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# Commercial-Sector Adjustable-Speed Drive Market Research Study

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## Executive Summary

The Northwest Energy Efficiency Alliance (NEEA) contracted with Johnson Consulting Group (JCG) to conduct market research on the pairing of adjustable-speed drives (also called variable-frequency drives or simply “drives,” and referred to hereinafter as “ASDs”) in the commercial clean-water pumps market. Specifically, NEEA’s Extended-Motor Products market transformation program focuses on clean-water pumps regulated by the Department of Energy (DOE) Energy Conservation Standard 81 FR 4367 (“regulated pumps”) and labeled circulators.

JCG also looked at the pairing of ASDs in the fans commercial market, in alignment with NEEA’s Efficient Fans market transformation program focus on non-embedded fans or units not packaged as part of larger equipment with additional operating functions (e.g. HVAC, Make-up Air or Outdoor-Air units) at the manufacturer. For clarity, all ASD-fan pairings described in this report refer specifically to standalone or non-embedded fans, referred to hereinafter simply as “fans.”

Specifically, this research study assessed the market penetration of ASDs that are paired with commercial pumps and fans across the alliance’s four-state region (Idaho, Montana, Oregon, and Washington). It also documented the key steps and factors that inform relevant market actors’ decisions to pair ASDs with commercial pumps and fans.

The research study gathered data from multiple perspectives to form a holistic understanding of how ASD pairing choices are made in the pumps and fans markets. Market actors identified the critical decision-makers for ASD pairings for new construction, retrofit and Replace on Burnout (ROB) projects in commercial buildings. This research also highlighted emerging trends that will affect ASD pairing decisions in the future.

JCG completed 47 in-depth interviews with several different market actor groups active across the commercial pump, standalone fan and ASD markets: subject matter experts (SMEs), manufacturers/manufacturers’ representatives (Mfg/Mfg Reps), specifying/design engineers (Specifying Engineers), systems integrators/contractors, and distributors.

The Mfg/Mfg Reps specialized in either pumps or fans, while the distributors, specifying engineers, and system integrators/contractors served both markets. Overall, the market actors provided more insights about pump-ASD pairings than fan-ASD pairings. However, unique features or characteristics of the fans market are highlighted throughout the report.

After reviewing previously published materials provided by NEEA, including in-depth reports on the regional pumps and fans markets, and earlier analyses of the market dynamics, JCG developed interview guides tailored for each market group. Each interview guide explored the following research objectives (RO):

- **RO1:** *Assess the proportion of commercial pumps and fans that are paired with ASDs across the alliance’s four-state region.*
- **RO2:** *Assess the distribution, by horsepower and by application (retrofit, naturally occurring replacement, new construction), of commercial fans and pumps that are paired with commercial ASDs across the alliance’s four-state region.*
- **RO3:** *Explore and document the decision-making process for purchasing and installing ASDs paired with commercial pumps and fans, including triggers for consideration of drive/device pairing, steps typically taken, and influential factors throughout the process.*

## Study Conclusions and Recommendations

### RO#1: Pumps and Fans Conclusions

- **The majority of pumps and fans are paired with ASDs at the planning/design phase for new construction projects.** The market actors estimated that 8% to 15% of ASDs are paired with pumps or fans for retrofit and ROB projects, as the primary driver for these decisions is to replace the malfunctioning unit as quickly as possible.
- **Sales of pumps and fans vary significantly across market actors.** For example, some market actors work across multiple market channels, so pumps and fans account for just a small percentage of their annual sales. Other market actors, such as the Mfg/Mfg Reps, specialize in the pumps or fans market exclusively, and their revenue can account for a larger percentage of their annual revenue.
- **Few regional variations exist for either ASD pump or ASD fan pairings. The market actors estimated that up to 85% of pumps were paired during the planning/design phase, regardless of location.**
- **Building codes and building performance standards in Oregon and Washington, especially for new construction projects, are driving the push to install ASDs with both pumps and fans.**

### Pumps and Fans Recommendation

- **NEEA's Motor-Driven Products team can address the current data gaps in understanding the scope and size of the ASD market for pumps and fans.** While most market actors are necessarily focused on relatively narrow market segments, NEEA has the resources, capabilities, and regional relationships to gather and share more holistic sales pattern data to better understand the regional market potential for ASD pairings with both pumps and fans.

### Fans Recommendation

- **NEEA should continue distinguishing the fan market from the pump market sector with regard to ASD applications and processes.** Although ASDs are installed for pumps and fans, each market sector's decision-making process is unique. Therefore, NEEA should work to leverage its relationships within the fans market, especially among Mfg/Mfg Reps, to develop integrated offerings beyond new construction projects.

### RO #2 Pumps and Fans Conclusions

- **The new energy codes in Washington require motors above 5 HP to be paired with a drive.** However, smaller (<1) HP pump and fan motors are paired with Electrically Commutated Motors (ECMs) in all four states, even though these pairings are not dictated by code requirements.
- **As noted by multiple market actor groups interviewed in this study, larger motors, especially over 100 HP, will always be paired with an ASD due to the energy efficiency savings achieved for both pumps and fans.**

### Pumps Conclusion

- **Due to size and space limitations, retrofit and replace-on-burnout projects are less likely to have a pump-ASD pairing.** Both SMEs and distributors noted that building owners and maintenance staff

are reluctant to change out equipment configurations, especially for pumps, as this would require learning new technology.

#### Pumps and Fans Recommendations

- **NEEA should consider focusing any potential ASD-related market transformation activities on the retrofit and ROB market segments.** To support this focus, NEEA should work with distributors to identify optimal pairing configuration packages for retrofit and ROB projects for both pump and fan pairings.
- **NEEA should explore how brand loyalty and resistance to change influence retrofit and ROB decisions for both pumps and fans and develop strategies to reduce these barriers in the commercial market.**
- NEEA should also consider working with Mfg./Mfg Reps to develop ASD pairings with pumps specifically for retrofit or ROB projects.

#### **RO #3:** Pumps and Fans Conclusions

- **From the perspectives of the market actors included in this study, cost, lack of awareness, and the complexity of ASD pairing decisions are the most significant barriers to ASD pairings for both pumps and fans.** The specifying engineers and distributors view the lack of customer knowledge about ASD benefits and the scarcity of rebates and incentives to finance these installation upgrades as primary barriers.
- **Specifying engineers will recommend a fan-ASD pairing in almost every scenario. But ASD pairings with pumps are dictated more by the size of motors, project requirements and ASD cost.**
- **Pump and fan manufacturers are selling ASDs as part of an integrated unit rather than as standalone applications.** These applications are primarily for new construction projects.
- **Specifying engineers are the most influential decision-makers for new construction projects.** However, the Mfg/Mfg Reps often provide technical assistance for large new construction projects requiring fans and pumps.
- **Systems integrators are the most influential decision maker for retrofit projects,** as they have to connect the various control panels. Systems integrators influence the specifying engineers' decisions regarding ASD pairings for both new construction and retrofit projects.

#### Pumps Conclusions

- **Distributors are critical decision-makers in retrofit and ROB projects, especially when building owners or maintenance staff make the purchase decision.**
- **The pump-ASD market is siloed, so even if the company sells ASDs and pumps, the companies rely on different sales channels.**

Pumps Recommendation

- **NEEA should develop targeted outreach and educational activities focused on building owners and maintenance staff.** These activities should include case studies demonstrating the benefits of pump-ASD installations in existing buildings.

Fans Recommendation

- **NEEA should contact fan Mfg/Mfg Reps and distributors to better understand how fans can best be paired with ASDs in retrofit and ROB projects.**

# 1 Introduction

The Northwest Energy Efficiency Alliance (NEEA) continues researching critical components and dynamics within the commercial market for clean-water pumps<sup>1</sup> and fans.<sup>2</sup> This research focuses on patterns and behaviors related to the pairing of Adjustable Speed Drives (ASDs) with pumps and fans in the commercial market.

## What is an ASD?

ASD stands for “Adjustable Speed Drive”. This memo uses the term ASD to describe any electronic controls that allow a motor to rotate at different speeds, controlling the equipment load via changes in rotational speed.

Source: Industrial Pump Fan and Adjustable Speed Drives Data Collection Summary Memo

NEEA has completed multiple studies examining various aspects of this market, which laid the foundation for this research inquiry. Specifically, this research study assesses the market penetration of ASDs paired with commercial pumps and fans across the alliance’s four-state region (Idaho, Montana, Oregon, and Washington). It documents the key steps and factors that inform relevant market actors’ decisions to pair ASDs with commercial pumps and fans.

To better understand the interplay between pumps, fans, and ASDs, the Johnson Consulting Group (JCG) team conducted eight preliminary interviews with subject matter experts (SMEs), including representatives from trade associations and fan manufacturers. These primary research activities, combined with analyzing the data already collected by NEEA and its consultants,

provided an initial framework addressing these research objectives, which were to:

- Assess the proportion of commercial pumps and fans that are paired with ASDs across the alliance’s four-state region.
- Assess the distribution, by horsepower and by application (retrofit / naturally occurring replacement due to equipment failure / new construction) of commercial pumps and fans that are paired with ASDs in the field across the alliance’s four-state region.
- Explore and document the decision-making process for purchasing and installing ASDs paired with commercial pumps and fans, including triggers for consideration of drive/device pairing, steps typically taken, and influential factors throughout the process.

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<sup>1</sup> The XMP Product Plan: *Products currently eligible for the NEEA program include clean water pumps regulated by the Department of Energy (DOE) Energy Conservation Standard 81 FR 4367 (“regulated pumps”) and labeled circulators.*”

<sup>2</sup> For clarity, all fans-ASD pairings described in this report refer specifically to standalone or non-embedded fans and will be described simply as “fans.”

## 2 Methodology, Approach and Literature Review

### 2.1 Methodology and Approach

Reaching key market actors in the pumps and fans markets is daunting, as equipment installers and consulting engineers are often overloaded with high-priority projects. Manufacturers’ representatives want to sell equipment, and distributors want to stock equipment in combinations that will move quickly. All these market actors are busy, which makes reaching them challenging.

The project team used a two-fold approach to identify and recruit respondents for this market study. First, we leveraged the existing database of market actors that NEEA has already contacted for previous studies (see Section 2.2: Literature Review).

To enhance NEEA’s current respondent lists of market actors in the pumps and fans market, JCG conducted customized Internet searches to identify respondents specializing in the ASD drives and fans market sectors. To develop our proposed sampling frame for this study, we reviewed trade associations and state licensing boards to identify potential respondents for this market research. Our Internet searches also drew up lists provided by trade associations, including NEMA (National Electrical Manufacturers Association) and AHRI (American Heating and Refrigeration Institute (AHRI)<sup>3</sup>. We also identified additional sources for fans and motors manufacturers currently not participating in the Extended Motor Products (XMP) Initiative.

Table 1 shows the estimated populations we developed based on these Internet searches.

**Table B-1 1: Estimated Likely Population of Market Actors by State and Segment**

State	Consulting Engineers Estimated Populations	Drive Installers Estimated Population	ASD/Fan Distributors Estimated Population
<b>ID</b>	784	725	15
<b>MT</b>	1,130	875	5
<b>OR</b>	1,230	982	30
<b>WA</b>	1,472	1,020	39
<b>Total</b>	<b>4,616</b>	<b>3,582</b>	<b>89</b>

Sources: State licensed firms, drive installers, licensed HVAC contractors by state, Thomas net for ASDs, and trade associations

Based on the likely population estimates in Table 1, we developed the proposed sample sizes for each market group, summarized in Table 2.

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<sup>3</sup> <https://www.ahrinet.org/home>

**Table B-1 2: Proposed Sampling Plan by State and Market Actor Group**

State	Mfg/Mfgs Reps	Specifying/ Consulting Engineers	Systems Integrators/ Contractors	Pump/Fan Distributors	SMEs	Total
ID		2	4	2		8
MT		2	2	2		6
OR		6	14	6		26
WA		5	10	5		20
<b>Not State-Specific</b>	<b>5-10</b>				<b>5</b>	<b>10-15</b>
<b>Total</b>	<b>5-10</b>	<b>15</b>	<b>30</b>	<b>15</b>	<b>5</b>	<b>70-75</b>

This research study was exploratory and largely qualitative in nature; therefore, the study sample was not designed to be representative of the entire Northwest market or to meet specific confidence/precision thresholds.

#### *Interview Guide Question Overview*

Drawing on lists provided by NEEA and supplemented with Internet searches of engineers, systems integrators/contractors and distributors who work in the commercial pumps and/or fans markets, we completed 47 in-depth interviews. As Table 3 shows, these interviews, which included insights from eight SMEs, provided the team with a holistic understanding of the market dynamics influencing the decision to pair ASDs with pumps and fans.

**Table B-1 3: Completed Sample of Market Actors and SMEs**

State	Mfg./Mfgs. Reps	Specifying/ Consulting Engineers	Systems Integrators/ Contractors	Pump/Fan Distributors	SME Experts <sup>4</sup>	Total
ID		3	2	2		7
MT		2		2		4
OR		2	2	6		10
WA		2	4	5		11
<b>Not State Specific</b>	<b>7</b>				<b>8</b>	<b>15</b>
<b>Total</b>	<b>7</b>	<b>9</b>	<b>8</b>	<b>15</b>	<b>8</b>	<b>47</b>

The team developed separate interview guides for each market group, which addressed the Research Objectives through multiple questions.

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<sup>4</sup> The SME interviews included representatives from fan manufacturers.

**Table B-1 4: Summary of In-Depth Interview Guides by Market Actor Group**

SME Interview Guide Topic Areas	Topic Areas for Interview Guides for Market Actors
<b>Respondent Background/Role in Pumps and/or Fans Market</b>	Respondent Recruitment and Qualifying Questions
<b>“Firmographic” Questions</b>	“Firmographic” Questions
<b>Market Characteristics of Pump-Fan Pairings by HP and Application</b>	Role in Pump/Fan Selection Process
<b>Key Factors Driving Pump-Fan Pairings</b>	<ul style="list-style-type: none"> <li>• Pumps Expertise (C1-C8)</li> <li>• Fans Expertise (C9-C18)</li> </ul>
	Decision-Making Process for Pump/Fan-Drive Pairings. <ul style="list-style-type: none"> <li>• Pumps Expertise (D1-D2)</li> <li>• Fans Expertise (D3-D4)</li> </ul>
<b>Barriers to Pump-Fan Pairings</b>	Barriers to Pump/Fan-Drive Pairings <ul style="list-style-type: none"> <li>• Pumps Expertise (E1)</li> <li>• Fans Expertise (E2)</li> </ul>
	Closing Thoughts

The interview guides were developed in collaboration with members of NEEA’s Motor-Driven Products group, including representatives of both the XMP Pumps and Efficient Fans programs teams. The guides were tailored to capture insights from each market actor group. For example, the questions explored the complex decision-making process used to pair ASDs with commercial pumps and fans. Copies of the interview guides are provided in Appendix A.

## 2.2 Literature Review

The JCG team completed a literature review to inform the development of the in-depth interview guides by reviewing the extensive set of studies that NEEA and others have completed on the pumps, fans, and drives markets. Specifically, JCG reviewed the following studies to gain a better understanding of the roles of pumps, fans, and ASDs in the commercial market and to formulate the questions for our in-depth interview guides with the SMEs and market actors:

- [Commercial & Industrial Standalone Fans Market Research Report](#)
- [PDS Energy Savings and Non-Energy Benefits in Constant & Variable Load Applications](#)
- [XMP Market Characterization Report](#)
- [Bonneville Power Administration \(BPA\) Industrial Pump and Fan ASD Data Collection Summary](#)
- [BPA ASD Market Actor Interview Findings Memo](#)
- [LBL Motor System Market Assessment Report v3](#)
- [2019 Commercial Building Stock Assessment Data](#)

### Pumps Findings

- Specifying engineers are more likely to be involved in new construction projects and less likely to have input into process applications. These engineers will work with distributors and manufacturers' representatives.
- Contractors rely on manufacturers, sales representatives, and distributors for information on retrofit and new construction applications. In retrofit work, they are less likely to consider options with which they are not familiar.
- In new construction scenarios, a specifying engineer working with the design team will create specifications for any required pumps. The contractor will bid specific pumps, but the customer is following direction rather than leading the selection process. In this scenario, the market is best served when specifiers and purchasers are fully versed in smart pump options and applications.
- In replacement scenarios, such as when a pump breaks down, the end user will call a contractor. The contractor is likely to select a replacement pump that is similar in characteristics to the failed pump, replace like-for-like, or select another familiar pump type.<sup>5</sup>

### Fans Findings

- Specifiers are the critical actors in selecting and influencing the standalone fan selection for both new construction and renovation projects.
- Standalone fans are primarily sold through manufacturers and their representatives.
- Cost, and specifically first cost, is the primary influence on fan selection, particularly for installers.
- Exhaust is the primary application for standalone fans. Other common commercial applications include ventilation and air.
- Code requirements, specifically energy code requirements, have an influence on fan selection.<sup>6</sup>

### ASD Findings

- Companies often manufacture both motors and ASDs, but motor and ASD manufacturing is "siloe" within these organizations. Motors and drives are almost always paired downstream of the manufacturer.<sup>7</sup>
- Motors and ASDs have the same supply chain structure, with the same market actors and similar paths to market. Motors most often flow through Original Equipment Manufacturer (OEM) such as fan or pump manufacturers to end users, whereas ASDs are most often sold from manufacturers to distributors, to be paired with motors and equipment at installation.

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<sup>5</sup> Cadmus, 2019. "Extended Motor Products Market Characterization," NEEA Report #E-19-397, December 10, Appendix D., pp. 2-3.

<sup>6</sup> DNV 2021. "Commercial & Industrial Stand-Alone Fans Market Research Report E21-432," December 9., pp. 1, 3, 9.

<sup>7</sup> Cadeo Group, 2021. "Memo to BPA: Adjustable Speed Drives Market Actor Interview Findings," March 26., p. 2

- ASDs sold with a motor or ASDs sold with a motor and equipment are becoming more popular, but most ASDs are still most commonly sold alone and paired at the installation level. An exception is advanced motor technologies like electronically communicated motors (ECMs), which are often smaller size motors and are always sold by manufacturers as a motor-and-ASD combination.
- The price of electricity and the prevalence of utility energy-efficiency programs, which are regionally dependent, impact the saturation of ASDs.<sup>8</sup>

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<sup>8</sup> Ibid, pp. 2, 3, 11.

## 3 Subject-Matter Expert Interview Findings

The project team completed eight in-depth interviews with SMEs specializing in the pumps, fans, motors, and ASD industries; of these eight SME interviews, two were with fan manufacturers. The in-depth interviews were completed in December 2022 and January 2023. The goal was to provide insights into developing the interview guides with market actors working in the commercial pumps and fans markets.

These interviews explored the market characteristics, decision-making processes, and barriers associated with pairing ASDs with pumps and fans in the commercial market. The key findings, organized by topic area, are summarized next.

### 3.1 Factors Driving Overall ASD Pairings

#### Pumps and Fans Findings

The respondents all agreed that pairing pumps or fans with ASDs saves energy in nearly all applications. They expect these pairings to increase during the next decade, but likely in the higher horsepower (HP) ranges.

*“There is no technical reason not to install a drive; not to run a motor with drive.”*

Beyond energy savings, these pairings offer greater control over the equipment operation for variable-speed applications while also creating value for the end user. These experts observed that ASD pairings with pumps and fans benefit both constant- and variable-speed applications.

*“It is a smart use of energy, and we can only control things that we have a knowledge of. (The ASD) allows us to map out and see what’s happening across the different grids.”*

#### Pumps Findings

Pairing pumps with ASDs on constant-load systems creates savings opportunities due to the tendency to over-size pumps. As one SME explained, 18% to 24% of all motors are oversized because of the “inherent uncertainty” of the operation and the desire to ensure that the pump motor can operate effectively.

*“There is a tendency to oversize motors, and motors are sold in discrete nominal HP... usually by 25 HP (the) systems will be oversized and an ASD allows the pump or fan to right-size the application.”*

*“Ninety-nine percent of the time, a motor is oversized. If it’s perfectly sized, it could stop working, and no engineer wants that... everybody adds a bit to make it overbuilt or future-proofed.”*

However, ASD pairings are more common with large horsepower units: *“the larger the motor, the bigger the energy consumption.”* Larger motors are also typically oversized as that is based on the size of the motor.

*“More money is spent in designing and sizing the larger system.”*

In contrast, the experts agreed that ASD pairings are less likely to be paired with smaller pumps and motors as *“a 5 HP pump doesn’t get much attention.”*

#### Fans Findings

One fan manufacturer pointed out that fan-ASD pairings may also save energy in most applications. The most common fan applications are those connected with commercial rooftop units, exhaust vents and kitchen hoods. On average, with few exceptions, these pairings lead to some energy savings.

Several SMEs also noted that ASD pairings are becoming more commonplace with small horsepower fans than with small horsepower pumps. However, specific fan applications, particularly fans paired with a belt, will not benefit from an ASD pairing, as *“they are already operating at a lower speed so that they won’t see any energy savings.”*

*“Fans manufacturers are more likely to pair ASDs with fans than pump manufacturers [are with pumps].”*

### 3.2 Influence of HP Rating on ASD Pairing Rates

#### Pumps and Fans Findings

The SMEs explained that most ASDs are paired with pumps or fans above 5 HP, especially for new construction projects. Below 5 HP, pumps and fans tend to be paired with Electrically Commutated Motors (ECMs).

*“An ASD can add value regardless of what the horsepower is. We see that with Variable Frequency Drives on pumps today, and there’s a value of having something that’s adjustable or variable, even on small motors.”*

Although ASD pairings offer energy savings, even in smaller motors, one SME noted that most of the fractional horsepower motors for pumps and fans use ECMs rather than ASDs.

Building codes and building performance standards have been a driving factor in increasing the pairings of ASDs with pumps and fans. Moreover, LEED-certified buildings<sup>9</sup> also influence this push for installing ASDs with pumps and fans, as these building owners value energy-efficiency savings.

#### Fans Findings

Similar to pumps, pairing large horsepower fans with ASDs is becoming more common, especially for commercial equipment.

One SME observed that fans may also be paired with a permanent magnet motor, reducing the Variable Frequency Drive (VFD) burden while generating “instant energy savings.” So these ECMs are often sold as part of the larger fan unit.

### 3.3 ASDs Sold as Integrated Units

#### Pumps and Fans Findings

Two SMEs noted that pump and fan manufacturers are now selling ASDs as part of a combined unit.

Some pump manufacturers guarantee the pump's energy efficiency and sell the pump and drive as an integrated unit. Moreover, ECMs are pre-packaged and included in fan and controller packages.

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<sup>9</sup> LEED promotes energy efficiency in new building construction, so pairings ASDs with pumps and fans is one way to acquire LEED points, details are available here: <https://www.usgbc.org/leed/v41#bdc>

Another SME observed that it is easier to integrate the ASDs while manufacturing the pumps as it simplifies the installation.

*“It ensures optimal pairing of the drive to that other device, such as fans. The pump fan is not working as hard, so it will last longer and have less maintenance and downtime.”*

### 3.4 Regional Variation in ASD Value Proposition

#### Pumps and Fans Findings

One SME explained that if electricity costs are relatively low, the energy savings offered by pairing pumps and fans with drives is less compelling. In these scenarios, the SME explained that *“value proposition is less about energy savings and more about reliability.”* However, as energy prices increase, then the energy savings offered by pairing drives with pumps and fans become more appealing as the end-user will achieve energy savings when the equipment is operated.

These observations are consistent with the previous research studies, which concluded:

*“The price of electricity and the prevalence of utility energy-efficiency programs, which are regionally dependent, impact the saturation of ASDs.”<sup>10</sup>*

### 3.5 Variation in ASD Pairing Rates by Project Type

#### Pumps Findings

Most ASD installations occur in new construction projects rather than retrofit projects. Installing an ASD with a pump may require removing the existing infrastructure as *“there’s barely room for a thumb tack in some cases.”*

While ASD pairings are more common in the new construction market, according to one motor manufacturer, this market segment accounts for just 10% of the installed base of ASDs. The largest energy savings potential for ASD pairings is in the retrofit market, but this SME noted that *“pairing motors with drives can be quite expensive and problematic.”* Furthermore, according to this SME, adding an ASD in a retrofit application may increase the overall project cost by \$10,000 or more.

#### Fans Findings

One fan SME estimated that *“80% of the (existing market) are not paired with an ASD;”* however, 60% of new construction projects have fans paired with an ASD. This estimate is slightly lower than the percentages reported in the market actors’ interviews but does suggest that new construction projects account for the largest percentage of fan-ASD pairings.

### 3.6 Influence of Market Actors on ASD Pairings with Pumps and Fans

The SMEs also provided insights regarding how different market actors influence the decisions to pair ASDs with pumps and fans. These findings are summarized next by market actor.

#### **Manufacturer/Manufacturer’s Representatives’ Influence**

##### Pumps and Fans Findings

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<sup>10</sup> Cadeo Group, 2021. *“Memo to BPA: Adjustable Speed Drives Market Actor Interview Findings,”* March 26., p. 3

The Mfg/Mfg Reps are considered the “technical subject matter expert” and inform these pairing decisions for larger systems. They are also part of the market selling “higher end” equipment and serving large key account customers. However, the influence of technical experts such as design engineers and Mfg. Reps declines as the size of the pump or motor decreases.

The Mfg/Mfg Reps also work to develop an integrated solution, “*which simplifies the installation*” while offering value to the customer. Moreover, Mfg/Mfg Reps may be able to offer a more cost-competitive solution if they can sell the whole unit together, such as integrating a motor, pump, and ASD.

These findings are also consistent with the previous NEEA-sponsored research, which revealed that “*standalone fans are primarily sold through manufacturers and their representatives*”<sup>11</sup>.

## **Specifying/Design Engineers Influence**

### *Pumps and Fans Findings*

The design engineer is another critical decision-maker for larger projects, defined as motors 10 horsepower or above, as that may trigger ASD pairings in new construction projects.

These findings are consistent with the market actor interview findings and previous studies which clearly identified that Specifiers are the critical actors in selecting and influencing the standalone fan selection for both new construction and renovation projects.<sup>12</sup>

Furthermore, as one SME explained, the specifying engineer has a professional obligation “to give the best care,” which includes basing recommendations on the total cost of ownership. Pairing pumps or fans with ASDs will result in fewer mechanical losses and positively influence preventative and predictive maintenance, thus lowering the total cost of ownership, a factor that a specifying engineer would highly value.

## **Systems Integrator/Contractor Influence**

### *Pumps and Fans Findings*

In the commercial market, the fans, circulators, pumps, and controls with lower horsepower are all assembled by one entity: the systems integrator. For example, a municipality relies on an OEM or systems integrator, such as Rockwell, specializing in system integrations. In addition to the Electrical Apparatus Service Association (EASA)<sup>13</sup> there is also the Control Systems Integrators Association (CSIA)<sup>14</sup>, which includes experts in pairing ASDs with pumps or fans.

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<sup>11</sup> DNV 2021. “*Commercial & Industrial Standalone Fans Market Research Report E21-432*,” December 9, p. 3.

<sup>12</sup> Ibid

<sup>13</sup> The Electrical Apparatus Service Association, Inc. (EASA) is an international trade organization of more than 1,700 electromechanical sales and service firms in nearly 70 countries. Our members sell and service industrial electric motors and related rotating apparatus such as generators, pumps, fans, compressors, gearboxes and blowers. <https://easa.com/About-EASA><<Accessed May 15, 2023>>

<sup>14</sup>Control System Integrators Association (CSIA) is a not-for-profit, global trade association that seeks to advance the industry of control system integration. Control system integrators use their engineering, technical and business skills to help manufacturers and others automate their industrial equipment and systems. <https://www.controls.org/home> <<Accessed May 15, 2023>>

System integrators are critical in integrating these equipment pairs after the sale as they *“will piece it together and pick out the components.”*

According to the SMEs, system integrators are very influential in pairing ASDs with pumps and fans as *“they are actually driving the conversation. Their job is to ensure the building is habitable and the equipment and sensors are operating at peak efficiency to give the performance that it wanted.”* Therefore, the specifying/design engineer will rely on the systems integrators for the technical guidance regarding pairing ASDs with pumps and fans.

*“The systems integrators have all that expertise to coordinate all the communications associated with these different technologies.”*

## **Distributor Influence**

### Pumps Findings

According to these experts, about 75% of all electric motors are sold to OEMs, and most are not sold to end-users or distributors. Instead, the *“motor and pump get sold and shipped as one unit, and the ASD is added in the field after the sale.”*

*“The drive gets married at the pump distributor levels.”*

*“In the pump world, front-line distributors are more likely to pair a motor and controls.”*

The SMEs also explained that the distributors often influence the equipment replacement decision in retrofit and ROB scenarios. As one SME noted, the *“focus is on the distributor who is selling on price only. They are not interested in explaining the equipment, so smaller customers are more dependent upon the distributor”* to select the replacement equipment.

### Fans Findings

Most fans bypass the distributor altogether, as the SMEs noted that most fans are paired with ASDs at the manufacturing level. Moreover, fans are commonly sold as integrated units, including ASDs, rather than as individual units like pumps.

### **3.7 Benefits of Fan-ASD Pairings**

ASD pairings with fans also create opportunities for economies of scale, as large commercial retailers will want to maximize energy savings.

*“There are so many benefits of the ASD (with a fan). It gradually increases the speed which is easier on the equipment...it increases the life of the equipment while decreasing the amount of maintenance required.”*

### **3.8 Market Barriers to ASD Pairings with Pumps**

The SMEs also identified several barriers to pairing ASDs with pumps in the commercial market, described next.

**Cost:** The first cost remains a barrier to pump-ASD pairings as an ASD price may be significantly higher than the motor or the pump.

*“90% of the time, the decision is driven by cost, but availability is key right now.”*

Since adding an ASD (individually) to a pump system increases the price, many Mfg Reps are less likely to promote this purchase as “it is complicating their sales process by introducing something that costs more, and you have to explain why it costs more.”

**Supply Chain Issues:** As the SME noted above, the lack of availability of equipment is causing major project delays. This finding was further reinforced by the interviews with the Mfg/Mfg Reps who explained that it may take between eight and 55 weeks to receive the pump or fan from overseas suppliers.

**Lack of Awareness:** Another SME observed that small end users are “not going to be inquiring about ASDs,” so this pairing decision may never be discussed in a typical sales transaction.

**Durability:** Pumps last for decades; even when they fail, they can be easily repaired. There is no sense of urgency to replace current pump configurations with pumps paired with ASDs.

**Risk Avoidance:** There is a high level of resistance to change among specifying/design engineers. Since the specifying engineers are risk-averse, they will focus on “*using what they have always used*,” whether it is a particular brand name pump or a proven pump-ASD system.

Convincing end users with existing pump applications to add an ASD is also tricky.

*“If it is running fine in the existing system, then improving my system may put me at risk.”*

*“I'm not interested in introducing risk into my system design...even if a variable speed or adjustable speed drive is better, does have value; it's not worth the risk to me.”*

Many building owners are reluctant to change the pump-drive configuration in retrofit projects, as the new configuration will require the maintenance staff to become familiar with the new technology.

*“One of the big barriers to adopting anything new is say, I've got 40 pumps, and I've got one guy who's trained on how to fix pumps. If I introduce one brand new pump, I've now doubled my work. Granted, 39 are the same, and one is different. But now, I have to train somebody on two different technologies, and he has to be proficient in two different technologies. It's 4% of my inventory, but it's 50% more work.”*

**Lack of Value Proposition for ASD Pairings:** Several SMEs noted that the biggest challenge to promoting ASD pairings with pumps is creating a compelling value proposition to the end-user. Convincing end-users to purchase a new system that increases the cost by as much as 30% is often tricky, especially if the current system is working properly.

As one SME explained, “*the value proposition is stronger for end users who are going to be building new systems, rather than in retrofit projects...More upset is involved in (retrofits).*”

**No Incentives for Realizing Energy Savings:** There is also a disconnect between building decisions and energy savings. As one SME said, “*95% of the actors we talk with have no visibility to what the energy costs are. They have no reward mechanism for saving energy.*” And most of these market actors are not even recognized for the energy savings that result from these decisions.

**Silos within the Motors and Drive Sectors:** The SMEs also identified a major disconnect within the motors market: manufacturers may offer products in both markets but have developed separate sales

processes. As one SME explained that most motor companies also manufacture ASDs, but these systems are rarely integrated.

Even more revealing, the motor and drive divisions are frequently bought and sold within the industry. However, the internal corporate culture remains in place even if the division ownership has changed. The sales process for motors and ASDs remains unchanged. For example, customers interested in ASDs will go to one part of the website; those interested in motors will go to another. Each piece has its own sales process and they do not mix.

According to one expert, ABB and WEG are “*closer to breaking down the motor-drive silo than most other companies.*” However, current motor manufacturers tend to specialize in one part of the market, such as:

- NIDEC and Regal’s motor manufacturers do not sell ASDs.
- Schneider, Rockwell, and Delta only sell ASDs.
- Toshiba and Siemens sell both but are siloed.

*“ABB and WEG are the most likely candidates to unlock selling the whole solution.”*

This expert likens it to a “Microsoft Approach” where there are multiple suppliers for each component of a computer (i.e., monitor, mouse, printer, hard drive, etc.) The other approach is used by a few manufacturers, such as ABB, where they design the entire system like an Apple computer. It will be completely integrated at the time of sale. But the Apple configuration approach is rare as most motors and ASDs are sold separately, and then the systems integrator will put the equipment together “*piecemeal.*”

*“These guys should work together, but they don’t.”*

### 3.9 Role of Voluntary Programs (e.g., NEEA’s XMP Program) for Pumps

Programs like NEEA’s XMP Pumps program can help narrow the market for decision-makers. Furthermore, certifications “*can help transform markets.*” But the most effective tool is purchasing specifications, as once the equipment is specified, it is purchased.

One expert worked closely with previous motor programs to get the NEMA Premium Specification written into the federal procurement regulations. That approach narrowed the list of eligible equipment to 18 manufacturers, simplifying the end user’s decision-making process.

But the customer focuses only on buying equipment that meets the technical specifications without considering other features, such as energy savings. As we learned in the Pump Awareness Study, procurement rules are more important than technical features in making equipment decisions for these routine purchases.

The SMEs provided a long-term perspective in the pump-ASDs market, noting that implementing these changes may take up to a decade.

*“If we don’t mandate or regulate (these pairings), it won’t happen because the cost is so much more with an ASD.”*

Another possible approach is to develop a strategy to encourage pairings in the installed base through new codes and standards.

### 3.10 Future of ASD Pairings with Commercial Pumps and Fans

The SMEs also provided insights regarding the trajectory of ASD pairings in the commercial pumps and fans markets. All SMEs believe this is a fast-growing market where motor manufacturers invest in this sector.

*“Pairing of ASDs will increase as there is less pushback and more understanding about the benefits, energy and otherwise, so we will continue to see drive pairings increase with pumps.”*

One SME also noted that as the installed base of pumps fails, some market actors may see this as an opportunity to generate additional revenue by selling replacement pumps with ASDs. They could position this as a way to add value to their customers while also creating an incremental revenue stream.

## 4 Market Actor Interview Findings

This section summarizes the key findings from the interviews with the market actors, which included 39 specifying engineers, systems integrators/contractors, distributors, and Mfg/Mfg Reps. Although these respondents worked with commercial pumps and fans, the systems integrators worked primarily with the pumps market. Conversely, two Mfg/Mfg. Reps only worked for fan companies.

### 4.1 Respondent Firmographics

Most market actors worked for well-established companies with offices in NEEA’s region (Idaho, Montana, Oregon, and Washington). Table 5 and Figure 1 display these highlights. Some of these market actors specialized in the pump or fan commercial markets, while others, such as the distributors and Mfg/Mfg Reps, served both product channels.

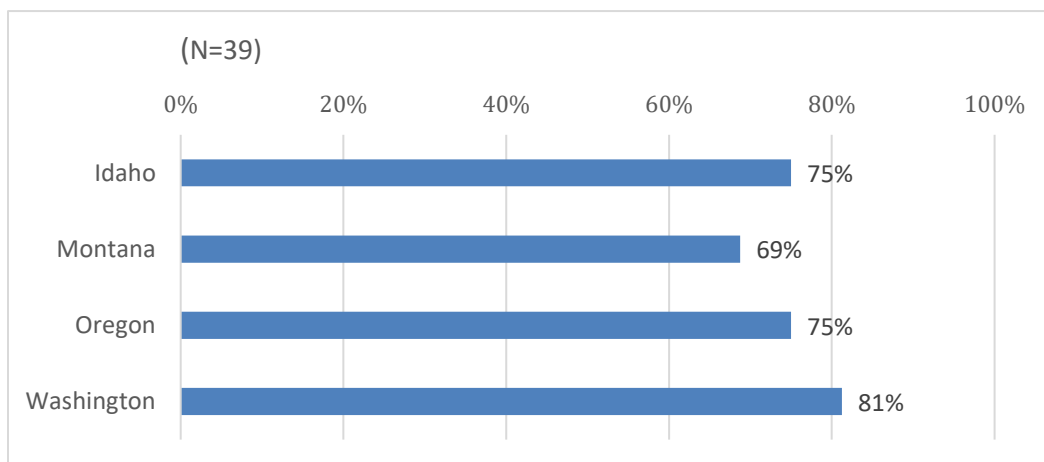
Several contractors worked with pumps as part of their company’s larger focus on plumbing, mechanical contracting, or systems integration.

**Table B-1 5: Summary of Respondent Characteristics**

Respondent Demographics	Market Actors (n=39)		
	Average	Minimum	Maximum
Years in Business	55	15	107
Number of Employees-Overall	5,503	3	75,000
Number of Employees in Northwest	133	3	1,000

All respondents were located in the four-state region served by NEEA (i.e., Idaho, Montana, Oregon, and Washington), with most respondents serving customers in at least two states (see Figure 1).

**Figure 1: States Where Market Actors Do Business**



\*Participants could select multiple response options so answers will not total to 100%

## Findings by Research Objective

The key findings from these market actors for each research objective are summarized next. Differences among and between market actor segments are noted where appropriate.

### 4.2 Research Objective #1: Market Characteristics of ASD Pump and Fan pairings

- **Most pump-ASD pairings occur during the planning or design stage.** Most market actors reported that 97% to 100% of all pairings are completed at the planning and design phase.

**Pumps:** The market actors estimated the distribution of ASD pairings with pumps across critical project stages; outlined in Table 6; these percentages were estimated within each project stage rather than across all stages, so the percentages will not add up to 100%. Furthermore, these market actors worked in different sectors; some focused primarily or entirely on retrofit or ROB projects, while others worked exclusively on new construction projects. Therefore, these qualitative estimates are based on the averages reported by market actors. However, these estimates are in line with the SME projections.

Additionally, these are qualitative estimates rather than quantitative figures derived directly from actual sales records, and some market actors could not provide reliable estimates after the planning/installation design phase.

Notably, the distributors provided slightly lower estimates than the other market actors. But all the market actors noted that pairings of ASDs with pumps rarely occur at the time of purchase or during the installation process.

Two Mfg/Mfg Reps noted that most of the pump-ASD pairings are either driven by the building code or the building owner’s preferences, both occurring during the planning stage.

**Table B-1 6: Estimated Percentage of ASD Pairings with Pumps by Project Stage**

	% During Planning/Design		
Market Actor	Average	Min	Max
<b>Specifying/Consulting Engineer (n=9)</b>	97%	90%	100%
<b>Distributor (n=15)</b>	78%	10%	100%
<b>Systems Integrators/Installers (n=9)</b>	97%	60%	100%
<b>Manufacturer/Manufacturers Rep (n=5)</b>	100%	100%	100%
	% At Time of Purchase		
Market Actor	Average	Min	Max
<b>Distributor (n=4)</b>	20%	5%	33%
<b>Systems Integrators/Installers (n= 3)</b>	8%	5%	10%
	% During Installation		
Market Actor	Average	Min	Max
<b>Distributor (n=10)</b>	16%	10%	33%
<b>Systems Integrators/Installers (n=4)</b>	15%	5%	30%

**Fans:** The qualitative estimates provided by market actors regarding ASD pairings with fans are nearly identical to pump-ASD pairing estimates. Few regional variations exist in ASD pairings with fans. The market actors estimated that up to 85% of all ASD pairings for either pumps or fans occur during the planning/design phase, regardless of state location.

Like the pump-ASD pairing responses, only a few market actors provided insights regarding fan-ASD pairings for project phases beyond the planning/design phase, as Table 7 shows.

- **Most fans are paired with ASDs during the planning/design phase.** Only the distributors reported a lower rate of fan-ASD pairings (77%) compared to the other market actors, which estimated that 96% to 100% of all fan-ASD pairings occur during the planning stage. This is consistent with the previous market research and SME findings that most fan purchases are made directly from the Mfg/Mfg Reps rather than through distributors.
- **Overall, most pumps and fans are paired during the planning/design phase of the project.** However, distributors reported higher rates of pairings of ASDs at the purchase or installation, reflecting their role in providing equipment to installers.
- **Fewer fan-ASD pairings occur at the time of purchase or installation.** However, the distributors estimated a higher percentage of pairings of fans with ASDs during these critical project milestones.

**Table B-1 7: Estimated Percentage of ASD Pairings with Fans by Project Stage**

	% During Planning/Design		
Market Actor	Average	Min	Max
Specifying/Consulting Engineer (n=8)	96%	90%	100%
Distributor (n=14)	77%	34%	100%
Systems Integrators/Installers (n=5)	100%	100%	100%
Manufacturers/Manufacturers Reps (n=2)	100%	100%	100%
	% At Time of Purchase		
Market Actor	Average	Min	Max
Distributor (n=4)	20%	5%	33%
Systems Integrators/Installers (n=3)	8%	5%	10%
	% During Installation		
Market Actor	Average	Min	Max
Specifying/Consulting Engineer (n=5)	9%	5%	10%
Distributor (n=9)	19%	10%	33%
Systems Integrators/Installers (n=3)	8%	5%	10%

**Pumps:** The respondents estimated the percentage of pump-ASD pairings for each specific project type. Table 11 summarizes these findings.

- **New Construction projects account for the highest percentage of pump-ASD pairings.**
- **Pump-ASD pairings are less common for Retrofit and ROB projects.**

As Table 8 shows, ROB projects have the lowest rate of pump-ASD pairings (29%), closely followed by retrofit projects (35%).

**Table B-1 8: Pump ASD Pairings by Project Type\***

*Project Type	Market Actors (n=35)	
	Number Mentioned	Average %
<b>New Construction</b>	35	74%
<b>Retrofit</b>	32	35%
<b>Replace on Burnout</b>	22	29%

\*multiple response question; responses will not total to 100%

**Fans:** The respondents also estimated the percentage of fan-ASD pairings for each specific project type. Table 9 summarizes these findings.

- **Primarily, the distributors and Mfg/Mfg Reps estimated that about 25% of fans are paired with ASDs for either retrofit or (ROB) projects, as Table 12 shows.**

**Table B-1 9: Fan ASD Pairings by Project Type\***

Project Type	Market Actors (n=21)	
	Number Mentioned	Average %
<b>New Construction</b>	21	65%
<b>Retrofit</b>	19	25%
<b>Replace on Burnout</b>	16	25%

\*multiple response question; responses will not total to 100%

#### 4.3 *Research Objective #2: Distribution of pump-ASD and fan pairings by HP and Application*

##### 4.3.1 Horsepower Bin Distribution

- **The new energy codes require motors above 5 HP for both pumps and fans must be paired with an ASD.** While this is not a code requirement, smaller (<1) HP pump and fan motors are often, but not always, paired with ECMs.
- **Larger motors, especially over 100 HP, will always be paired with an ASD due to the energy efficiency savings achieved for both pumps and fans.**

Building codes, especially in Washington, require all pumps with motors above 5 HP to be paired with an ASD. However, the pump size and application also dictate the parameters for pairing pumps with ASD. Two market actors also pointed out that pairing ASDs with pumps and fans is a more economical choice as the HP increases.

Pumps and fans with less than 5 HP are more often paired with ECMs which is better suited to their particular applications.

*“The motor is so small (the drive) is not needed.”*

The Mfg/Mfg Reps explained, *"The ECM has gotten a lot better and is slowly filling the sub HP void."* However, all fans with motors above 5 HP are paired with ASDs for HVAC<sup>15</sup> applications.

Specifying engineers look for reasons to with pumps and/or fans in their design of mechanical systems: *"Anything over 1 HP will always get a drive; if it is less than 1 HP, it depends, but usually, yes."*

The equipment's voltage is another critical factor in determining when to pair ASDs with either pumps or fans. ASDs have a 100% voltage rating at specific volts. Facilities will have different high and low line levels that the ASD must be able to safely operate within without being damaged. If the tolerance rating of the ASD does not fall within that range, then you could have a catastrophic failure.

Additionally, for system replacement situations (retrofit and equipment failure) where the previous system did not have an ASD, the system needs to be properly evaluated to ensure an ASD is a viable addition.

#### 4.3.2 Pump-ASD Pairing Applications

Specifying engineers identified the following three factors that influence the viability of pairing a motor with an ASD: (1) the size of the motor/system, (2) the design requirements of the system, and (3) ASD first cost.

Additionally, the efficiency of the motor selected during design may impact the ability to add an ASD. It was emphasized by one engineer that ASDs follow specific "Affinity Laws" and that they are the most important consideration when making pairings. So, it is important to *"make sure the speeds are above the rated speed of the fans or pumps i.e. are they within the system curves?"*

Most distributors emphasized that while there are some common factors to be addressed when considering pairing an ASD with a pump or fan (e.g. cost and availability), the most important consideration is the specific needs of a system, whether it already exists or is still being planned.

*"Pumps are a different animal than, say, a cooling fan so there are different factors that need to be asked about or known before a [pairing] can be made; a fan just pushes air while pumps have a considerably broader range of tasks."*

According to these market actors, pump-ASD pairings are not viable in the following situations:

- The motor load is constant and has an unrestricted flow;  
*"Where you don't need to vary the load ... There are no energy savings in just start-stop"*
- Smaller heating and chilled water systems 5 tons or below because they are used only for start-stop functions;
- Single-phase installations;
- If the pump is required to provide full output
- When the pump is paired with an ECM (for small HP motors);
- Harsh environmental conditions (e.g. really wet environments); and
- When the installation is not going to be cost-effective.

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<sup>15</sup> Note, the market actors described these installations as HVAC when they are likely standalone or non-embedded fans.

*“(ASDs have a lot of benefit, but it comes at a cost. So any time the total energy cost is relatively small (you are) less likely to need an ASD.”*

#### 4.3.3 Fan-ASD Pairing Applications

The specifying engineers also noted that system design requirements influence pairing an ASD with the pump or fan motor. In some situations, process fans (fans used for various industrial applications, such as process cooling, fume mitigation, and/or ventilation) and/or control valves *“allow flow to be bypassed or recirculated.”*

The market actors explained that ASDs paired with commercial fans make sense in HVAC applications *“ninety-eight percent of the time.”* However, these market actors also identified scenarios where ASD pairings with fans are not feasible, including:

- In applications where the dampers are a better option (than ASDs) for HVAC systems;
- Fans with DC motors;
- Single-phase motor applications;
- If the fan is required to provide full output (e.g. cubic feet per minute);
- Constant volume systems (single zone);
- Applications with small HP (<5 HP); and
- Start-Stop Applications.

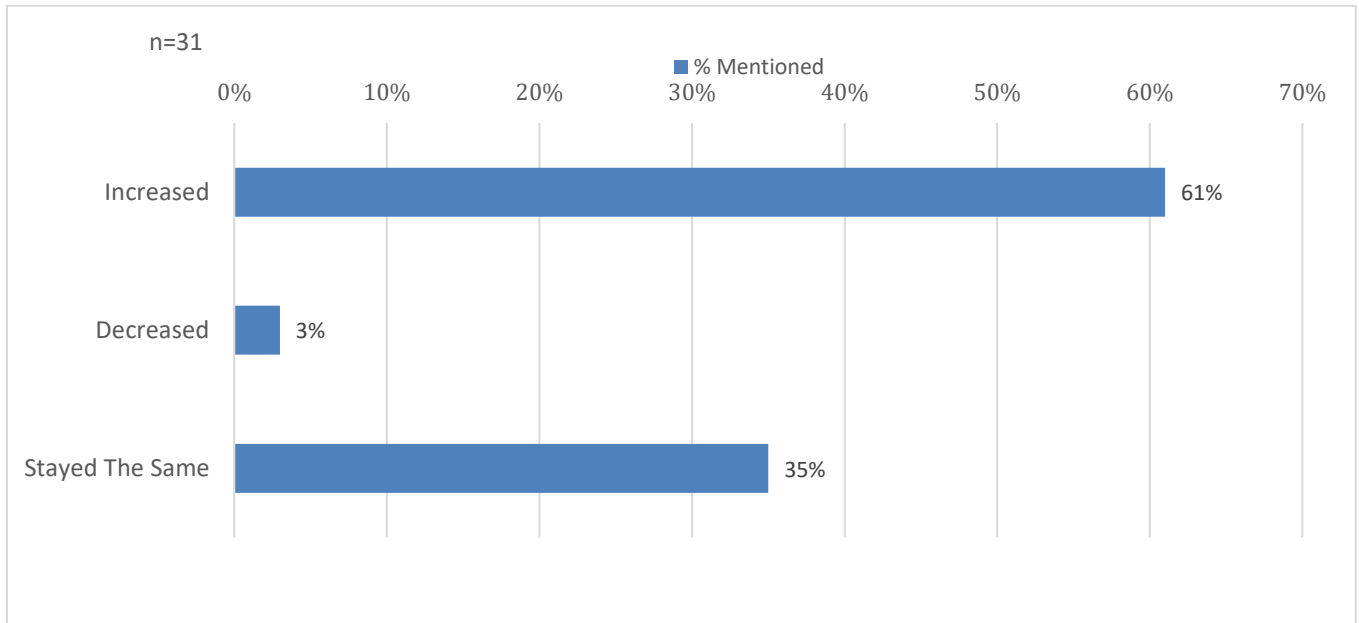
However, one manufacturer reported that his company consciously decided only to sell fan motors with ASDs and stopped selling belt drive fans.

#### 4.3.4 Changes in Pump-ASD Pairings

The market actors also provided insights into the current trends in pump-ASD pairings.

- **Most market actors (61%) believed that the number of pump-ASD pairings has increased in the past year**, while 36% said the rate remained the same. Only 3% reported a decline in pump-ASD pairings.
- The Mfg/Mfg Reps attributed the increase in pump-ASD pairings to the Northwest building code requirements and an increased trend related to environmental savings.

**Figure 2: Changes in the Number of ASD-Pump Pairings**



Most specifying engineers believe that pump-ASD pairings have increased over the last year. One respondent claimed that this was due to a steady reduction in their cost, a continuing trend beginning about five years ago. This reduced cost has removed a barrier that hindered customers from opting for the greater “control and energy efficiency capture” that ASDs offer.

The market actors attributed the increase in ASD pump pairings to the following factors:

- Rising energy costs and increased focused on reducing energy usage, and
- Code requirements.

Nearly all of the specifying engineers cited energy codes as promoting the adoption of ASDs because they encourage and/or require the adoption of more energy-efficient technology; sometimes this involves incentives and sometimes pairings are made to comply with the standard they must follow simply.

Interestingly, one engineer was cautious about adopting energy codes, clarifying that there can be situations where an ASD doesn’t make sense but because of a regulatory requirement, you may have to incorporate one: “Codes play a big role, but you have to be careful - if it doesn’t make sense you don’t want to codify it.”

As the market actors explained, the codes and the culture in the Northwest pushing for green technology has contributed to the push for more ASD pump pairings.

*“It’s increasing at an incremental rate. The new norm is putting everything on a drive with exceptions for small pumps.”*

Other factors driving these pairings include:

- Saves wear and tear on the pump motors;

*“Increased because (ASDs) save the motors and reduces down time.”*

- The size and footprint of the ASD has gotten smaller, making it easier to install in retrofit projects;
- Increased new construction projects, especially in Montana; and
- Changing attitudes among market actors.

*“It’s increased because the older generation of workers is retiring, and the younger generation is more able and open to comprehend ASD application benefits.”*

Several engineers claim that ASD technological innovation has been making ASDs smaller, cheaper, and more efficient; this is seen as a reason for a potential increase in their adoption, both recently and within the last 10 to 20 years. A few respondents were surprised that this research was being conducted, as from their perspectives ASDs are not a new technology and are well-known to anyone involved in the industry.

A single distributor estimated that pump-ASD pairings have decreased over the last year or so due to supply chain issues, while the demand for ASDs has remained the same.

A few market actors also suggested that pump-ASD pairings have not changed, citing the fact that ASD prices have remained constant with no major increases in the past 15-20 years.

Two specifying engineers believe that pump-ASD pairing rates have remained the same within the last year because, within that time, there has not been a significant enough reduction in ASD costs compared to reductions seen within the last 10 to 20 years.

- Energy codes have been in effect for several years;
- Customers do not want to change the way they do business; and
- It is stabilized as *“now the equipment is paired in almost every possible scenario.”*

One market actor observed that the push for pump-ASD pairings has stabilized as pairings with ASDs has been going on for *“quite a while.”*

Several distributors estimated that the number of ASD pairings with pumps and fans had remained the same over the last year. These distributors believe that ASDs have already been installed in almost every system where they can be. Following along with this, they cited that over the last 10 to 20 years drive pairings have increased to the point of *“near 100%”* in scenarios where they can or should be paired.

One individual mentioned that an attitude of *“why swap in new equipment when the old system architecture is working just fine”* may also contribute to this reported market stabilization.

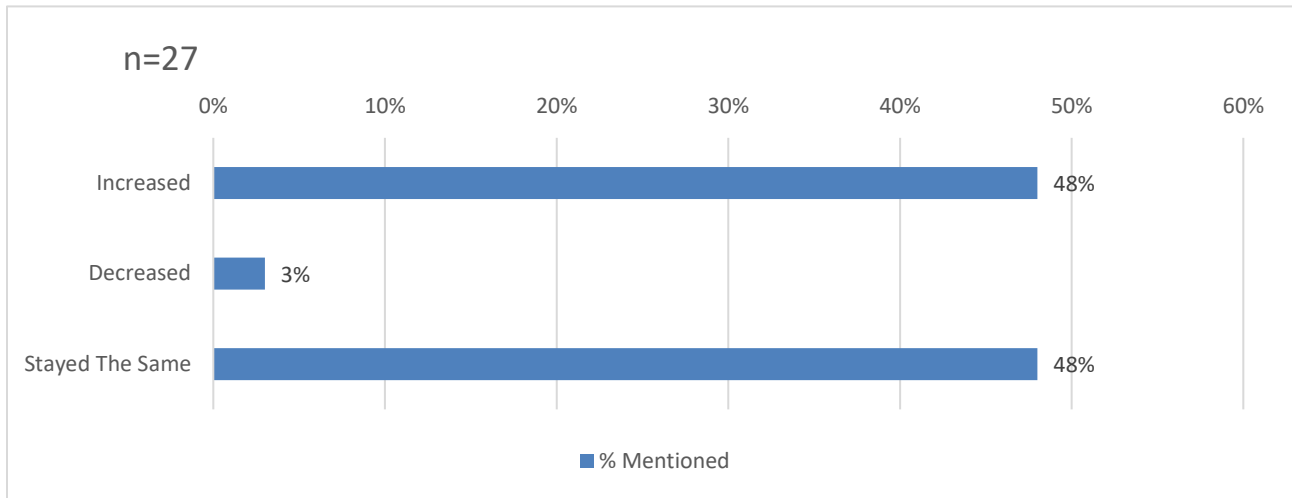
Two market actors indicated that the rate of ASD pairings with pumps has actually decreased as they *“have taken over the marketplace.”*

Another respondent observed that supply chain issues may have caused a decrease in pairings due to availability issues.

#### 4.3.5 Changes in Fan-ASD Pairings

The market actors were equally divided as to whether the number of ASD pairings with fans has increased (48%) or stayed the same (48%).

**Figure 3: Changes in the Number of ASD-Fan Pairings**



Consistent with the findings for the pumps, the Mfg/Mfg Reps reported that pairing fans with ASDs have increased by 90% due to the new code requirements. Another manufacturer explained that *“most manufacturers are moving towards direct-driven fans.”*

Other reasons for driving the increased rate of ASD fan pairings include:

- ASD fan pairings are becoming more commonplace as one respondent estimated that 60% of all total installed fans are paired with ASDs;
- Increased installations in retrofit situations as the old systems are being phased out and replaced with new ones containing ASDs; and  
*“We are seeing a lot more (ASDs) for ventilation fans.” (in retrofits)*
- Increased customer awareness that ASD pairings with fans offer solutions for retrofit projects.

Similar to the pumps market, one market actor believes that the fan-ASD pairings have reached total market saturation.

One market actor believes that the supply chain issues contributed to a decline in fan-ASD pairings in 2022. However, they acknowledged that there is still a constant customer base for these applications.

#### 4.3.6 Barriers to ASD Pairings with Pumps and Fans

The market actors identified the following major barriers to pairing ASDs for both pumps and fans (see Figure 4).

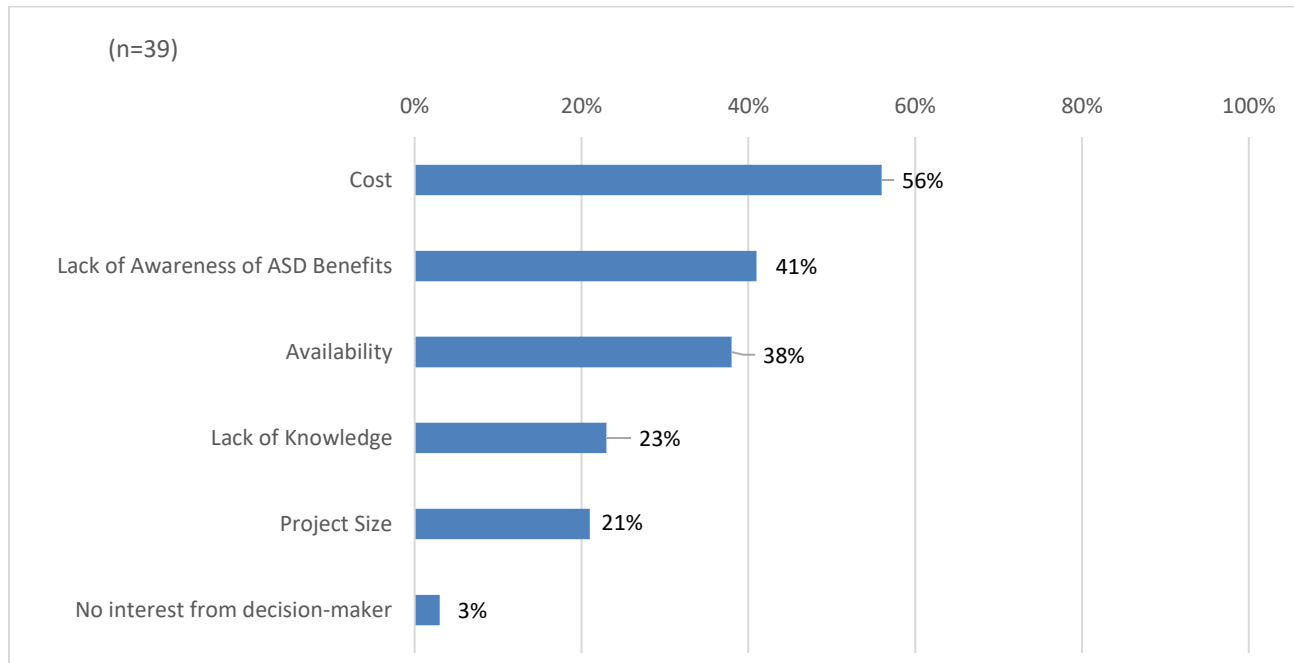
- **The First Cost mentioned by 56% of the market actors remains the biggest obstacle to ASD pairings.** Many specifying engineers noted that, while ASD costs have generally decreased over the last several years, the cost of incorporating an ASD remains a key factor in the decision to add to a system design.

- Other major barriers include a lack of awareness of ASD benefits, mentioned by 41% of the market actors, and a lack of availability due to supply chain issues, mentioned by 38% of the market actors and all of the manufacturers/manufacturers’ representatives (see Figure 4).

*“The lead times are off the chart, whether the parts are sourced from Germany or China.”*

*“Price increases have been historically high but delivery for the drive is difficult. It used to be 5 weeks, now it is between 8 and 55 weeks.”*

**Figure 4: Barriers to Pairing ASDs with Pumps or Fans**



The pumps’ or fans’ operational requirements, such as running with varying degrees of output intensity and/or with reversing of air or liquid flow directions, are the primary determinants of ASD pairing decisions. For systems with these needs, the distributors explained that ASDs are highly beneficial and often integral to system functionality and are, for the most part, already paired into such systems.

Systems that do not have any need for variable control options and are capable of operating efficiently with a constant load rarely contain ASDs; from the perspective of study respondents, there are simply no savings, whether in terms of power consumption, operational efficiency, or dollar cost, to be realized in either the short or long term. While some systems may need some degree of output or power consumption “ramping” up or down, it is usually not enough of a need to justify the cost of installing an ASD (e.g. you can “get away with soft starts”).

Several distributors noted that customers are often hesitant to try a new and unfamiliar technology, especially if it is complex like ASD pairings with pumps or fans.

#### 4.4 Research Objective #3: Decision-Making Process for ASD-Pump-Fan Pairings

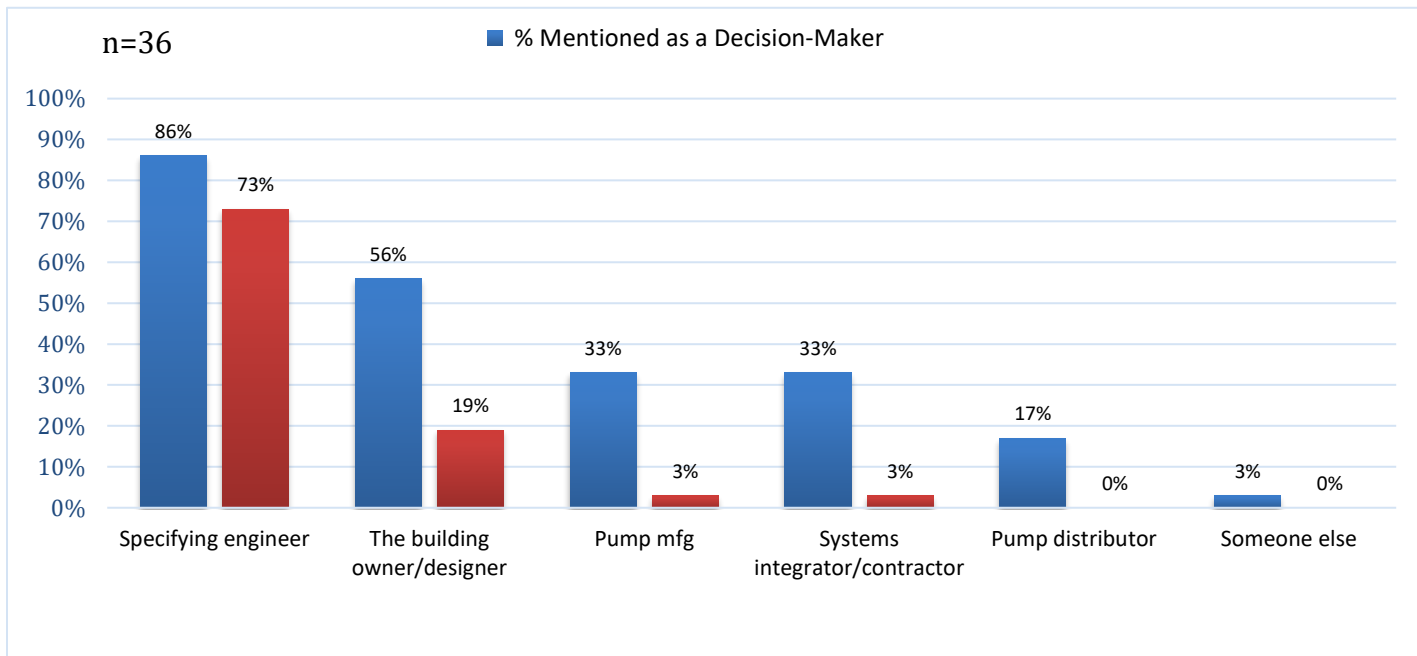
##### 4.4.1 Key Decision-makers for Pump-ASD Pairings

###### New Construction

- **Market actors view the specifying/design engineer as the most important (73%) decision maker for New Construction projects.** Other key decision-makers include the pump manufacturers (38%) and systems integrators/contractors (33%).

Figure 5 summarizes these findings by market actor.

**Figure 5: Decision-Makers (for Pump-ASD Pairings) in New Construction Scenarios**



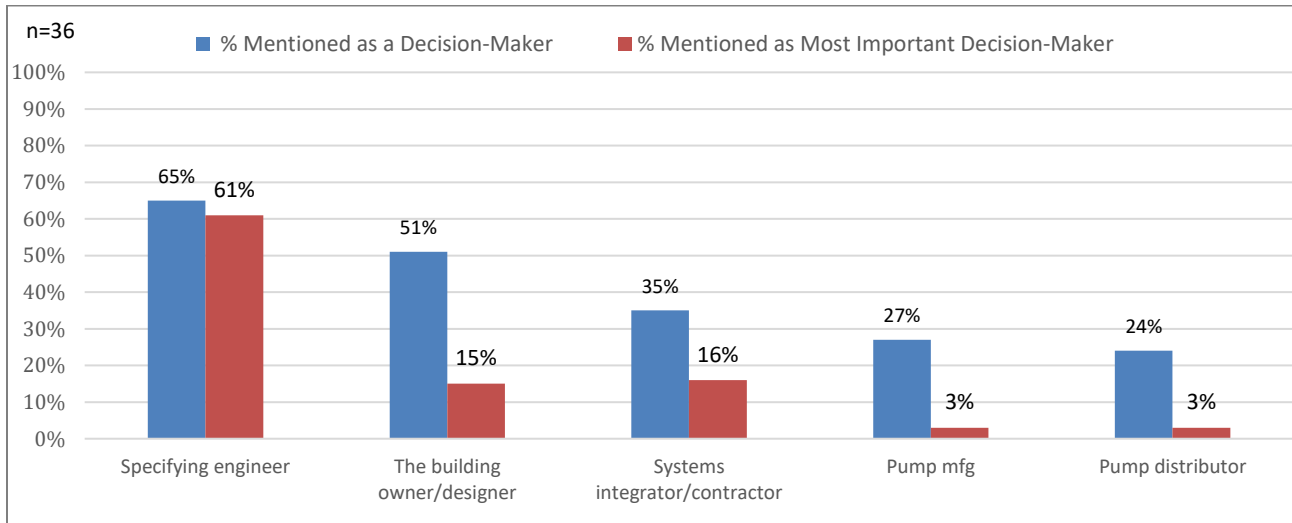
Specifying engineers are a key market actor in the ASD market; for new construction and retrofit projects, the majority of respondents indicated that the specifying engineer is the most important decision maker:

*“It is always the consultant (who is the most important decision maker); an owner or contractor may have input, but ultimately, they (the specifying engineer) decide.”*

###### Retrofit Projects

- **Specifying engineers (61%) are the most important decision-makers for pump-ASD pairings for retrofit projects** (see Figure 6). Most market actors (59%) identified this market actor as the most important decision maker for these ASD pairing decisions; and
- In contrast, the Mfg/Mfg Reps viewed all market players as equally important.

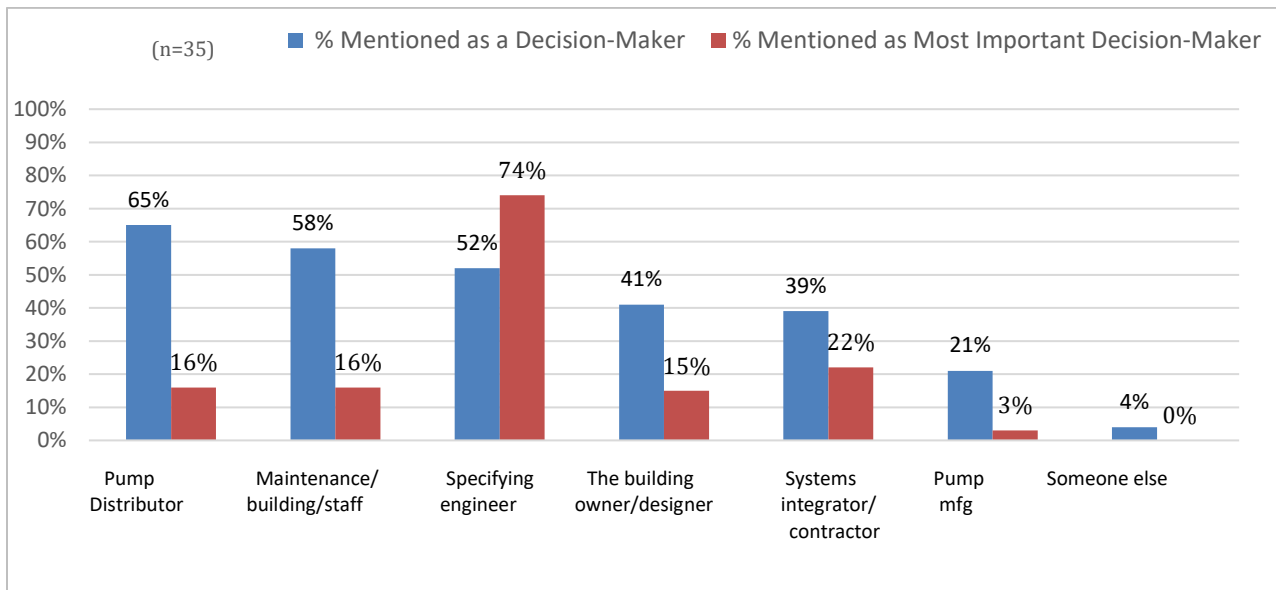
**Figure 6: Decision-Makers (for Pump-ASD Pairings) in Retrofit Scenarios**



### Replace on Burnout Projects

- Although the market actors identified many key decision-makers for ROB projects, the **specifying engineer (74%) is considered the most influential player**. Notably, distributors identified building/maintenance staff as a critical influencer of ASD pump pairings for ROB projects (see Figure 7).
- Exploring these results further revealed that the Mfg/Mfg Reps identified the building owner/manager and systems integrator/contractors as equally important decision-makers for ROB installations.

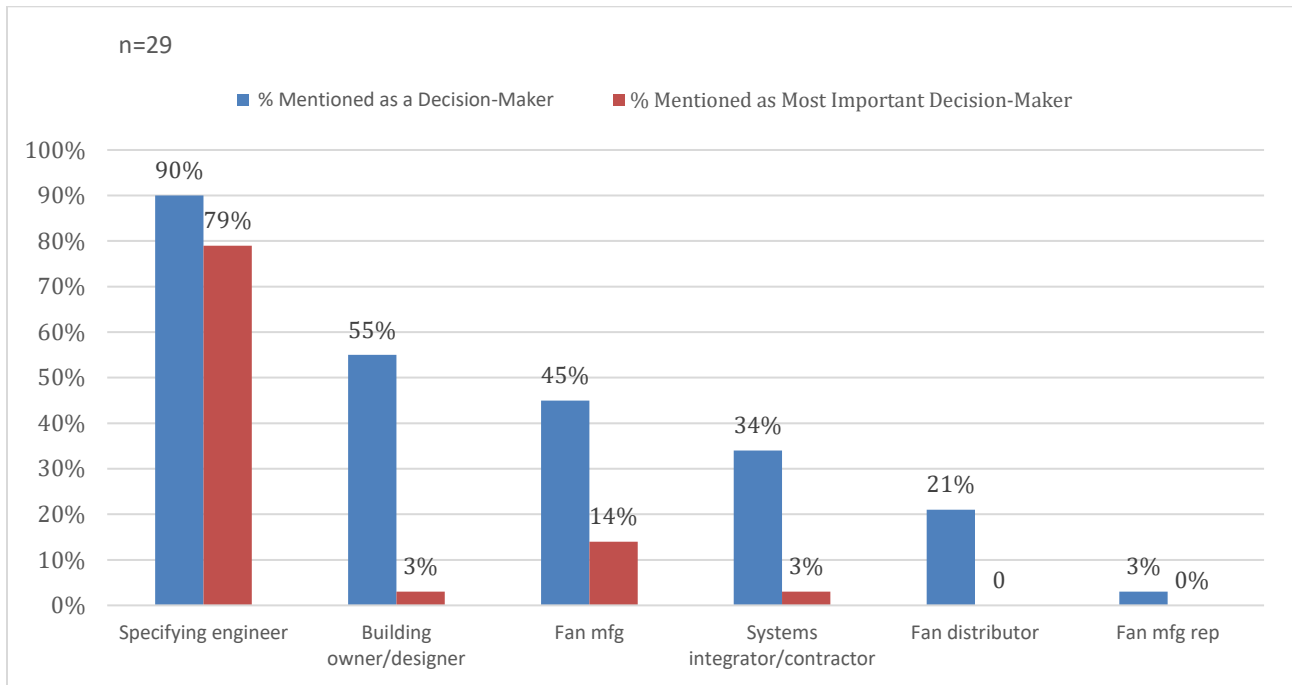
**Figure 7: Decision-Makers (for Pump-ASD Pairing) in Replace on Burnout Scenarios**



#### 4.4.2 The Decision-Making Process for Fan-ASD Pairings New Construction

- **Specifying/design engineers are the most important decision maker (79%) for fan-ASD pairings for new construction projects.** Other key decision-makers include the building owners (55%) and fan manufacturers (45%).

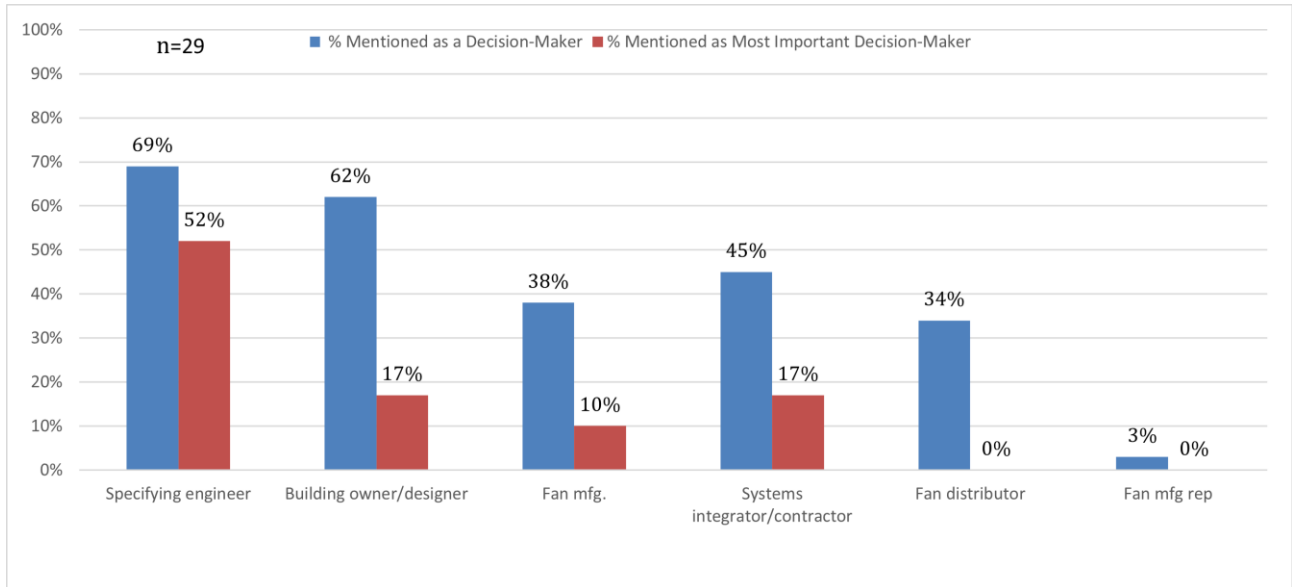
**Figure 8: Decision-Makers (for Fan-ASD Pairings) for New Construction Scenarios**



#### Retrofit Projects

- **Specifying engineers (69%), building owners (62%), and system integrators/contractors (45%) are considered important decision-makers in fan retrofit projects by market actors.** Fan manufacturers (38%) are also considered critical decision-makers in these fan-ASD pairings (See Figure 9); and
- When analyzing the results by market actor group, the Mfg/Mfg Reps reported the systems integrator/contractor, specifying engineer and building owner as equally important decision-makers for these installations.

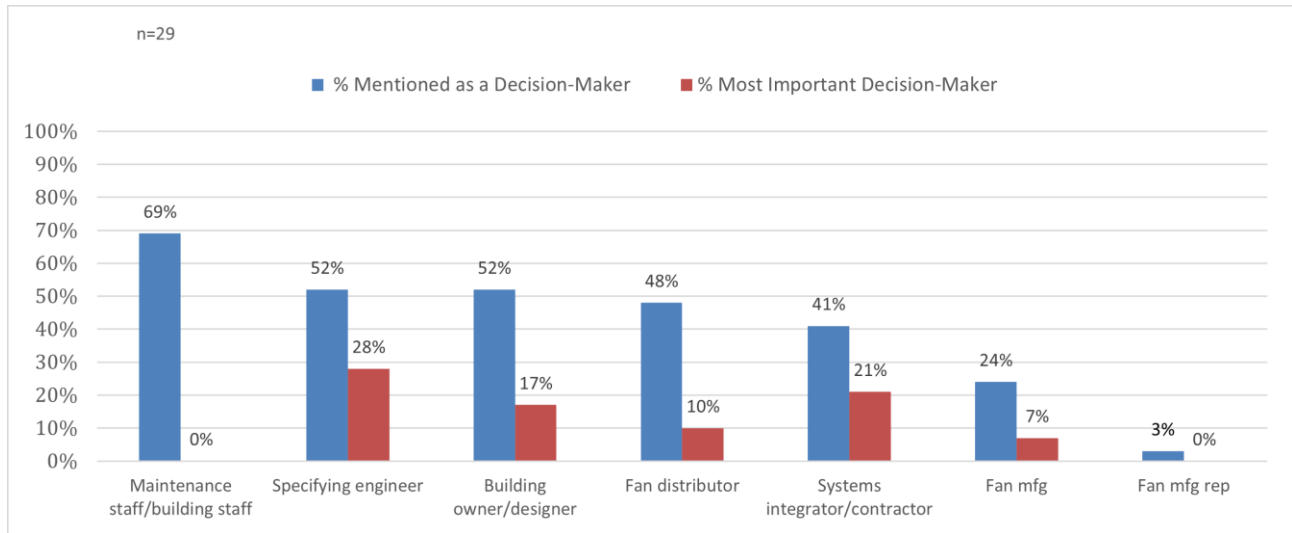
**Figure 9: Decision-makers (for Fan-ASD Pairings) for Retrofit Scenarios**



### Replace on Burnout

- **Market actors are more likely to consider maintenance/building staff (69%) as a decision-maker compared with other groups; however, this group was not considered the most important decision-maker for ROB projects by any of the respondents (see Figure 10); and**
- Further analysis by market group revealed that the Mfg/Mfg Reps viewed fan manufacturers and building owners as equally influential for these pairings.

**Figure 10: Decision-Makers (for Fan-ASD Pairings) for Replace on Burnout Scenarios**



#### 4.4.3 Fan-ASD Pairing Decision-Making Factors

Study respondents also identified the essential factors they consider in making ASD fan pairing decisions. Table 10 shows that the load type (68%) and noise reduction (56%) play an important role in pairing decisions.

**Table B-1 10: Critical Fan-ASD Pairing Factors**

Requirements	Number Mentioned (n = 25)	% Mentioned
Type of Load	17	68%
Something Else	15	60%
Noise Reduction/Noise Level	14	56%
CFM	13	52%
AMCA/Industry Rating	9	36%

\*Multiple response questions; percentages do not total 100%

The market actors named several additional requirements to consider when making these pairing decisions which include:

- Motor efficiency;
- Brand loyalty;
- Building new systems;
- Voltage and input amperage;
- Power Quality;
- Installation environment; and
- Availability of BACnet<sup>16</sup> communications.

<sup>16</sup> <https://bacnet.org/>

#### 4.5 Additional Market Actor Feedback regarding Market Stimulation

Almost all respondents believe that rebate programs offered to customers would significantly stimulate increased adoption of this technology. While many said incentives or rebates would increase market adoption, a few engineers placed the responsibility for doing this upon the equipment manufacturers. For example, a few engineers emphasized that having access to “*smaller, faster, cheaper [ASDs]*” would encourage specifying them for a system. Distributors and specifying engineers cited two common themes to increase market adoption of ASDs: decreased costs and increased education and awareness.

The distributors shared the same concerns and emphasized that increased customer education combined with rebate/incentive programs are critical to improving the adoption of ASDs in the Northwest.

Most customers, especially building owners/ designers, must be made aware of current rebates or incentive programs.

*“In the past year, the ETO (Energy Trust of Oregon) has started to put [ASDs] into a category where rebates exist, but this isn’t marketed well as 95% of jobs we handle aren’t sending in any rebate information.”*

Although this technology has been available since the 1980s, respondents indicated there remains a need to educate the market about the benefits and proper use of ASDs. Education about what an ASD is, and the energy benefits of adoption is important; however, just as important, if not more so, is how to operate an ASD properly. Many end users may shy away from adoption because it is considered too complex. Specifying engineers believe that increasing awareness, education, and availability of that education to end users will assist with market adoption.

## 5 Key Conclusions and Recommendations

**Research Objective #1:** *Assess the proportion of commercial pumps and fans that are paired with ASDs across the alliance's four-state region.*

### Pumps and Fans Conclusions

- **The majority of pumps and fans are paired with ASDs at the planning/design phase for new construction projects.** The market actors estimated that 8% to 15% of ASDs are paired with pumps or fans for retrofit and ROB projects, as the primary driver for these decisions is to replace the malfunctioning unit as quickly as possible.
- **Sales of pumps and fans vary significantly across market actors.** For example, some market actors work across multiple market channels, so pumps and fans account for just a small percentage of their annual sales. Other market actors, such as the Mfg/Mfg Reps, specialize in the pumps or fans market exclusively, and their revenue can account for a larger percentage of their annual revenue.
- **Few regional variations exist for either ASD pump or ASD fan pairings. The market actors estimated that up to 85% of pumps were paired during the planning/design phase, regardless of location.**
- **Building codes and building performance standards in Oregon and Washington, especially for new construction projects, are driving the push to install ASDs with both pumps and fans.**

### Pumps and Fans Recommendation

- **NEEA's Motor-Driven Products team can address the current data gaps in understanding the scope and size of the ASD market for pumps and fans.** Most market actors focus only on their slice of the market. At the same time, NEEA has the resources and capabilities to gather and share more regional and holistic data to better understand the market potential for both pumps and ASDs.

### Fans Recommendation

- **NEEA should continue distinguishing the fan market from the pump market sector with regard to ASD applications and processes.** Although ASDs are installed for pumps and fans, each market sector's decision-making process is unique. Therefore, NEEA should work to leverage its relationships within the fans market, especially among Mfg/Mfg Reps, to develop integrated offerings beyond new construction projects.

**Research Objective #2:** *Assess the distribution, by horsepower and by application (retrofit, naturally occurring replacement, new construction), of commercial fans and pumps that are paired with commercial ASDs across the alliance's four-state region.*

### Pumps and Fans Conclusions

- **The new energy codes in Washington require motors above 5 HP to be paired with a drive.** However, smaller (<1) HP pump and fan motors are paired with Electrically Commutated Motors (ECMs) in all four states, even though these pairings are not dictated by code requirements.
- **Larger motors, especially over 100 HP, will always be paired with an ASD due to the energy efficiency savings achieved for both pumps and fans.**

### Pumps Conclusion

- **Due to size and space limitations, retrofit and ROB projects are less likely to have a pump-ASD pairing.** Both SMEs and distributors noted that building owners and maintenance staff are reluctant to change out equipment configurations, especially for pumps, as this would require learning new technology.

### Pumps and Fans Recommendations

- **NEEA should consider focusing any potential ASD-related market transformation activities on the retrofit and ROB market segments.** To support this focus, NEEA should work with distributors to identify optimal pairing configuration packages for retrofit and ROB projects for both pump and fan pairings.
- **NEEA should explore how brand loyalty and resistance to change influence retrofit and ROB decisions for both pumps and fans and develop strategies to reduce these barriers in the commercial market.**
- NEEA should also consider working with Mfg./Mfg Reps to develop ASD pairings with pumps specifically for retrofit or ROB projects.

**Research Objective #3:** *Explore and document the decision-making process, including triggers for consideration of drive/device pairing, steps that are typically taken and influential factors throughout the process.*

### Pumps and Fans Conclusions

- **Cost, lack of awareness and the complexity of the ASD pairing decisions are the most significant barriers to ASD pairings for both pumps and fans.** The specifying engineers and distributors view the lack of customer knowledge about ASD benefits and the scarcity of rebates and incentives to finance these installation upgrades as primary barriers.
- **Specifying engineers will recommend a fan-ASD pairing in almost every scenario. But ASD pairings with pumps are dictated more by the size of motors, project requirements and ASD cost.**
- **Pump and fan manufacturers are selling ASDs as part of an integrated unit rather than as standalone applications.** These applications are primarily for new construction projects.
- **Specifying engineers are the most influential decision-makers for new construction projects.** However, the Mfg/Mfg Reps often provide technical assistance for large new construction projects requiring fans and pumps.
- **Systems integrators are the most influential decision maker for retrofit projects,** as they have to connect the various control panels. Systems integrators influence the specifying engineers' decisions regarding ASD pairings for both new construction and retrofit projects.

### Pumps Conclusions

- **Distributors are critical decision-makers in retrofit and ROB projects, especially when building owners or maintenance staff make the purchase decision.**

- **The pump-ASD market is siloed, so even if the company sells ASDs and pumps, the companies rely on different sales channels.**

Pumps Recommendation

- **NEEA should develop targeted outreach and educational activities focused on building owners and maintenance staff.** These activities should include case studies demonstrating the benefits of pump-ASD installations in existing buildings.

Fans Recommendation

- **NEEA should contact fan Mfg/Mfg Reps and distributors to better understand how fans can best be paired with ASDs in retrofit and ROB projects.**

Pumps and Fans Recommendations

- **NEEA should develop new strategies to increase the visibility and accessibility of rebate/incentive programs to customers.**

## Appendix A: Interview Guide - Subject Matter Experts (SMEs)

Table A-1 Subject Matter Expert Interview Guide

	Question Number
<b>Respondent Background</b> <ul style="list-style-type: none"> <li>Pumps Expertise (A2, A6, A7)</li> <li>Fans Expertise (A1, A2, A3, A6, A7)</li> </ul>	A1-A3
Market Characteristics of Pump/Fan- Drive Pairings by HP and Application	A-B6
<ul style="list-style-type: none"> <li>Pumps Expertise (B1-B3)</li> <li>Fans Expertise (B4-B6)</li> </ul>	B1-B6
Key Factors Driving Pump/Fan-Drive Pairings	C1-C4d
<ul style="list-style-type: none"> <li>Pumps Expertise (C1-C2)</li> <li>Fans Expertise (C3-C4d)</li> </ul>	
Decision-Making Process for Pump/Fan-Drive Pairings.	D1-D2.7
<ul style="list-style-type: none"> <li>Pumps Expertise (D1-D1.9)</li> </ul>	
<ul style="list-style-type: none"> <li>Fans Expertise (D1-D2.7)</li> </ul>	
Barriers to Pump/Fan-Drive Pairings	E1-E2
<ul style="list-style-type: none"> <li>Pumps Expertise (E1)</li> </ul>	
<ul style="list-style-type: none"> <li>Fans Expertise (E2)</li> </ul>	
Closing Thoughts	F1

### Critical Research Objectives

- Assess the proportion of commercial pumps and fans that are paired with drives across the alliance’s four-state region;
  - Types of applications in which these pairings are most common.
  - In what applications are these pairings expected to increase in the future?
- Assess the distribution, by horsepower and by application (retrofit / naturally occurring replacement due to equipment failure / new construction) of commercial pumps and fans that are paired with drives in the field across the alliance’s four-state region;
  - What is the proportional bin distribution of regional (ID/MT/OR/WA) pairings of drives with commercial pumps and fans by horsepower bin?
  - How, if at all, does the application project/type distribution of units vary by pumps vs. fans?
- Explore and document the decision-making process for purchasing and installing drives paired with commercial pumps and fans, including triggers for consideration of drive/device pairing, steps typically taken, and influential factors throughout the process.

## Respondent Recruitment

Hello, my name is \_\_\_\_\_ from Johnson Consulting Group. My firm has been hired by the Northwest Energy Efficiency Alliance (NEEA) to conduct a market research study in the commercial and industrial pumps and fans market; We are reaching out to industry experts like yourself to understand better the market dynamics of pairing Adjustable Speed Drives (ASDs) with commercial pumps and fans. Our research is focused on the Northwest, but we would appreciate any general insights regarding the factors influencing the decision to pair ASDs with commercial pumps and/or fans.

### **When is a convenient time to talk?**

Day:

Time:

Link:

**Schedule call back.** I understand you're busy. When would be a good time to call back to schedule this interview?

**Contact Name** \_\_\_\_\_

**Company Name** \_\_\_\_\_

**Contact Email** \_\_\_\_\_

**Telephone Number** \_\_\_\_\_

**Interview Date** \_\_\_\_\_

**City** \_\_\_\_\_

**State** \_\_\_\_\_

## Introduction

Hello. Thanks for talking with me today. Can I record this interview to streamline the note-taking process? All your responses will be kept confidential. **(Proceed and record if permission is granted; if declining recording, continue interview with notes only)**. First, I'd like to get some information about your organization.

## A. Qualifying Questions

- A1. What is your current role in your organization?
- A2. What is your involvement in the commercial pumps market?
- A3. What is your involvement in the commercial fans market?
- A4. If not involved in either part of the market, ask, “Who would be a good contact at your organization for me to talk to about commercial pumps and/or commercial stand-alone fan systems products (i.e., fans not embedded in HVAC equipment; if needed fans for supply air and exhaust air in commercial buildings) ?”
- A5. Capture new contact information; thank and terminate.

Contact Name \_\_\_\_\_

Company Name \_\_\_\_\_

Contact Email \_\_\_\_\_

Telephone Number \_\_\_\_\_

- A6. How long have you been involved in this/these market(s)?
- A7. How familiar how you with the commercial Adjustable Speed Drives (ASD) market? This equipment is also known as Variable Frequency Drives (VFDs) or Variable Speed Drives (VSDs) **(If not familiar, thank and terminate)**

## B. Market Characteristics of Pump/Fan-Drive Pairings

*(Ask only questions that relate to the respondent’s specific area of expertise, i.e., fans, pumps or both)*

- B1. Which types of applications are most common for pairing an ASD with a commercial pump motor?
- B2. Does the HP of the motor influence the addition of an ASD pairing with a pump? What are the general parameters for pairing an ASD with a pump?
- B3. What applications or conditions, if any, do you see as not viable for pairing ASDs with commercial pumps?
- B4. Which types of applications most common for pairing an ASD with a commercial stand-alone fan system?
- B5. Does the HP of the motor influence the addition of an ASD pairing with a stand-alone fan? What are the general parameters for pairing an ASD with a stand-alone fan?
- B6. What applications or conditions, if any, do you see as not viable for pairing ASDs with commercial stand-alone fan systems?
- B7. What applications do you see as having the greatest potential for increased use of ASDs in the future?

*(Ask only questions that relate to the respondent's specific area of expertise, i.e., fans, pumps or both)*

**For Pump Experts continue; For Fan Experts ONLY Skip to C3**

- C1. Based on your experience, has the number of pairings of ASDs with pumps in the commercial sector increased, decreased, or stayed the same in the past year?
1. (IF number has changed ask: What seems to be the primary reasons for this change in the number of ASD pairings with pumps?)
  2. (IF stayed the same: Why do you think that ASD pairings with pumps are not becoming more prevalent?)
- C2. Please describe the supply chain flow by which **ASDs are typically paired with pump motors in commercial applications.**
1. When are most pump motors paired with an ASD (at or after the initial time of the purchase of the pump)?
  2. When would pumps be paired with an ASD as part of a "packaged system" of pump, motor drive and controls shipped as one unit from the pump manufacturer?
  3. Are pump manufacturers promoting the addition of a drive before and/or after installation?
    - (1) What do you see as the advantages, if any, of pairing an ASD with a pump post-purchase?
    - (2) What do you see as the advantages, if any, of pairing an ASD with a pump as part of a "package" installation?
    - (3) Overall, what changes, if any, do you expect to see regarding the nature and frequency of commercial pump-ASD pairings?

**For Fan Experts continue; For Pump Experts ONLY Skip to Section D**

- C3. Based on your experience, has the number of pairings of ASDs with stand-alone fans in the commercial sector increased, decreased or stayed the same in the past year?
1. (IF number has changed ask: What seems to be the primary reasons for this change in the number of ASD pairings with fans?)
  2. (IF stayed the same: Why do you think that ASD pairings with fans are not becoming more prevalent?)
- C4. Please describe the supply chain flow by which **ASDs are typically paired with stand-alone fans in commercial applications.**
1. When are most commercial stand-alone fans paired with a drive (at or after the initial time of the purchase of the fan)?
  2. In what circumstances would a stand-alone fan be paired with a drive, at the time of installation? What are the trends regarding stand-alone fans and drive pairings?
    - (1) Are fan manufacturers promoting the addition of an ASD before and/or after installation?
    - (2) What do you see as the advantages, if any, of pairing an ASD with a fan post-purchase?

- (3) What do you see as the advantages, if any, of pairing an ASD with a fan as part of a “package” installation?
- (4) Overall, what changes, if any, do you expect to see regarding the nature and frequency of commercial fan-ASD pairings?

#### ***D. Decision-Making Process for Pump/Fan ASD Pairings***

*(Ask only questions that relate to the respondent’s specific area of expertise, i.e., fans, pumps or both)*

**For Pump Experts continue; For Fan Experts ONLY Skip to D2**

**D1. Who typically decides to pair an ASD with a commercial pump?**

1. What role, if any, does the pump manufacturer play in this decision-making process?
2. What about the role of the pump Manufacturer’s Representative or distributor?
3. What role, if any, does the design or specifying engineer play in this decision-making process?
4. What role, if any, do controls contractors play in this decision-making process?
5. What other market actors, if any, are typically involved in the decision-making process regarding the pairing of ASDs with commercial pumps?
6. Who would you say is the most critical decision-maker in this selection process, and why?
7. What role does fan selection software play in the decision-making process?
8. What factors are considered when assessing the suitability of pairing an ASD with a commercial pump?
  - (1) What metrics, if any, are used to guide this decision? (If so, probe on PEI, ER label, or other metrics)
9. What role, if any, do state and/or municipal energy codes play in encouraging or discouraging commercial pump-ASD pairings?

***For Fan Experts continue; For Pump Experts ONLY Skip to Section E***

**D2. Who typically decides to pair an ASD with a commercial stand-alone fan?**

1. What role, if any, does the Manufacturer play in this decision-making process?
2. What about the role of the Manufacturer's Representative?
3. What role, if any, does the design or specifying engineer play in this decision-making process?
4. What other market actors are typically involved in the fan-ASD drive pairing specification?
5. Who is the most critical decision-maker regarding the selection of equipment?
6. What factors are considered when assessing the suitability of pairing an ASD with a commercial fan?
  - (1) What metrics, if any, are used to guide this decision?
7. What role, if any, do state energy codes play in encouraging or discouraging commercial fan - ASD pairings? What about *upcoming federal standards for fans*?

**E. Barriers to Pump/Fan-Drive Pairing**

*(Ask only questions that relate to the respondent's specific area of expertise, i.e., fans, pumps or both)*

**For Pump Experts continue; For Fan Experts ONLY Skip to F**

E1. Are you aware of any specific barriers in the Northwest market regarding commercial pump-ASD pairings?

**For Fan Experts continue; For Pump Experts ONLY Skip to Section F**

E2. Are you aware of any specific barriers in the Northwest market regarding commercial fan-ASD pairings?

**F. Closing**

F1. Before we wrap up, is there anything else you'd like to share, either regarding the pairing of ASDs with [commercial pumps/commercial stand-alone fans/commercial pumps and stand-alone fans] or anything else we may have missed?

*Thanks so much for your time!*

## Appendix B: Interview Guide - Specifying/Design Engineers

**Table B-1: Quotas by Market Actor**

State	Consulting Engineers	Drive/Controllers (System Integrators)	Total
ID	2	4	8
MT	2	2	6
OR	5	10	20
WA	6	14	26
<b>Total</b>	<b>15</b>	<b>30</b>	<b>45</b>

**Table B-2: Summary of Questions by Topic Area**

	Question Number
<b>Respondent Recruitment and Qualifying Questions</b>	A1-A2
“Firmographic” Questions	B1-B4
Role in Pump/Fan Selection Process	C1-C18
<ul style="list-style-type: none"> <li>Pumps Expertise (C1-C8)</li> <li>Fans Expertise (C9-C18)</li> </ul>	
Decision-Making Process for Pump/Fan-Drive Pairings.	D1-D4
<ul style="list-style-type: none"> <li>Pumps Expertise (D1-D2)</li> <li>Fans Expertise (D3-D4)</li> </ul>	
Barriers to Pump/Fan-Drive Pairings	E1-E2
<ul style="list-style-type: none"> <li>Pumps Expertise (E1)</li> <li>Fans Expertise (E2)</li> </ul>	
Closing Thoughts	F1-F3

### Critical Research Objectives

- Assess the proportion of commercial pumps and fans that are paired with drives across the alliance’s four-state region;
  - Types of applications in which these pairings are most common.
  - In what applications are these pairings expected to increase in the future?
- Assess the distribution, by horsepower and by application (retrofit / naturally occurring replacement due to equipment failure / new construction) of commercial pumps and fans that are paired with drives in the field across the alliance’s four-state region;
  - What is the proportional bin distribution of regional (ID/MT/OR/WA) pairings of drives with commercial pumps and fans by horsepower bin?

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2. How, if at all, does the application project/type distribution of units vary by pumps vs. fans?
  - Explore and document the decision-making process for purchasing and installing drives paired with commercial pumps and fans, including triggers for consideration of drive/device pairing, steps typically taken, and influential factors throughout the process.

### Respondent Recruitment

*Hello, my name is \_\_\_\_\_ from Johnson Consulting Group. My firm has been hired by the Northwest Energy Efficiency Alliance (NEEA) to conduct a market research study in the commercial and industrial pumps and fans market; We are speaking with key trade allies, like yourself, to understand better the market dynamics of pairing Adjustable Speed Drives (ASDs) with commercial pumps and non-embedded (or stand-alone fans). This interview will take about 20-25 minutes, and in exchange for your participation, we will send you an email gift card worth \$50,00).*

#### **When is a convenient time to talk?**

Day:

Time:

Link:

**Schedule call back.** I understand you're busy. When would be a good time to call back to schedule this interview?

**Contact Name** \_\_\_\_\_

**Company Name** \_\_\_\_\_

**Contact Email** \_\_\_\_\_

**Telephone Number** \_\_\_\_\_

**Interview Date** \_\_\_\_\_

**City** \_\_\_\_\_

**State** \_\_\_\_\_

#### **Type of Business**

1. C&I Specifying Engineer (\$75.00 stipend)
2. C&I Contractor/Installer/Systems Integrator (\$50.00 stipend)

### Introduction

*Hello. Thanks for talking with me today. Can I record this interview to streamline the note-taking process? All your responses will be kept confidential. **(Proceed and record if permission is granted; if***

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**declining recording, continue the interview with notes only).** First, I'd like to get some information about your organization.

### A. Qualifying Questions

A1. Is your firm involved in the specification or installation of **pumps and/or non-embedded (stand-alone) fans with ASDs** Adjustable Speed Drives (ASDs) (read definition if required: which are any electronic controls that allow a motor to rotate at different speeds, controlling the equipment via load changes in rotational speed) in the commercial market?

1. Yes
2. No- **Thank and Terminate**
3. Don't Know – **Thank and Terminate**

*Terminate- thanks for your time today, but your organization doesn't meet our requirements for this study. Have a good day.*

A2. Regarding your work in the commercial market, what is your firm's primary business?

engineer

1. Consulting Engineer
2. Drive Controllers/Systems Integrators
3. Other (Specify)

*Terminate- thanks for your time today, but your organization doesn't meet our requirements for this study. Have a good day.*

### B. "Firmographic" Questions

B1. How long has your organization been providing these services?

\_\_\_\_\_ number of years (best estimate is fine)

B2. What percentage of your firm's annual revenues are related to the commercial pumps market?

\_\_\_\_\_ % (your best estimate is fine)

**(If less than 10%, ask questions only about fans)**

B3. What percentage of your firm's annual revenues are related to the commercial market for non-embedded (stand-alone ) fans

\_\_\_\_\_ % (your best estimate is fine)

**(If less than 10%, ask questions only about pumps)**

B4. In which states does your firm provide these services? **(Mark all that apply)**

1. Idaho
2. Montana
3. Oregon

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- 4. Washington
- 5. Other (Specify)
- 6. If do not work in any of NEEA's service territory, THANK AND TERMINATE.

Approximately how many employees does your firm have?

- B5. Number of employees \_\_\_\_\_ entire organization
- B6. Number of employees \_\_\_\_\_ Northwest (defined as Idaho, Montana, Oregon, and Washington)

**C. Market Characteristics of Pump/Fan-Drive Pairings**

*(Ask only questions that relate to the respondent's specific area of expertise, i.e., fans, pumps or both)*

*(Pump expertise go to **QC1-C13**: Fan expertise only, Go to **QC14-C24**)*

C1. About what percentage of commercial pump-ASD pairings occur in the following stages (*your estimate is fine*):

- 1. During the planning/design process (pre-installation) \_\_\_\_\_%
- 2. At the time of purchase of the equipment \_\_\_\_\_%
- 3. During the installation process. \_\_\_\_\_%
- 4. Other (specify) \_\_\_\_\_%
- 5. Don't Know

C2. Based on your experience, what percentage of commercial pump/ASD pairings fall within each of the following project types?

- 1. New Construction Projects \_\_\_\_\_%
- 2. Retrofit Projects \_\_\_\_\_%
- 3. Replace on Burnout Projects \_\_\_\_\_%

C2a. Based on your best guess, how many ASDs are sold into the Northwest commercial market for

- (a) Number of ASDs sold for Pumps \_\_\_\_\_
- (b) Number of ASD sold for non-embedded (stand-alone) fans \_\_\_\_\_

C3. In your experience, who is involved in the decision to pair a pump with an ASD for new construction projects? (Open Ended).

(For coding responses only)

- 1. The building owner/designer
- 2. Specifying engineer
- 3. The pump distributor

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4. The pump manufacturer
5. Systems Integrator (Installation Contractor)
6. Someone else (Specify)
9. Don't Know

C3a. Of those roles, who would say is the important decision-maker in these types of projects?

(For coding responses only)

1. The building owner/designer
2. Specifying engineer
3. The pump distributor
4. The pump manufacturer
5. Systems Integrator (Installation Contractor)
6. Someone else (Specify)
9. Don't Know

C4. Who is involved in the decision to pair a pump with an ASD for **Retrofit Projects?** (Open Ended)

(For coding responses only)

1. The building owner/
2. Specifying engineer
3. The pump distributor
4. The pump manufacturer
5. Systems Integrator (Installation Contractor)
6. Maintenance Staff/Building Operators
7. Someone else (Specify)
9. Don't Know

C4a. Of those roles, who would say is the important decision-maker in these types of projects?

(For coding responses only)

1. The building owner/designer
2. Specifying engineer
3. The pump distributor
4. The pump manufacturer

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5. Systems Integrator (Installation Contractor)
6. Maintenance Staff/Building Operators
7. Someone else (Specify)
9. Don't Know

C5. Who is involved in the decision to pair a pump with an ASD for **Replace on Burnout projects? (Open Ended)**

(For coding purposes only)

1. The pump distributor
2. The building owner/designer
3. Specifying engineer
4. The pump distributor
5. The pump manufacturer
6. Systems Integrator (Installation Contractor)
7. Maintenance Staff/Building Operators
8. Someone else (Specify)
9. Don't Know

C5a. Of those roles, who would say is the important decision-maker for these types of projects?

(For coding responses only)

1. The building owner/designer
2. Specifying engineer
3. The pump distributor
4. The pump manufacturer
5. Systems Integrator (Installation Contractor)
6. Maintenance Staff/Building Operators
7. Someone else (Specify)
9. Don't Know

C6. What applications or conditions, if any, are **not viable** for pairing ASDs with commercial pumps?  
**(Open Ended)**

C7. Based on your experience, about what percentage of commercial pumps and ASDs are paired within each of the following HP bins:

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- 1. 1 to 5 HP \_\_\_\_\_%
- 2. 6-20 HP \_\_\_\_\_%
- 3. 21 to 50 HP \_\_\_\_\_%
- 4. 51 to 100 HP \_\_\_\_\_%
- 5. 101-200 HP \_\_\_\_\_%
- 6. Above 200 HP \_\_\_\_\_%
- 7. Don't Know

**Fan Pairings Questions.**

**Ask Questions C8- C18 for those respondents familiar with ASD pairings with non-embedded (stand-alone) commercial fans.**

C8. Based on your experience, about what percentage of commercial stand-alone fan/ASD pairings occur in the following stages (your estimate is fine):

- 1. During the planning/design process (pre-installation). \_\_\_\_\_%
- 2. At the time of purchase of the equipment \_\_\_\_\_%
- 3. During the installation process \_\_\_\_\_%
- 4. Other (specify) \_\_\_\_\_%
- 5. Don't Know

C9. Based on your experience, what percentage of commercial non-embedded (stand-alone) fan/ASD pairings fall within each of the following project types.

- 1 New Construction Projects \_\_\_\_\_%
- 2 Retrofit Projects \_\_\_\_\_%
- 3 Replace on Burnout Projects \_\_\_\_\_%

C10. Who is involved in the decision to pair an ASD with a commercial non-embedded (stand alone) d fan for **New Construction Projects? (Open Ended)**

(For coding responses only)

- 1. The building owner/designer
- 2. Specifying engineer
- 3. The fan distributor
- 4. The fan manufacturer
- 5. The manufacturers' rep
- 6. Systems Integrator (Installation Contractor)

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7. Someone else (Specify)
9. Don't Know

C11. Of those roles, who would say is the most important decision-maker in these types of projects?  
(For coding responses only)

1. The building owner/designer
2. Specifying engineer
3. The fan distributor
4. The fan manufacturer
5. The manufacturers' rep
6. Systems Integrator (Installation Contractor)
7. Someone else (Specify)
9. Don't Know

C12. Who is involved in the decision to pair an ASD with a commercial stand-alone fan for **Retrofit Projects (Open Ended)?**

(For coding purposes only)

1. The building owner/designer
2. The Specifying engineer
3. The fan distributor
4. The fan manufacturer
5. The manufacturers' rep
6. Systems Integrator (Installation Contractor)
7. Maintenance Staff/Building Operators
8. Someone else (Specify)
9. Don't Know

C13. Of those roles, who would say is the important decision-maker in these types of projects?

C14. Who is involved in the decision to pair an ASD with a commercial non-embedded (stand-alone) fan for **Replace on Burnout projects? (Open Ended)**

(For coding purposes only)

1. The building owner/designer
2. Specifying engineer
3. The pump distributor
4. The pump manufacturer

**Commercial ASD Penetration Market Research Study**

5. Systems Integrator (Installation Contractor)
6. Building/Maintenance Staff
7. Someone else (Specify)
9. Don't Know

C15. Of those roles, who would say is the most important decision-maker for these types of projects?  
(For coding responses only)

1. The building owner/designer
2. Specifying engineer
3. The pump distributor
4. The pump manufacturer
5. Systems Integrator (Installation Contractor)
6. Building/Maintenance Staff
7. Someone else (Specify)
9. Don't Know

C16. What applications or conditions, if any, are **not viable** for pairing ASDs with commercial non-embedded (stand-alone) fans? **(Open Ended)**

C17. Based on your experience, about what percentage of commercial non-embedded (stand-alone) fans and ASDs are paired within each of the following HP bins?

1. 1 to 5 HP \_\_\_\_\_%
2. 6-20 HP \_\_\_\_\_%
3. 21 to 50 HP \_\_\_\_\_%
4. 51 to 100 HP \_\_\_\_\_%
5. 101-200 HP \_\_\_\_\_%
6. Above 200 HP \_\_\_\_\_%
9. Don't Know

C18. What requirements do you consider when pairing a commercial stand-alone fan with an ASD?  
**(Read list: Mark all that apply)**

1. Cubic Feet per Minute (CFM)
2. AMCA Rating/Similar Industry Rating (e.g. FEI, FEG)
3. Type of load (constant vs. variable)
4. Cubic Feet Per Minute (CPM)
5. Noise reduction/noise level
6. Something else (Specify)

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### *D. Key Factors Driving Pump -Drive Pairings*

D1. Based on your best guess, about what percentage of commercial pumps in the Northwest are currently paired with ASDs?

\_\_\_\_\_ %

D2. Based on your experience, has the number of pairings of **ASDs with pumps** in the commercial market increased, decreased, or stayed the same in the past year?

1. (IF the number has changed, ask: What seems to be the primary reason for this change in ASD pairings with pumps?)
2. (IF stayed the same or decreased: Why do you think that ASD pairings with pumps are not becoming more prevalent?)
3. **For Specifying Engineers Only:** What role, if any, do state and/or municipal energy codes play in encouraging or discouraging pump-ASD pairings in the commercial market?

### **FAN Pairings**

D3. Based on your best guess, about what percentage of commercial stand-alone fans in the Northwest are currently paired with ASDs?

\_\_\_\_\_ %

D4. Based on your experience, has the number of pairings of ASDs with stand-alone fans in the commercial market increased, decreased or stayed the same in the past year?

1. (IF the number has changed, ask: What seems to be the primary reasons for this change in the number of ASD pairings with fans?)
2. (IF stayed the same or decreased: Why do you think that ASD pairings with fans are not becoming more prevalent?)
3. **For Specifying Engineers Only:** What role, if any, do state and/or municipal energy codes play in encouraging or discouraging fan-ASD pairings in the commercial market?

### **E. Barriers and Benefits to Pump-Drive and Fan-Drive Pairings**

- E1. What, if any, are particular factors in the Northwest market that notably impact, either positively or negatively, the decision to pair ASDs with commercial pumps and non-embedded (stand-alone) fans, and why? (*Probe on the following; mark all that apply*)
1. Lack of awareness of ASD benefits
  2. Not sure how to install the ASD with a pump or fan
  3. Cost
  4. Availability
  5. Project size
  6. No interest from the main decision-maker
  7. ASDs and pumps or fans are purchased separately
  8. Other (specify)
- E2. If you could change anything within the Northwest commercial market to increase ASD adoption for commercial pumps, what would it be?" (Open Ended)
- E3. If you could change anything within the Northwest commercial market to increase ASD adoption for non-embedded (stand-alone) fans, what would it be? (Open Ended)

### **F. Closing**

- F1. Does your firm typically track ASD sales and installations in general generally, just in terms of numbers of units, or include project details such as the unit and project characteristics?
1. Track general level only- Go to F3
  2. Include project level details- Go to F2
  3. Don't Track ASD Sales at all- Go to F3
- F2. In your opinion, what might your firm's position and level of interest be if an opportunity arose to contribute sales data in support of energy efficiency efforts in the Northwest?
- F3. Is there anything else you would like to add to our discussion today? (**Open Ended**)

***Thank you for your time today. May I confirm your email so we can send you a \$50.00/\$75.00 e-gift card?***

***Confirm email address:*** \_\_\_\_\_

*Thanks so much for your time!*

## Appendix C: Interview Guide - Systems Integrators/Contractors, and Distributors

Table C-11: Quotas by Market Actor

State	ASD/Fan Distributors
ID	2
MT	2
OR	5
WA	6
<b>Total</b>	<b>15</b>

Table C-2 Summary of Questions by Topic Area

	Question Number
<b>Respondent Recruitment and Qualifying Questions</b>	A1
“Firmographic” Questions	B1-B6
Role in Pump/Fan Selection Process	C1-C19
<ul style="list-style-type: none"> <li>Pumps Expertise (C1-C9)</li> <li>Fans Expertise (C10-C19)</li> </ul>	
Decision-Making Process for Pump/Fan-Drive Pairings.	D1-D2
<ul style="list-style-type: none"> <li>Pumps Expertise (D1)</li> <li>Fans Expertise (D2)</li> </ul>	
Barriers to Pump/Fan-Drive Pairings	E1-E2
<ul style="list-style-type: none"> <li>Pumps Expertise (E1)</li> <li>Fans Expertise (E2)</li> </ul>	
Closing Thoughts	F1

### Critical Research Objectives

- Assess the proportion of commercial pumps and fans that are paired with drives across the alliance’s four-state region;
  - Types of applications in which these pairings are most common.
  - In what applications are these pairings expected to increase in the future?
- Assess the distribution, by horsepower and by application (retrofit / naturally occurring replacement due to equipment failure / new construction) of commercial pumps and fans that are paired with drives in the field across the alliance’s four-state region;
  - What is the proportional bin distribution of regional (ID/MT/OR/WA) pairings of drives with commercial pumps and fans by horsepower bin?
  - How, if at all, does the application project/type distribution of units vary by pumps vs. fans?

## Commercial ASD Penetration Market Research Study

- Explore and document the decision-making process for purchasing and installing drives paired with commercial pumps and fans, including triggers for consideration of drive/device pairing, steps typically taken, and influential factors throughout the process.

### Respondent Recruitment

Hello, my name is \_\_\_\_\_ from Johnson Consulting Group. My firm has been hired by the Northwest Energy Efficiency Alliance (NEEA) to conduct a market research study in the commercial and industrial pumps and fans market; like yourself, to better understand the market dynamics of pairing Adjustable Speed Drives (ASDs) with commercial pumps and non-embedded or stand-alone fans. By this, I mean fans that are not embedded in packaged equipment, which I'll refer to just as "stand-alone" fans from here on out. This interview will take about 20- 25 minutes, and in exchange for your participation, we will send you an email gift card worth \$50.00.

#### **When is a convenient time to talk?**

Day:

Time:

Link:

**Schedule call back.** I understand you're busy. When would be a good time to call back to schedule this interview?

**Contact Name** \_\_\_\_\_

**Company Name** \_\_\_\_\_

**Contact Email** \_\_\_\_\_

**Telephone Number** \_\_\_\_\_

**Interview Date** \_\_\_\_\_

**City** \_\_\_\_\_

**State** \_\_\_\_\_

**Type of Business**

### Introduction

Hello. Thanks for talking with me today. Can I record this interview to streamline the note-taking process? All your responses will be kept confidential. **(Proceed and record if permission is granted; if declining recording, continue the interview with notes only).** First, I'd like to get some information about your company.

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**A. Qualifying Questions**

A1 Is your firm involved in the distribution of Adjustable Speed Drives for pumps or stand-alone fans?

- 1. Yes
- 2.No- **Thank and Terminate**
- 9. Don't Know – **Thank and Terminate**

*Terminate- thanks for your time today, but your organization doesn't meet our requirements for this interview. Have a good day.*

**B. "Firmographic" Questions**

B1. How long has your organization been in business?

\_\_\_\_\_ number of years (best estimate is fine)

B2. What percentage of your firm's annual revenues are related to the commercial pumps market?

\_\_\_\_\_ % (your best estimate is fine)

**(If less than 10%, ask questions only about fans)**

B3. What percentage of your firm's annual revenues are related to the stand-alone commercial fans market?

\_\_\_\_\_ % (your best estimate is fine) **(If less than 10%, ask questions only about pumps)**

B4. In which states does your firm provide these services? **(Mark all that apply)**

- 1. Idaho
- 2. Montana
- 3. Oregon
- 4. Washington
- 5. Other (Specify)

If do not work in any of NEEA's service territories, **Thank and Terminate.**

Approximately how many employees does your firm have?

B5. Number of employees \_\_\_\_\_ entire organization

B6. Number of employees \_\_\_\_\_ Northwest

### C. Role in Market Characteristics of ASD Pairings

(Ask only questions that relate to the respondent's specific area of expertise, i.e., fans, pumps or both)

(Pump expertise go to QC1-C9: Fan expertise only, Go to QC10-C19)

C1. About what percentage of commercial pump-ASD pairings occur in the following stages (*your estimate is fine*):

1. During the planning/design process (pre-installation) \_\_\_\_\_%
2. At the time of purchase of the equipment \_\_\_\_\_%
3. During the installation process \_\_\_\_\_%
4. Other (specify) \_\_\_\_\_%

C2. Based on your experience, what percentage of commercial pump/ASD pairings fall within each of the following project types?

1. Replace on New Construction Projects \_\_\_\_\_%
2. Retrofit Projects \_\_\_\_\_%
3. Burnout \_\_\_\_\_%

C3. In your experience, who is involved in the decision to pair a pump with an ASD for **new construction projects**? (Open Ended).

(For coding responses only)

1. The building owner/designer
2. Specifying engineer
3. The pump distributor
4. The pump manufacturer
5. Systems Integrator (Installation Contractor)
6. Someone else (Specify)
9. Don't Know

C4. Of those roles, who would say is the most important decision-maker in these types of projects?

(For coding responses only)

1. The building owner/designer
2. Specifying engineer
3. The pump distributor
4. The pump manufacturer

## Commercial ASD Penetration Market Research Study

5. Systems Integrator (Installation Contractor)
6. Someone else (Specify)
9. Don't Know

C5. Who is involved in the decision to pair a pump with an ASD for **Retrofit Projects?** (Open Ended)  
(For coding responses only)

1. The building owner/designer
2. Specifying engineer
3. The pump distributor
4. The pump manufacturer
5. Systems Integrator (Installation Contractor)
6. Maintenance Staff/Building Operators
7. Someone else (Specify)
9. Don't Know

C5a. Of those roles, who would say is the most important decision-maker in these types of projects?

(For coding responses only)

1. The building owner/designer
2. Specifying engineer
3. The pump distributor
4. The pump manufacturer
5. Systems Integrator (Installation Contractor)
6. Maintenance Staff/Building Operators
7. Someone else (Specify)
9. Don't Know

C6. Who is involved in the decision to pair a pump with an ASD for **Replace on Burnout projects?** (Open Ended)

(For coding purposes only)

The pump distributor

1. The building owner/designer
2. Specifying engineer
3. The pump distributor
4. The pump manufacturer

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- 5. Systems Integrator (Installation Contractor)
- 6. Maintenance Staff/Building Operators
- 7. Someone else (Specify)
- 9. Don't Know

C6a. Of those roles, who would say is the most important decision-maker for these types of projects?

(For coding responses only)

- 1. The building owner/designer
- 2. Specifying engineer
- 3. The pump distributor
- 4. The pump manufacturer
- 5. Systems Integrator (Installation Contractor)
- 6. Maintenance Staff/Building Operators
- 7. Someone else (Specify)
- 9. Don't Know

C7. What applications or conditions, if any, are **not viable** for pairing ASDs with commercial pumps?  
**(Open Ended)**

C8. Based on your experience, what percentage of commercial pumps and ASDs are paired within each of the following HP bins:

- 1. 1 to 5 HP \_\_\_\_\_%
- 2. 6-20 HP \_\_\_\_\_%
- 3. 21 to 50 HP \_\_\_\_\_%
- 4. 51 to 100 HP \_\_\_\_\_%
- 5. 101-200 HP \_\_\_\_\_%
- 6. Above 200 HP \_\_\_\_\_%
- 9. Don't Know

**Fan Pairings Questions.**

**Ask Questions C9- C19 for those respondents familiar with ASD pairings with non-embedded (stand-alone) commercial fans.**

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C9. Based on your experience, about what percentage of commercial non-embedded (stand-alone fan) /ASD pairings occur in the following stages (your estimate is fine):

- 1. During the planning/design process (pre-installation) \_\_\_\_\_%
- 2. At the time of purchase of the equipment \_ \_\_\_\_\_%
- 3. During the installation process \_\_\_\_\_%
- 4. Other (specify) \_\_\_\_\_%
- 9. Don't Know

C10. Based on your experience, about what percentage of commercial non-embedded (stand-alone) fan/ASD pairings fall within each of the following project types.

- 1. New Construction Projects \_ \_\_\_\_\_%
- 2. Retrofit Projects \_\_\_\_\_%
- 3. Replace on Burnout Projects \_\_\_\_\_%

C11. Who is involved in the decision to pair an ASD with a commercial stand-alone fan for **New Construction Projects? (Open Ended)** (For coding responses only)

- 1. The building owner/designer
- 2. Specifying engineer
- 3. The fan distributor
- 4. The fan manufacturer
- 5. The manufacturers' rep
- 6. Systems Integrator (Installation Contractor)
- 7. Someone else (Specify)
- 9. Don't Know

C12. Of those roles, who would say is the most important decision-maker in these types of projects? (For coding responses only)

- 1. The building owner/designer
- 2. Specifying engineer
- 3. The fan distributor
- 4. The fan manufacturer
- 5. The manufacturers' rep
- 6. Systems Integrator (Installation Contractor)
- 7. Someone else (Specify)
- 9. Don't Know

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C13. Who is involved in the decision to pair an ASD with a commercial non-embedded (stand-alone) fan for **Retrofit Projects (Open Ended)**?

(For coding purposes only)

1. The building owner/designer
2. The Specifying engineer
3. The fan distributor
4. The fan manufacturer
5. The manufacturers' rep
6. Systems Integrator (Installation Contractor)
7. Maintenance Staff/Building Operators
8. Someone else (Specify)
9. Don't Know

C14. Of those roles, who would say is the most important decision-maker in these types of projects?

(For coding purposes only)

1. The building owner/designer
2. The Specifying engineer
3. The fan distributor
4. The fan manufacturer
5. The manufacturers' rep
6. Systems Integrator (Installation Contractor)
7. Maintenance Staff/Building Operators
8. Someone else (Specify)
9. Don't Know

C15. Who is involved in the decision to pair an ASD with a commercial (non-embedded) stand-alone fan for **Replace on Burnout projects? (Open Ended)**

(For coding purposes only)

1. The building owner/designer
2. Specifying engineer
3. The pump distributor
4. The pump manufacturer

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5. Systems Integrator (Installation Contractor)
6. Building/Maintenance Staff
7. Someone else (Specify)
9. Don't Know

C16. Of those roles, who would say is the most important decision-maker for these types of projects?

(For coding responses only)

1. The building owner/designer
2. Specifying engineer
3. The pump distributor
4. The pump manufacturer
5. Systems Integrator (Installation Contractor)
6. Building/Maintenance Staff
7. Someone else (Specify)
9. Don't Know

C17. What applications or conditions, if any, are **not viable** for pairing ASDs with commercial non-embedded (stand-alone fans)? **(Open Ended)**

C18. Based on your experience, what percentage of commercial stand-alone fans and ASDs are paired within each of the following HP bins?

1. 1 to 5 HP      % \_\_\_\_\_
2. 6-20 HP      % \_\_\_\_\_
3. 21 to 50 HP      % \_\_\_\_\_
4. 51 to 100 HP      % \_\_\_\_\_
5. 101-200 HP      % \_\_\_\_\_
6. Above 200 HP      % \_\_\_\_\_
9. Don't Know

C19. What requirements do you consider when pairing a commercial stand-alone fan with an ASD?  
**(Read list: Mark all that apply)**

1. Cubic Feet per Minute (CFM)
2. AMCA Rating/Similar Industry Rating (e.g. FEI, FEG)
3. Type of load (constant vs. variable)
4. Cubic Feet Per Minute (CPM)
5. Noise reduction/noise level
6. Something else (Specify)

### **D. Key Factors Driving Pump -Drive Pairings**

- D1. Based on your experience, has the number of pairings of **ASDs with pumps** in the commercial market increased, decreased, or stayed the same in the past year?
1. (IF the number has changed, ask: What seems to be the primary reason for this change in ASD pairings with pumps?)
  2. (IF stayed the same or decreased: Why do you think that ASD pairings with pumps are not becoming more prevalent?)

#### **FAN Pairings**

- D3. Based on your experience, has the number of pairings of ASDs with stand-alone fans in the commercial market increased, decreased or stayed the same in the past year?
1. (IF the number has changed, ask: What seems to be the primary reasons for this change in the number of ASD pairings with fans?)
  2. (IF stayed the same or decreased: Why do you think that ASD pairings with fans are not becoming more prevalent?)

### **E. Barriers and Benefits to Pump-Drive and Fan-Drive Pairings**

- E1. What, if any, are particular factors in the Northwest market that notably impact, either positively or negatively, the decision to pair ASDs with commercial pumps and stand-alone fans, and why? (*Probe on the following; mark all that apply*)
1. Lack of awareness of ASD benefits
  2. Not sure how to install the ASD with a pump or fan
  3. Cost
  4. Availability
  5. Project size
  6. No interest from the main decision-maker
  7. ASDs and pumps or fans are purchased separately
  8. Other (specify)
- E3. If you could change anything within the Northwest commercial market to increase ASD adoption for commercial pumps, what would it be?" (Open Ended)
- E4. If you could change anything within the Northwest commercial market to increase ASD adoption for commercial stand-alone fans, what would it be?" (**Open Ended**)

**F. Closing**

- F1. Is there anything else you would like to add to our discussion today? **(Open Ended)**
  
- F2. In your opinion, what might your firm’s position and level of interest be if an opportunity arose to contribute sales data in support of energy efficiency efforts in the Northwest?

***Thank you for your time today. May I confirm your email so we can send you a \$50.00 e-gift card?***

***Confirm email address:*** \_\_\_\_\_

Thanks so much for your time!

## Appendix D: Interview Guide - Manufacturers/Manufacturers' Representatives (Mfg/Mfg Reps)

Table D-1: Quotas by Market Actor

State	Pump Mfgs	Pump Mfg Reps	Fan Mfg Reps
Total	3	3	4

Table D-2: Summary of Questions by Topic Area

	Question Number
<b>Respondent Recruitment and Qualifying Questions</b>	A1-A2
"Firmographic" Questions	B1- B6
Role in Pump/Fan Selection Process	C1-C19
<ul style="list-style-type: none"> <li>Pumps Expertise (C1-C9)</li> <li>Fans Expertise (C10-C19)</li> </ul>	
Decision-Making Process for Pump/Fan-Drive Pairings.	D1-D4
<ul style="list-style-type: none"> <li>Pumps Expertise (D1-D2)</li> <li>Fans Expertise (D3-D4)</li> </ul>	
Barriers to Pump/Fan-Drive Pairings	E1-E2
<ul style="list-style-type: none"> <li>Pumps Expertise (E1)</li> <li>Fans Expertise (E2)</li> </ul>	
Closing Thoughts	F1-F3

### Critical Research Objectives

- Assess the proportion of commercial pumps and fans that are paired with drives across the alliance's four-state region;
  - Types of applications in which these pairings are most common.
  - In what applications are these pairings expected to increase in the future?
- Assess the distribution, by horsepower and by application (retrofit / naturally occurring replacement due to equipment failure / new construction) of commercial pumps and fans that are paired with drives in the field across the alliance's four-state region;
  - What is the proportional bin distribution of regional (ID/MT/OR/WA) pairings of drives with commercial pumps and fans by horsepower bin?
  - How, if at all, does the application project/type distribution of units vary by pumps vs. fans?
- Explore and document the decision-making process for purchasing and installing drives paired with commercial pumps and fans, including triggers for consideration of drive/device pairing, steps typically taken, and influential factors throughout the process.

## Commercial ASD Penetration Market Research Study

### Respondent Recruitment

Hello, my name is \_\_\_\_\_ from Johnson Consulting Group. My firm has been hired by the Northwest Energy Efficiency Alliance (NEEA) to conduct a market research study in the commercial and industrial pumps and fans market; like yourself, to better understand the market dynamics of pairing Adjustable Speed Drives (ASDs) with commercial pumps (OR non-embedded (stand-alone) fans).

#### **When is a convenient time to talk?**

Day:

Time:

Link:

**Schedule call back.** I understand you're busy. When would be a good time to call back to schedule this interview?

**Contact Name** \_\_\_\_\_

**Company Name** \_\_\_\_\_

**Contact Email** \_\_\_\_\_

**Telephone Number** \_\_\_\_\_

**Interview Date** \_\_\_\_\_

**City** \_\_\_\_\_

**State** \_\_\_\_\_

**Type of Business**

### Introduction

Hello. Thanks for talking with me today. Can I record this interview to streamline the note-taking process? All your responses will be kept confidential. **(Proceed and record if permission is granted; if declining recording, continue the interview with notes only).** First, I'd like to get some information about your company.

### A. Qualifying Questions

A1. Is your firm involved in the manufacturing or distribution of Adjustable Speed Drives for (pumps or non-embedded fans **(ASK ONLY ABOUT PUMPS OR FANS, NOT BOTH)**)?

A1a. Yes- Manufacturer- PUMPS- ASK ONLY PUMP-RELATED QUESTIONS THROUGHOUT)

A1b. Yes- Manufacturer's Representative- PUMPS- (ASK ONLY PUMP-RELATED QUESTIONS THROUGHOUT)

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A1c. Yes- Manufacturer Rep- FANS- (ASK ONLY FAN-RELATED QUESTIONS THROUGHOUT)

1. No- **Thank and Terminate**
2. Don't Know – **Thank and Terminate**

*Terminate- thanks for your time today, but your organization doesn't meet our requirements for this interview. Have a good day.*

A2. Does your firm assist customers directly in pairing ASDs with pumps or fans?

1. Yes
2. No- **Thank and Terminate**
3. Don't Know-**Thanks and Terminate**

*Terminate- thanks for your time today, but your organization doesn't meet our requirements for this interview. Have a good day.*

### **B. "Firmographic" Questions**

B1. How long has your organization been in business?

\_\_\_\_\_ number of years (best estimate is fine)

B.2 FOR PUMPS ONLY: What percentage of your firm's annual revenues are related to the commercial pumps market?

\_\_\_\_\_ % (your best estimate is fine)

B3. FOR FANS ONLY: What percentage of your firm's annual revenues are related to the non-embedded (stand-alone) commercial fans market?

\_\_\_\_\_ % (your best estimate is fine)

#### **ASK ALL**

B4. In which states does your firm provide these services? (**Mark all that apply**)

1. Idaho
2. Montana
3. Oregon
4. Washington
5. Other (Specify)

If do not work in any of NEEA's service territories, **Thank and Terminate.**

Approximately how many employees does your firm have?

B5. Number of employees \_\_\_\_\_ entire organization

B6. Number of employees \_\_\_\_\_ Northwest (which we define as Idaho, Montana, Oregon, and Washington)

### C. Role in Market Characteristics of ASD Pairings

(Ask only questions that relate to the respondent's specific area of expertise, i.e., fans, pumps, or both)

(Pump expertise go to QC1-C9: Fan expertise only, Go to QC10-C19)

C1. About what percentage of commercial pump-ASD pairings occur in the following stages (*your estimate is fine*):

1. During the planning/design process (pre-installation) \_\_\_\_\_%
2. At the time of purchase of the equipment \_\_\_\_\_%
3. During the installation process. \_\_\_\_\_%
4. Other (specify) \_\_\_\_\_%

C2. Based on your experience, what percentage of commercial pump/ASD pairings fall within each of the following project types?

1. New Construction Projects \_\_\_\_\_%
2. Retrofit Projects \_\_\_\_\_%
3. Replace on Burnout \_\_\_\_\_%

C2a. Based on your best guess, how many ASDs are sold into the Northwest commercial market for

(a) Number of ASDs sold for Pumps \_\_\_\_\_

(b) Number of ASD sold for non-embedded (stand-alone) fans \_\_\_\_\_

C3. In your experience, who is involved in the decision to pair a pump with an ASD for **new construction projects? (Open Ended).**

(For coding responses only)

1. The building owner/designer
2. Specifying engineer
3. The pump distributor
4. The pump manufacturer
5. Systems Integrator (Installation Contractor)
6. Someone else (Specify)
9. Don't Know

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C4. Of those roles, who would say is the most important decision-maker in these types of projects?

(For coding responses only)

1. The building owner/designer
2. Specifying engineer
3. The pump distributor
4. The pump manufacturer
5. The pump manufacturer's representative
6. Systems Integrator (Installation Contractor)
7. Someone else (Specify)
9. Don't Know

C5. Who is involved in the decision to pair a pump with an ASD for **Retrofit Projects?** (Open Ended)

(For coding responses only)

1. The building owner/designer
2. Specifying engineer
3. The pump distributor
4. The pump manufacturer
5. The pump manufacturer's representative
6. Systems Integrator (Installation Contractor)
7. Maintenance Staff/Building Operators
8. Someone else (Specify)
9. Don't Know

C5a. Of those roles, who would say is the most important decision-maker in these types of projects?

(For coding responses only)

1. The building owner/designer
2. Specifying engineer
3. The pump distributor
4. The pump manufacturer
5. The pump manufacturer's representative
6. Systems Integrator (Installation Contractor)
7. Maintenance Staff/Building Operators
8. Someone else (Specify)
9. Don't Know

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C6. Who is involved in the decision to pair a pump with an ASD for **Replace on Burnout projects?** (Open Ended)  
(For coding purposes only)

1. The building owner/designer
2. Specifying engineer
3. The pump distributor
4. The pump manufacturer
5. The pump manufacturer's representative
6. Systems Integrator (Installation Contractor)
7. Maintenance Staff/Building Operators
8. Someone else (Specify)
9. Don't Know

C6a. Of those roles, who would say is the most important decision-maker for these types of projects?  
(For coding responses only)

1. The building owner/designer
2. Specifying engineer
3. The pump distributor
4. The pump manufacturer
5. The pump manufacturer's representative
6. Systems Integrator (Installation Contractor)
7. Maintenance Staff/Building Operators
8. Someone else (Specify)
9. Don't Know

C7. What applications or conditions, if any, are **not viable** for pairing ASDs with commercial pumps? (Open Ended)

C8. Based on your experience, what percentage of commercial pumps and ASDs are paired within each of the following HP bins:

1. 1 to 5 HP      % \_\_\_\_\_
2. 6-20 HP      % \_\_\_\_\_
3. 21 to 50 HP    % \_\_\_\_\_
4. 51 to 100 HP    % \_\_\_\_\_
5. 101-200 HP    % \_\_\_\_\_
6. Above 200 HP    % \_\_\_\_\_
9. Don't Know

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**Fan Pairings Questions.**

**Ask Questions C9- C19 for those respondents familiar with ASD pairings with non-embedded (stand-alone) commercial fans.**

C9. Based on your experience, what percentage of commercial non-embedded (stand-alone fan) /ASD pairings occur in the following stages (your estimate is fine):

- 1. During the planning/design process (pre-installation) \_\_\_\_\_%
- 2. At the time of purchase of the equipment \_\_\_\_\_%
- 3. During the installation process \_\_\_\_\_%
- 4. Other (specify) \_\_\_\_\_%
- 9. Don't Know

C10. Based on your experience, what percentage of commercial non-embedded (stand-alone) fan/ASD pairings fall within each of the following project types.

- 1. New Construction Projects \_\_\_\_\_%
- 2. Retrofit Projects \_\_\_\_\_%
- 3. Replace on Burnout Projects \_\_\_\_\_%

C11. Who is involved in the decision to pair an ASD with a commercial non-embedded (stand-alone) fan for **New Construction Projects? (Open Ended)**

(For coding responses only)

- 1. The building owner/designer
- 2. Specifying engineer
- 3. The fan distributor
- 4. The fan manufacturer
- 5. The manufacturers' rep
- 6. Systems Integrator (Installation Contractor)
- 7. Someone else (Specify)
- 9. Don't Know

C12. Of those roles, who would say is the most important decision-maker in these types of projects?

(For coding responses only)

- 1. The building owner/designer
- 2. Specifying engineer
- 3. The fan distributor
- 4. The fan manufacturer

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5. The manufacturers' rep
6. Systems Integrator (Installation Contractor)
7. Someone else (Specify)
9. Don't Know

C13. Who is involved in the decision to pair an ASD with a commercial non-embedded (stand-alone) fan for **Retrofit Projects (Open Ended)**?

(For coding purposes only)

1. The building owner/designer
2. The Specifying engineer
3. The fan distributor
4. The fan manufacturer
5. The manufacturers' rep
6. Systems Integrator (Installation Contractor)
7. Maintenance Staff/Building Operators
8. Someone else (Specify)
9. Don't Know

C14. Of those roles, who would say is the most important decision-maker in these types of projects?

(For coding purposes only)

1. The building owner/designer
2. The Specifying engineer
3. The fan distributor
4. The fan manufacturer
5. The manufacturers' rep
6. Systems Integrator (Installation Contractor)
7. Maintenance Staff/Building Operators
8. Someone else (Specify)
9. Don't Know

C15. Who is involved in the decision to pair an ASD with a commercial (non-embedded) stand-alone fan for **Replace on Burnout projects? (Open Ended)**

(For coding purposes only)

1. The building owner/designer
2. Specifying engineer

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3. The fan distributor
4. The fan manufacturer
5. The manufacturer's rep
6. Systems Integrator (Installation Contractor)
7. Building/Maintenance Staff
8. Someone else (Specify)
9. Don't Know

C16. Of those roles, who would say is the most important decision-maker for these types of projects?  
(For coding responses only)

1. The building owner/designer
2. Specifying engineer
3. The fan distributor
4. The fan manufacturer
5. The fan manufacturer's rep
6. Systems Integrator (Installation Contractor)
7. Building/Maintenance Staff
8. Someone else (Specify)
9. Don't Know

C17. What applications or conditions, if any, are **not viable** for pairing ASDs with commercial non-embedded (stand-alone fans)? **(Open Ended)**

C18. Based on your experience, what percentage of commercial stand-alone fans and ASDs are paired within each of the following HP bins?

1. 1 to 5 HP      % \_\_\_\_\_
2. 6-20 HP      % \_\_\_\_\_
3. 21 to 50 HP    % \_\_\_\_\_
4. 51 to 100 HP    % \_\_\_\_\_
5. 101-200 HP    % \_\_\_\_\_
6. Above 200 HP    % \_\_\_\_\_
9. Don't Know

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C19. What requirements do you consider when pairing a commercial stand-alone fan with an ASD?

(Read list: Mark all that apply)

1. Cubic Feet per Minute (CFM)
2. AMCA Rating/Similar Industry Rating (e.g. FEI, FEG)
3. Type of load (constant vs. variable)
4. Cubic Feet Per Minute (CPM)
5. Noise reduction/noise level
6. Something else (Specify)

### ***D. Key Factors Driving Pump -Drive Pairings***

D1. Based on your best guess, about what percentage of commercial pumps in the Northwest are currently paired with ASDs?

D2. Based on your experience, has the number of pairings of **ASDs with pumps** in the commercial market increased, decreased, or stayed the same in the past year?

1. (IF the number has changed, ask: What seems to be the primary reason for this change in ASD pairings with pumps?)
2. (IF stayed the same or decreased: Why do you think that ASD pairings with pumps are not becoming more prevalent?)

### **FAN Pairings**

D3. Based on your best guess, about what percentage of commercial stand-alone fans in the Northwest are currently paired with ASDs?

D4. Based on your experience, has the number of pairings of ASDs with non-embedded (stand-alone) fans in the commercial market increased, decreased, or stayed the same in the past year?

1. (IF the number has changed, ask: What seems to be the primary reasons for this change in the number of ASD pairings with fans?)
2. (IF stayed the same or decreased: Why do you think that ASD pairings with fans are not becoming more prevalent?)

### **E. Barriers and Benefits to Pump-Drive and Fan-Drive Pairings**

- E1. What, if any, are particular factors in the Northwest market that notably impact, either positively or negatively, the decision to pair ASDs with commercial pumps and stand-alone fans, and why? (*Probe on the following; mark all that apply*)
1. Lack of awareness of ASD benefits
  2. Not sure how to install the ASD with a pump or fan
  3. Cost
  4. Availability
  5. Project size
  6. No interest from the main decision-maker
  7. ASDs and pumps or fans are purchased separately
  8. Other (specify)
- E2. If you could change anything within the Northwest commercial market to increase ASD adoption for commercial pumps, what would it be?" (**Open Ended**)
- E3. If you could change anything within the Northwest commercial market to increase ASD adoption for commercial non-embedded (stand-alone) fans, what would it be?" (**Open Ended**)

### **F. Closing**

- F1. Does your firm typically track ASD sales and installations in general regarding the number of units, or include project details such as the unit and project characteristics?
1. Track general level only- Go to F3
  2. Include project-level details- Go to F2
  3. Don't Track ASD Sales at all- Go to F3
- F2. In your opinion, what might your firm's position and level of interest be if an opportunity arose to contribute sales data in support of energy efficiency efforts in the Northwest?
- F3. Is there anything else you would like to add to our discussion today? (**Open Ended**)

***Thank you for your time today.***