identify all available program offerings to encourage efficient equipment selection.

APPENDIX A. MANUFACTURER AND MANUFACTURERS' REPRESENTATIVE INTERVIEW GUIDE

Purpose

The DNV Team will conduct interviews with manufacturers and manufacturers' representatives for stand-alone fans that are 50 horsepower or less. These interviews will focus on topics listed in Table A-1. below.

Table A-1. Research Objectives Mapped to Questions in This Instrument

Research Questions/Topics	Survey Questions Address the Objectives
What are market barriers for high efficiency stand-alone C&I fans in the NW? ▪ Cost, unfamiliarity with eq./solution, reliability/performance/ maintenance concerns (ask each market actor group)? ▪ What are barriers in new construction, existing building applications or by end use or sector? ▪ Are barriers similar to those for pumps (see XMP logic model) or are some barriers more important for fans compared to pumps?	Q12, Q20 through Q26
What is the relative distribution of annual fan purchases for new installations, planned replacement installations, and emergency replacement installations?	Q28
Map the general distribution flow(s) from manufacturing to end user	Q9, Q6, Q10, Q11
How do manufacturers differentiate themselves from their competitors, including the degree to which they see energy efficiency as an opportunity to stand apart?	Q27
Do interviewed/surveyed distributors distribute fans and pumps to the agricultural market?	Q6, Q29
What are roles of various market actors in key purchase decision scenarios (planned replacement, emergency replacement, new construction and if possible by end use)? Inquire about: ▪ Key market/customer segments, including their key requirements for purchase (for example, price, ease of installation) ▪ The role each market actor plays and who are their typical buyers ▪ How market actors assess fan options ▪ How market actors interact to reach decisions about fans – in particular, the influence they exert in the decision	Q9 through Q12
What are market actors' current awareness and use of the FEI label? ▪ What proportion of market actors are aware of the FEI label? ▪ Are market actors using the FEI label in sales/purchasing decisions for stand-alone C&I fans and, if so, what role(s) does the label play in their decision-making processes? (Specifically, is efficiency integrated into the "basis of design" for fans and how is FEI used in deciding whether a fan or fan system is efficient enough?) ▪ To what degree are market actors interested in using the FEI label in each of the following applications: stand-alone fans, fans sold with motors or motors and drives, and smart fans?	Q13 through Q29
To what degree are market actors using other efficiency labels, such as the FEG label, in sales/purchasing decisions for stand-alone C&I fans? Do market actors understand the difference between the FEI label and the FEG label?	Q16, Q19
From where can NEEA obtain annual NW fan shipment data?	Q30

Instrument and Data Collection Information

Table A-2. Overview of Data Collection Approach

Data Collection	Description
Population Description	Manufacturers, Manufacturers' Representatives of stand-alone fans used in C&I applications
Type of Sampling	Purposive for Manufacturers and Manufacturers' Reps.
Target Sample - Interview Completions	Manufacturers = 10 Manufacturers' Rep.= 10
Instrument Type	Phone Semi-structured Interview (Mix of open-ended and closed-ended responses, but more open-ended than closed-ended questions)
Survey/Interview Length	30-40 min.
Description of Contact Sought	Engineers, sales staff, or senior staff at relevant organizations familiar with stand-alone fan sales for C&I buildings in the NW

Interviewer instructions are in *italics*.

Instrument

Before reaching out, please select here whether this contact is labeled in the contact list as:

( ) Manufacturer

( ) Manufacturers' Rep.

Introduction/Screening

Q1. [*ASK MANUFACTURERS' REPS*] Which of these states do you serve? [*Read*]

( ) Washington

( ) Oregon

( ) Idaho

( ) Montana

[*IF ANY SAY THEY DO NOT SERVE THE AFOREMENTIONED STATES, RE-ASK THE Q:*] Let me re-phrase. Does your organization serve any of the states I just mentioned?

[*IF YES*:] Who in your company is familiar with the fan market or sales in those states? [*Record name and phone number and contact this new contact*.] _____

[*IF NO:*] *Thank and terminate the interview.*

Q2. [*ASK MANUFACTURERS*] Are you familiar with the Northwest market or the market in any of these four states: Washington, Oregon, Idaho, or Montana?

( ) Yes – familiar with the fan market in the Northwest

( ) No → [*FOLLOW UP*:] Can you speak about the national or U.S. fan market? ( ) Yes ( ) No

[*If they can speak about the Northwest or the U.S. market proceed with the interview, otherwise ask who in the organization could speak about the Northwest or the U.S. market*.]

Q3. [*ASK ALL*] Just to confirm, does your organization [*if manufacturer say "*manufacture,*" otherwise say "*sell*"*] axial, centrifugal, rooftop, mixed-flow, or other stand-alone fans for commercial or industrial applications? Stand-alone fans are those that are not embedded into another piece of equipment or a system – that is, they are purchased as fans. This excludes fans embedded in packaged units and custom-built air-handler systems, for example.

[*If they are unclear about the stand-alone definition say this: Example of stand-alone fan would be exhaust fans and even warehouse ceiling fans*.]

( ) Yes

( ) No - *Terminate the interview; say, we are looking to speak with those selling stand-alone fans.*

( ) Don't Know - *Ask who would know and ask if you could be transferred to that person*.

Q4. [*IF MANUFACTURE/SELL STAND-ALONE FANS*] How familiar are you with those stand-alone fan [sales or products] at your organization? Would you say you are…(*Read*)

( ) Very familiar

( ) Moderately familiar, or

( ) Not at all familiar – *Ask who is familiar and ask if you could be transferred to that person*.

Interviewer: Only proceed if respondent is very or moderately familiar with stand-alone fan sales/requests in their organization.

Q5. Of your company's total fan sales in the past year, what percentage of fan sales would you consider to be stand-alone that are 50 horsepower or less? Your best estimate is fine. _____

Q6. [*ASK ALL*] What are the top three applications for those stand-alone fans that you sell or distribute that are 50 horsepower or less? (*If needed say: for example, an office building exhaust stack, or industrial blowers for material transport.*) (*If they simply say exhaust, probe for specific types of exhaust applications. Also ask about the sector if their response is not sector-specific.*)

a. [*IF NOT MENTIONED*] Do you sell stand-alone fans that are up to 50 horsepower to the agricultural sector? _____

	Application	Sector
#1:		
#2:		
#3:		

Q7. [*IF MANUFACTURERS REP.*] Are you an independent company or part of a national chain or publicly owned company? (*Based on their answer, select the appropriate option below.*)

( ) Independent Company

( ) National Chain/Publicly Owned Company

( ) Other – *Interviewer record their response*: _____

Q8. [*IF MANUFACTURERS REP.*] Would you say you are manufacturer representative representing one manufacturer, a manufacturer representative representing multiple manufacturers or a distributor who sells many manufacturer brands of fans?

( ) Manufacturer representative for a single manufacturer brand

( ) Manufacturer representative for multiple manufacturer brands

( ) Distributor (sells many brands)

( ) Both – *If this option*, *interviewer record their response*: _____

Roles, Customers and Purchase Decision Drivers

Q9. [*ASK ALL*] Who are your typical customers for stand-alone fans? ____ . [*IF NOT ADDRESSED]* Are your customers [Y/N]:

a. Building designer/specifiers

b. Mechanical contractor/installers

c. Building owners

d. A combination of these or other market actors? _____

e. Other _____

Q10. [*ASK ALL*] There may be a lot of people that influence the final fan selection, including multiple decision makers on the customer side and different professionals and building trades on the supply side. Can you sketch out who typically has some influence on stand-alone fan equipment selection (50 horsepower or less) and their roles in the process? _____

a. Do these roles vary by customer type? If so, please describe. _____

b. Do these roles vary by installation context? By installation context, we mean new construction, planned replacement, and emergency replacement. _____

c. [*IF NOT ADDRESSED*] Under what conditions, if any, are you one of the principal people influencing the choice of fan type? _____

Q11. *[IF MANUFACTURERS REP.*] Do you or the staff at your company help select fan(s) for your clients?

( ) Yes

( ) No

( ) Don't Know

Q12. *[ASK ALL]* What are the key factors that influence [*if manufacturer say* "sales of," *otherwise say* "your recommendations for"] stand-alone fans 50 horsepower or less? (*Probe for first cost, reliability, ease of installation, operating costs, maintenance, and efficiency.*) _____

a. Do these decision factors vary by the installation context – new construction vs planned replacement vs emergency replacement? _____

b. Do these decision factors vary by customer type – for example, restaurants, high-rise buildings, industrial facilities and so forth – or by application– and if so, how? _____

FEI

Q13. [*ASK IF THEY DID NOT MENTION THE FEI LABEL PREVIOUSLY*] Have you heard of the Fan Energy Index or FEI metric?

( ) Yes

( ) No

( ) Don't Know

Q14. [*ASK IF THEY DID NOT MENTION THE FEG LABEL PREVIOUSLY*] Have you heard of the Fan Efficiency Grade or FEG metric?

( ) Yes

( ) No

( ) Don't Know

Q15. [*ASK IF MANUFACTURERS REP. HEARD OF FEI*] How often do you use the FEI metric when helping clients select a fan? Would you say…(*read*):

( ) Never

( ) Less than 50% of the time

( ) About 50% of the time

( ) More than 50% of the time, or

( ) All the time

Do not read:

( ) Don't Know

Q16. [*ASK IF MANUFACTURERS REP. HEARD OF FEG*] How about the FEG metric? How often do you use FEG metric when helping clients select a fan? Would you say…(*read*):

( ) Never

( ) Less than 50% of the time

( ) About 50% of the time

( ) More than 50% of the time, or

( ) All the time

Do not read:

( ) Don't Know

Q17. [*ASK IF MANUFACTURERS REP. SAID THEY USE FEI <50%, 50%, >50% OR ALL THE TIME*] How do you use the FEI metric? [*Probe*: for fan selection, as a sales tool to discuss efficiency of a product, or in some other way?]_____

a. [*IF THEY SAY THEY DON'T USE IT OR DON'T KNOW*] Do you know how equipment designers/specifiers that work with customers looking for fans use the FEI metric? If so, how?_____

b. [*IF APPLICABLE*] Does this process/thinking vary if selecting for new construction, planned replacement or emergency replacement? _____

[*ALSO ASK*] How does the FEI label influence customer decision to buy a fan, if at all? ___

Q18. [*ASK ALL*] Approximately, what proportion of your customers specifically request efficient fans? _____

a. [*If proportion is > 0%, ask*] What do they ask for or how do they talk about efficiency? _____

b. [*IF NOT MENTIONED:*] And what type of metrics do customers use to identify efficient fans?

( ) Fan Energy Index (FEI)

( ) Fan Efficiency Grade (FEG)

( ) Other (*interviewer record response*:) _____

( ) Don't Know

Q19. [*ASK IF MANUFACTURERS REP. USE FEG AS MUCH OR MORE THAN FEI*] Thinking of FEI and FEG metrics, how are they each applied to identify efficient fans? [*Probe for market confusion and market preference*?] _____

MARKET BARRIERS

Q20. [*IF MANUFACTURER*] From your perspective, what are the factors that inhibit sales of high efficiency stand-alone fans? (*Probe for first cost, ROI, reliability concerns, performance concerns, maintenance concerns)* _____

a. [*IF THEY NOTED RELIABILITY/PERFORMANCE/MAINTANANCE CONCERNS, ASK*] You said reliability, performance, or maintenance concerns inhibit sales of high efficiency stand-alone fans. Why are customers concerned about these factors - is it because the market is not as familiar with such products, or many customers are experiencing performance issues, or perhaps there is another reason?

b. [*IF THEY NOTED ROI CONCERNS]* You said ROI can inhibit sales of high efficiency stand-alone fans. Can you tell us more – is it that buyers perceive poor ROI for efficient fan purchases, lack knowledge on how to estimate ROI for efficient fan purchases, or perhaps there is another reason?

Q21. [*IF MANUFACTURERS REP.*] From your perspective, what are the reasons you might be hesitant to recommend high efficiency stand-alone fans to your customers? (*Probe for first cost, ROI, reliability, performance, or maintenance concerns)* _____

a. Do these reasons vary by new construction, planned replacement, and emergency replacement?) _____

b. [*IF THEY NOTED RELIABILITY/PERFORMANCE/MAINTANANCE CONCERNS, ASK*] You said reliability, performance, or maintenance concerns do make you hesitant to recommend high efficiency stand-alone fans. Can you tell us more – are you hesitant due to your comfort or familiarity with those products, or because you

heard that many customers are experiencing performance issues with such products, or perhaps there is another reason?

Q22. [*ASK ALL*] Which customer segments are more likely to buy high-efficiency stand-alone fans whether it is for a new application or a replacement? _____

Q23. [*IF MANUFACTURERS REP.*] How often do buyers initially request like-for-like replacements when they are replacing existing fans?

( ) Never

( ) Sometimes

( ) Often

( ) Always

( ) Don't know

Q24. *[IF MANUFACTURERS REP.]* How often do you encourage those customers to choose more efficient fans instead of like-for-like replacements? Would you say [*read*]:

( ) Never

( ) Sometimes

( ) Often

( ) Always

Q25. [*ASK ALL*] Are any of the stand-alone fans that you sell characterized as smart fans? [*If respondent says, what do you mean by smart fan, say, "fan that automatically adjusts speed using integrated sensors and controls."]*

a. [ASK ONLY *IF THEY DID NOT ASK US TO DEFINE SMART FANS AND THEY SAID SOME STAND-ALONE FANS ARE CONSIDERED SMART FANS:*] Can you explain what features define them as smart fans? _____

b. And for what applications are they typically used? _____

Q26. [*ASK ALL*] From your perspective are there any design or specification challenges or concerns associated with high efficiency stand-alone fans that are 50 horsepower or less? _____

Q27. [*ASK ALL*] How do you differentiate yourself from your competitors in the stand-alone fan market? [IF NOT MENTIONED] Do you use efficiency to differentiate yourself? Why or why not? _____

SALES

Q28. [*IF MANUFACTURERS REP.*] In the previous 12 months, what proportion of your customers bought stand-alone fans for planned replacements, emergency replacements, and new construction? Your best estimate is fine. _____.

a. How, if at all, do you think COVID-19 affected these proportions? Is this different than what you saw in previous years?

Q29. [*ASK MANUFACTURERS REP.*] Do you also sell pumps for commercial and industrial applications, and if so, do you sell pumps to the agricultural sector?

( ) Yes, sell pumps to the agricultural sector

( ) No, sell pumps but not to the agricultural sector

( ) No, do not sell pumps

( ) Don't Know

Q30. This is my last question. If you know, are you aware of any sources of annual fan shipment data that could tell us about fan shipments to the Northwest? *[DO NOT ASK THE CONTACT TO PROVIDE ANY ACTUAL DATA]*

Those are all my questions. Thank you for your time and valuable feedback. If we need additional input to clarify some of your responses, can we email you?

APPENDIX B. FAN SPECIFIER AND INSTALLER GUIDE

PURPOSE

The DNV Team will conduct interviews with fan equipment specifiers (e.g., mechanical contractors) and also firms that install and/or provide service and maintenance for stand-alone fans that are 50 horsepower or less. These interviews will focus on topics listed in Table B-1 below.

Table B-1. Research Objectives Mapped to Questions in This Instrument

Research Questions/Topics	Survey Questions Address the Objectives
What are market barriers for high efficiency stand-alone C&I fans in the NW? ▪ Cost, unfamiliarity with eq./solution, reliability/performance/ maintenance concerns (ask each market actor group)? ▪ What are barriers in new construction, existing building applications or by end use or sector? ▪ Are barriers similar to those for pumps (see XMP logic model) or are some barriers more important for fans compared to pumps?	Q12, Q20 through Q24
What is the relative distribution of annual fan purchases for new installations, planned replacement installations, and emergency replacement installations?	Q28
Map the general distribution flow(s) from manufacturing to end user	Q9, Q6, Q10
What are roles of various market actors in key purchase decision scenarios (planned replacement, emergency replacement, new construction, fan repair, and if possible by end use)? Inquire about: ▪ Key market/customer segments, including their key requirements for purchase (for example, price, ease of installation) ▪ The role each market actor plays and who are their typical buyers ▪ How market actors assess fan options ▪ How market actors interact to reach decisions about fans – in particular, the influence they exert in the decision	Q9 through Q11
What are market actors' current awareness and use of the FEI label? ▪ What proportion of market actors are aware of the FEI label? ▪ Are market actors using the FEI label in sales/purchasing decisions for stand-alone C&I fans and, if so, what role(s) does the label play in their decision-making processes? (Specifically, is efficiency integrated into the "basis of design" for fans and how is FEI used in deciding whether a fan or fan system is efficient enough?) ▪ To what degree are market actors interested in using the FEI label in each of the following applications: stand-alone fans, fans sold with motors or motors and drives, and smart fans?	Q13 through Q19
To what degree are market actors using other efficiency labels, such as the FEG label, in sales/purchasing decisions for stand-alone C&I fans? Do market actors understand the difference between the FEI label and the FEG label?	Q13, Q16, Q19

INSTRUMENT AND DATA COLLECTION INFORMATION

Table B-2. Overview of Data Collection Approach

Data Collection	Description
Population Description	Fan equipment specifiers and installers/maintenance providers serving the C&I sector

Type of Sampling	Purposive
Target Sample - Interview Completions	Installers = 8 Specifiers= 30
Instrument Type	Phone Semi-structured Interview (Mix of open-ended and closed-ended responses)
Survey/Interview Length	30-40 min.
Description of Contact Sought	Those who select stand-alone fans or develop fan specifications for their C&I clients and those who install/service fans in C&I buildings.

INTERVIEWER INFORMATION

Interviewer instructions are in italics.

Introduction/Screening

Q1. [*ASK ALL*] Which of the following states do you serve?

( ) Washington
( ) Oregon
( ) Idaho
( ) Montana

[*IF ANY SAY THEY DO NOT SERVE THE AFOREMENTIONED STATES, RE-ASK THE Q:*] Let me re-phrase. Does your organization serve any of the states I just mentioned?

[*IF YES:*] Who in your company is familiar with the fan market or sales in those states? [*Record name and phone number and contact this new contact*.] _____

[*IF NO:*] *Thank and terminate the interview.*

Q2. [*ASK ALL*] Just to confirm, does your organization select and/or install or service axial, centrifugal, rooftop, mixed-flow, or other stand-alone fans for commercial or industrial? Stand-alone fans are those that are not embedded into another piece of equipment or a system – that is, they are purchased as fans. This excludes fans embedded in packaged units and custom-built air-handler systems, for example. And it includes exhaust fans and even warehouse ceiling fans, for example. [*Probe if needed to make sure you understand whether they select/specify only, install only, service fans only, or offer a combination of those services. Select all that apply.*]

( ) Yes – we help clients select those fans

( ) Yes – we help clients install those fans

( ) Yes – we help clients service those fans

( ) Yes – we do all of the above

( ) No – we offer none of these services - *Terminate the interview. Say, we are looking to speak with those familiar with selecting and/or installing stand-alone fans. (Also select this option If they say they serve the residential market only.)*

( ) Don't Know - *Ask who would know and ask if you could be transferred to that person*.

Q3. [*IF YES – EITHER SELECT OR INSTALL STAND-ALONE C&I FANS, OR BOTH*] How familiar are you with those stand-alone fan products, selection requests and/or installs at your organization? Would you say, you are…(*Read*)

( ) Very familiar

( ) Moderately familiar, or

( ) Not at all familiar – *Ask who is familiar and ask if you could be transferred to that person*.

Interviewer: Only proceed if respondent is very or moderately familiar with stand-alone fan sales/requests in their organization.

Q4. Approximately what percentage of your company's total projects in the past year included a [*design/selection/install*] of stand-alone fans that are 50 horsepower or less? Your best estimate is fine. _____

Q5. [*ASK ALL*] Can you describe the top three applications for those stand-alone fans that you [*design/select/install*[that are 50 horsepower or less? (*If needed say: for example, an office building exhaust stack, or industrial blowers for material transport?*)

	Application	**Sector**
#1:		
#2:		
#3:		

Roles, Customers and Purchase Decision Drivers

Q6. [*ASK ALL*] I'd like to know who your typical customers are. Is it a building or equipment mechanical contractor/installer, the building owner, a combination of these, or other market actors? _____

Q7. [*ASK ALL*] There may be a lot of people that influence the final fan selection, including multiple decision makers on the customer side and different professionals and building trades on the supply side. Can you sketch out who typically has some influence on stand-alone fan equipment selection (50 horsepower or less) and their roles in the process? _____

f. Do these roles vary by customer type or by installation context? By Installation context, we mean new construction, planned replacement, and emergency replacement. _____

g. [*IF NOT ADDRESSED*] Under what conditions, if any, are you one of the principal people influencing the choice of fan type? _____

Q8. *[ASK ALL]* What are the key factors that influence selection and/or installation of stand-alone fans 50 horsepower or less? (*Probe for first cost, reliability, ease of installation, operating costs, maintenance, and efficiency.*) _____

c. Do these decision factors vary by the installation context – new construction vs planned replacement vs emergency replacement? _____

d. Do these decision factors vary by customer type – for example, restaurants, high-rise buildings, industrial facilities and so forth – or by application– and if so, how? _____

Q9. [*ASK THOSE WHO SELECT/SPECIFY FAN EQUIPMENT:*] Since the Covid-19 pandemic hit – that is, since March of 2020 – would you say you are getting more or less, or the same amount of requests for stand-alone fan selection or specification compared to the year prior to Covid-19 pandemic? _____ [*IF MORE OR LESS, ASK*] Do you know why you are getting [more/less] requests since Covid-19 pandemic hit?

Q10. *[ASK IF THEY SERVICE/REPAIR FANS]* Why do customers elect to repair existing fans rather than replacing them altogether?

a. *[IF NOT ADDRESSED]* Do you repair or replace motors within fan assembly? If so, when motors are replaced, are they ever replaced with ECM motors? If yes, under what circumstances? If no, why not?

    a. Are drives ever added to fan motors? If yes, under what circumstances? If not, why not?

b. Thinking of your commercial and industrial clients looking for either fan repair or replacement, what are the key factors that influence your recommendation on whether the stand-alone fan(s) should be replaced or repaired?

c. At what age are stand-alone fans typically replaced in commercial and industrial settings?

Q11. *[ASK if THEY SERVICE/REPAIR FANS]* Approximately what percentage of your company's stand-alone fan projects in the past year included fan repair? Your best estimate is fine. _____

FEI

Q12. [*ASK IF THEY DID NOT MENTION THE FEI LABEL PREVIOUSLY*] Have you heard of the Fan Energy Index or FEI metric?

( ) Yes, familiar with FEI

( ) No

( ) Don't Know

Q13. [*ASK IF THEY DID NOT MENTION THE FEG LABEL PREVIOUSLY*] Have you heard of the Fan Efficiency Grade or FEG metric?

( ) Yes, familiar with FEG

( ) No

( ) Don't Know

Q14. [*ASK IF HEARD OF FEI*] How often do you use FEI metric when helping clients select a fan? Would you say…(*read*):

( ) Never

( ) Less than 50% of the time

( ) About 50% of the time

( ) More than 50% of the time, or

( ) All the time

Do not read:

( ) Don't Know

Q15. [*ASK IF HEARD OF FEG*] How about the FEG metric? How often do you use FEG metric when helping clients select a fan? Would you say…(*read*):

( ) Never

( ) Less than 50% of the time

( ) About 50% of the time

( ) More than 50% of the time, or

( ) All the time

Do not read:

( ) Don't Know

Q16. [*ASK IF THEY USE FEI <50%, 50%, >50% OR ALL THE TIME*] What role does the FEI label play in the fan selection process? _____

c. [*IF THOSE WHO INSTALL ONLY AND THEY SAY THEY DON'T USE FEI OR DON'T KNOW*] Do you know how equipment designers/specifiers that work with customers looking for fans use the FEI metric? _____

d. *[IF APPLICABLE*] Is FEI typically included in the basis of design documentation?

e. [*IF APPLICABLE*] Does this process/thinking vary if selecting for new construction, planned replacement of emergency replacement? _____

Q17. [IF THEY DO NOT USE FEI] How do you determine whether a fan or fan system is efficient?

Q18. [IF THEY USE FEI] Are there other ways besides the FEI that help you determine whether a fan or fan system is efficient? If so, please explain.

Q19. [*ASK THOSE AWARE OF FEI LABEL*] How does the FEI label influence customer decision to buy a fan, if at all? ___

Q20. [*ASK ALL*] Approximately what proportion of your customers specifically request efficient fans? ____

a. *[If proportion is > 0%, ask]* What do they ask for or how do they talk about efficiency? _____

b. *[IF NOT MENTIONED]* And what type of metrics do buyers use to identify efficient fans?

( ) Fan Energy Index (FEI)

( ) Fan Efficiency Grade (FEG)

( ) Other (*interviewer record response*:) _____

( ) Don't Know

Q21. [*ASK IF USE FEG AS MUCH OR MORE THAN FEI*] Thinking of FEI and FEG metrics, how are they each applied to identify efficient fans? [*Probe for market confusion and market preference]*

MARKET BARRIERS

Q22. [*ASK ALL*] From your perspective, what are the reasons you might be hesitant to recommend high efficiency stand-alone fans to your customers? [*Probe for first cost, ROI, concerns about reliability, performance, or maintenance issues]* _____

c. Again, do these reasons vary by new construction, planned replacement, and emergency replacement? _____

d. Which customer segments are more likely to buy high-efficiency stand-alone fans whether it is for a new application or a replacement? _____

e. How often do customers initially request like-for-like replacements when they are replacing existing fans?

( ) Never

( ) Sometimes

( ) Often

( ) Always

( ) Don't know

f. [*ALSO ASK*] How often do you encourage customers to choose more efficient fans instead of like-for-like replacements? Would you say [*read]:*

( ) Never

( ) Sometimes

( ) Often

( ) Always

Q23. [*ASK ALL*] Are any of stand-alone fans that you sell characterized as smart fans? [*If respondent says, what do you mean by smart fan, say, "fan that automatically adjusts speed based on integrated sensors and controls."]*

c. *[ASK ONLY IF THEY DID NOT ASK US TO DEFINE SMART F ANS AND THEY SAID SOME STAND-ALONE FANS ARE CONSIDERED SMART FANS:*] Can you explain what features define a stand-alone fan as smart fan? _____

d. And for what applications are they typically used? _____

Q24. [*ASK ALL*] From your perspective are there any design or specification challenges or concerns associated with high efficiency stand-alone fans that are 50 horsepower or less? _____

SALES

Q25. [*ASK ALL*] In the 12 months prior to COVID-19 pandemic, what proportion of your customers bought stand-alone fans for planned replacements, emergency replacements, and new construction? Your best estimate is fine.

_____

( ) Don't Know

Those are all my questions. Thank you for your time and valuable feedback. If we need additional input to clarify some of your responses, can we email you?

About DNV

DNV is a global quality assurance and risk management company. Driven by our purpose of safeguarding life, property and the environment, we enable our customers to advance the safety and sustainability of their business. We provide classification, technical assurance, software and independent expert advisory services to the maritime, oil & gas, power and renewables industries. We also provide certification, supply chain and data management services to customers across a wide range of industries. Operating in more than 100 countries, our experts are dedicated to helping customers make the world safer, smarter and greener.