Water and Wastewater Pump Replacement Industry Standard Practice & Measure Package Update

Final Report

ET24SWE0038

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Disclaimer

Executive Summary

The existing SWWP004-03 Measure Package currently applies only to pumps used for clean water applications, even though similar pump types are also used in wastewater applications. The reason why wastewater pumps were not considered initially is because the baseline Pump Energy Index (PEI) criteria used in the Measure Package is from the Department of Energy (DOE)-developed Energy Conservation Standards. These standards only apply to their definition of "clean water pumps."

Wastewater pumping of water treated to secondary treatment standards or better meets the DOE definition, but is not necessarily subject to the standard. Additionally, any wastewater pumps cleared of rags, grit, and other solids that cannot pass through a bar screen are of similar design to wastewater pumps located in subsequent treatment processes at a wastewater treatment plant. Therefore, non-solids handling wastewater pumps also go through the same PEI testing as clean water pumps. This creates a critical need for a comparable measure package for wastewater pumps, to encourage the adoption of high-efficiency pumps in the wastewater market segment. A previous CalNEXT Emerging Technologies (ET) study — ET23SWE0039: Wastewater Pump Measure Development — also identified this gap, recommending the development of a deemed measure package for wastewater pumps. One purpose of this market study is to establish the industry standard practice (ISP) baseline PEI rating for both clean water and wastewater pumps for future measure package updates. The second purpose is to use the ISP findings to update the existing SWWP004 Measure Package.

To conduct the ISP study, the project team developed several survey questionnaires targeting a range of stakeholders, including end-use customers, pump and variable frequency drive (VFD) manufacturers, distributors, installers, pump testers, and subject matter experts. The intent of the surveys was to obtain feedback from pump professionals on their knowledge of the DOE Energy Conservation Standards, the end-use customer markets they serve, common pump model purchases, and the drivers for pump equipment purchases. Participant outreach targeted at least 16 survey participants, covering pumps being installed in agricultural, commercial, industrial, municipal (clean water), residential, and wastewater applications and all pump classes.

Survey results show that a majority of pump end-use customers are not aware of the PEI rating, and pump efficiency tends to be a secondary factor in the decision-making process when purchasing new pumps. The key factors driving purchase decisions are pump reliability and initial cost. Additionally, even vendors familiar with the PEI rating often do not include it in equipment specifications or recommend pumps based on this rating. Only one survey respondent was knowledgeable about the PEI ratings of commonly sold pumps in California, and this individual relied on data from the Northwest Energy Efficiency Alliance (NEEA) to determine PEIs.

Vendors contacted for this study did not provide pump sales data nor PEI ratings of commonly sold pumps in California. The project team received a summary of sales data from six pump manufacturers in the Northwest region from the 2021 and 2022 period. This data, collected from distributors participating in NEEA's Extended Motor Products (XMP) program, includes average PEIs for all pumps sold by these manufacturers. The data is categorized by pump types and maximum pump speed for constant speed pumps. The average PEIs from this sales data ranks at the 76th percentile of pump PEIs listed in the DOE's Pump Compliance Certification Database, meaning only

about 24 percent of pumps listed in the DOE database are more efficient than the average PEIs from the NEEA sales database. This suggests that the XMP sales data does not accurately represent what pump sales would look like without an incentive program in place.

Survey responses revealed differences between pumps sold for the wastewater market and those for the clean water market. However, there is no indication that the rated PEIs of wastewater pumps differ from those of clean water pumps.

Based on the above discussions, it is recommended to use the recent DOE Pump Compliance Certification Database to update the baseline PEI values in the SWWP004 Measure Package for clean water and wastewater pumps. It is also recommended to establish the baseline PEI values at the 25th percentile of the DOE database for each pump size range and control strategy. This approach balances the survey results, which indicated that customers are largely unaware of PEIs and do not consider PEI in their purchasing decisions, and the PEI ratings of all pumps in the DOE database that exceeded the minimum DOE standards.

Abbreviations and Acronyms

Acronym	Meaning
CPUC	California Public Utilities Commission
DOE	Department of Energy
ECS	Energy Conservation Standard
EE	Energy Efficiency
ESCC	End Suction Closed Coupled
ESFM	End Suction Frame Mounted
ET	Emerging Technology
eTRM	Electronic Technical Reference Manual
HI	Hydraulic Institute
HP	Horsepower
HTR	Hard-to-Reach
IL	In-line
IOU	Investor-Owned Utility
ISP	Industry Standard Practice
kWh	Kilowatt-hour
NEEA	Northwest Energy Efficiency Alliance
PA	Program Administrator
PEI	Pump Energy Index
PG&E	Pacific Gas & Electric
RSV	Radially split, multistage, vertical, in-line casing diffuser
SCE	Southern California Edison

Acronym	Meaning
ST	Submersible Turbine
TPM	Technology Priority Map
WWTP	Wastewater Treatment Plant

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Introduction

The California Electronic Technical Reference Manual (eTRM) serves as the official repository of California's energy efficiency measure data[1] and is now the sole source for energy efficiency measure package development, submittal, review, and publication. One measure available in the eTRM is the Water Pump Upgrade, Measure ID: SWWP004-03, which involves installation of a clean water pump that exceeds specific Pump Energy Index (PEI) criteria. The PEI represents the pump's weighted average performance at specific load points and normalized with respect to the performance of a minimally compliant pump.

Under Title 10 Section 431.462, the United States (U.S.) Department of Energy (DOE) developed the Energy Conservation Standard (ECS) for commercial, industrial, and agricultural clean water pumps. According to this standard, all constant speed clean water pumps sold on or after January 2020 must have an ECS label with a PEI rating of 1.0 or lower. It is important to note that, since 2016, pumps have been sold with ECS labels that include PEI values, as part of DOE's efforts to standardize pump efficiency requirements and to encourage the market shift toward high-efficiency pumps.

The existing SWWP004-03 Measure Package currently applies only to pumps used for clean water applications, even though similar pump types are also used in wastewater applications and undergo the same rigorous PEI rating tests. This creates a critical need for a comparable measure package for wastewater pumps to encourage the adoption of high-efficiency pumps in the wastewater market segment. A previous CalNEXT Emerging Technologies (ET) study — ET23SWE0039: Wastewater Pump Measure Development — also identified this gap, recommending the development of a deemed measure package for wastewater pumps.

Additionally, the existing SWWP004-03 Measure Package, approved through December 31, 2024, uses the DOE-mandated PEI rating as a measure baseline to calculate the electric energy savings. The California Public Utilities commission (CPUC) has requested to conduct a Market-Based Industry Standard Practice (ISP) study in accordance with the latest CPUC ISP Guidance v3.1[22] to establish and update the baseline PEI in future measure package updates. Establishing the true ISP baseline PEI rating for both clean water and wastewater pumps is required for determining the measure baseline and calculating energy savings. This is essential for the design and implementation of new energy efficiency programs and success of existing programs. Therefore, a market-based ISP study is needed to specify the ISP baseline for clean water and wastewater pumps among agricultural customers; municipal clean water and wastewater customers; commercial irrigators; and heating, ventilation, and air-conditioning (HVAC) pumping systems.

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[1] https://www.caetrm.com

[2] https://file.ac/41slG_rLPjs/

Background

Nearly one-fifth of electricity generated in California supports water-related end uses[3]. The U.S. DOE has been developing efficiency standards for numerous equipment types, and recently included water pumps as part of this work. In order to standardize pump efficiency requirements, DOE facilitated an amendment to the Energy Policy and Conservation Act (EPCA) of 1975, Part C of Title III which established the "Energy Conservation Program for Certain Industrial Equipment," including pumps.[4] The effective date of the rule for pumps was March 28, 2016, but compliance with the standards went into effect on January 27, 2020.[5] These Energy Conservation Standards apply to commercial, industrial, and agricultural "clean water pumps."

The Hydraulic Institute (HI) published HI 40.6—Methods for Rotodynamic Pump Efficiency Testing and established the pump energy efficiency rating system, PEI, in alignment with the standards. The scope of the standards is specified at 10 CFR 431.464 and 10 CFR 431.465,[6] respectively, and concerns what is referred to as clean water pumps.

The following categories and characteristics of clean water pumps are included in the above standards:

- Pump categories
  - End suction frame mounted/own bearings (ESFM);
  - End suction close coupled (ESCC);
  - In-line (IL);
  - Radially split, multistage, vertical, in-line casing diffuser (RSV);
  - Submersible turbine (ST);
  - Radially split, multi-stage, horizontal, end-suction diffuser casing (RSHES);
  - Radially split, multi-stage, horizontal, in-line diffuser casing (RSHIL);
  - Small vertical in-line (SVIL); and
  - Vertical turbine (VT) pumps.
- Pump characteristics

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[3] California Energy Commission (CEC). 2005. California's Water – Energy Relationship . CEC-700-2005-011-SF. https://www.caetrm.com/media/reference-documents/CEC-700-2005-011-SF.PDF

[4] S.622 - Energy Policy and Conservation Act of 1975. Title III. Part C. https://www.congress.gov/bill/94th-congress/senate-bill/622/text

[5] Robinson, Reece. 2019. 2020 Pump Efficiency, DOE Requirements. https://www.pumpsandsystems.com/2020-pump-efficiency-doe-requirements

[6] https://www.ecfr.gov/current/title-10/chapter-II/subchapter-D/part-431/subpart-Y?toc=1

- Flow rate of 25 gpm or greater at best efficiency point (BEP) and full impeller diameter;
- Maximum head of 459 feet at BEP and full impeller diameter and the number of stages required for testing (see section 1.2.2 of appendix A of §431.464);
- Design temperature range wholly or partially in the range of 15 to 250°F;

- Designed to operate with either:
  - A two- or four- or six-pole induction motor, or
  - A non-induction motor with a speed of rotation operating range that includes speeds of rotation between 2,880 and 4,320 revolutions per minute (rpm) and/or 1,440 and 2,160 rpm and/or 960 and 1,439 revolutions per minute, and in each case, the driver and impeller must rotate at the same speed;
- For ST, and VT pumps, a six-inch or smaller bowl diameter; and
- For ESCC, and ESFM pumps, a specific speed less than or equal to 5,000 when calculated using U.S. customary units.

A "clean water pump" is defined as a pump that is designed for use in pumping water with a maximum nonabsorbent free solid content of 0.016 pounds per cubic foot, and with a maximum dissolved solid content of 3.1 pounds per cubic foot. This is based on the premise that the total gas content of the water does not exceed the saturation volume and disregards any additives necessary to prevent the water from freezing at a minimum of 14°F. Wastewater treated to the National Pollutant Discharge Elimination System discharge permit limits for surface water discharge exceeds the water quality standard specified by the clean water definition. Wastewater is treated to the point of meeting the clean water definition during secondary treatment, as depicted in stage 5 of Figure 1, which shows the stages of treatment at a typical WWTP (WWTP).

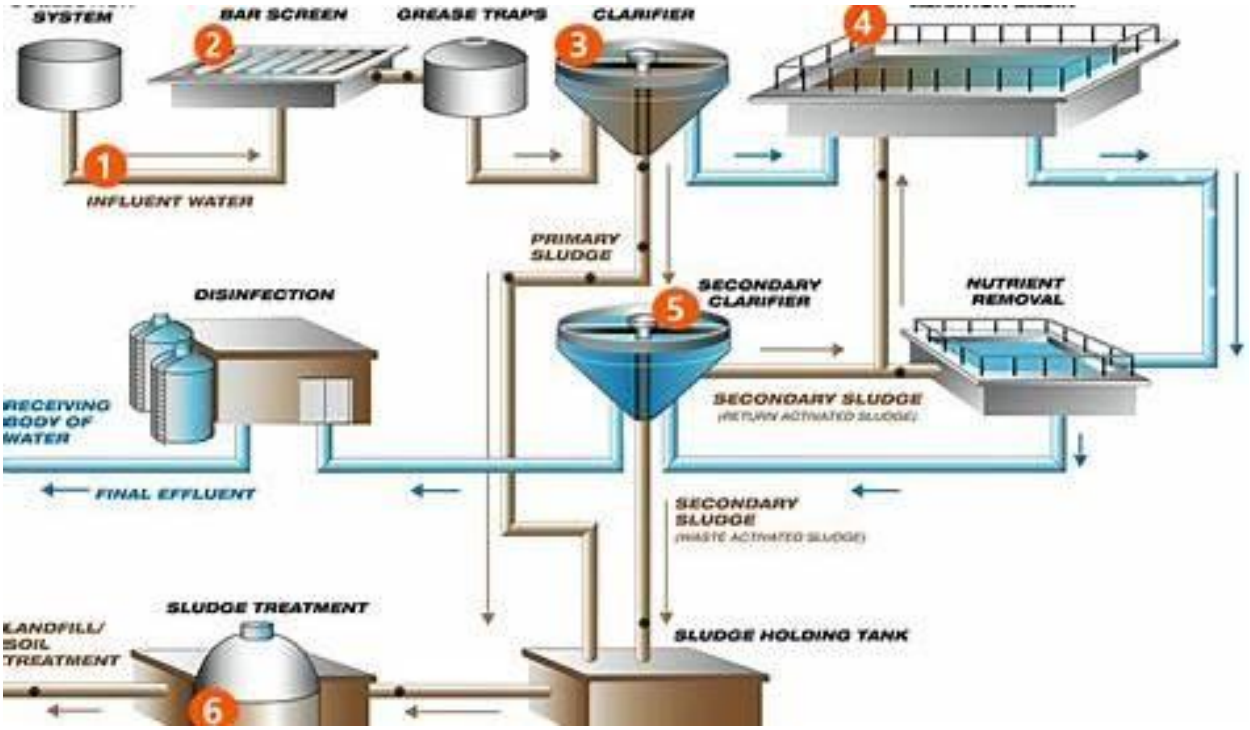

Figure 1: Wastewater treatment plant process diagram

Source: (Avijit Mallik 2018)

Pump models that meet DOE's Pump Energy Conservation Standards are being installed at WWTPs, pumping fluids with solid content that meet the clean water pump definition. These pump applications are not required to meet DOE's ECS. For this reason, they were excluded from the SWWP004 Water Pump Upgrade Measure Package.

As defined by DOE, "clean water pumps" are found in irrigation, wastewater pumping, water distribution systems, and HVAC pumping systems (chiller pumps, boiler plant pumps, and cooling tower pumps). The above standard does not apply to submersible vertical turbine pumps greater than 75 HP, due to bowl diameter limits. While wastewater pumps do not pump clean water and are not applicable to the current offering, both pump types share similar energy efficiency challenges. Including wastewater pumps in the existing deemed offering would address the gap in the measure offering and expand the reach of this measure into the wastewater industry.

The water pump upgrade measure package has had limited historical market adoption despite its availability for program adoption in January 2020, which is when compliance with DOE's ECS for pumps took effect. The baseline PEIs became more efficient from Version 1 to Version 2 of the measure package, as shown in Table 1 below.

Table 1: Comparison of Baseline PEI with Measure PEI by Statewide Measure Package Version[7]

Measure Package ID	Effective Dates	Pump Motor Horsepower, Control Strategy	Baseline PEI	Measure PEI
SWWP004-01	1/1/20-10/11/22	1-200 HP, Constant Speed	0.96-1.00	<0.96
SWWP004-02	10/12/22-12/31/23	1-50 HP, Constant Speed	0.94	0.88 - 0.92
SWWP004-03	1/1/24-12/31/24	1-50 HP, Constant Speed	0.94	0.88 - 0.92
SWWP004-02	10/12/22-12/31/23	>50-250 HP, Constant Speed	0.95	0.89 - 0.93
SWWP004-03	1/1/24-12/31/24	>50-250 HP, Constant Speed	0.95	0.89 - 0.93
SWWP004-01	1/1/20-10/11/22	1-200 HP, Variable Speed	0.49-0.66	<0.49
SWWP004-02	10/12/22-12/31/23	1-15 HP, Variable Speed	0.47	0.41 - 0.45
SWWP004-03	1/1/24-12/31/24	1-15 HP, Variable Speed	0.47	0.41 - 0.45
SWWP004-02	10/12/22-12/31/23	>15-250 HP, Variable Speed	0.49	0.43 - 47
SWWP004-03	1/1/24-12/31/24	>15-250 HP, Variable Speed	0.49	0.43 -4 7

Table 1 shows Version 1 of the measure package used the DOE Pump ECS with a PEI of 1.00 for constant speed pumps and 0.66 for variable load pump as the baseline. However, Version 2 of the measure package reduced the baseline PEI to 0.94-0.95 for constant speed pumps and 0.47-0.49 for variable speed pumps at various pump motor HPs. “Per direction from the CPUC the baseline PEI ratings are representative of the most commonly available (model) of the data set for each control strategy and pump horsepower range”.

[7] eTRM. SWWP004 Water Pump Upgrade. Base Case Description. Versions 1, 2, and 3.

Version 3 of the Water Pump Upgrade measure package was an extension of Version 2 with cost updates. Therefore, Table 2 below shows the baseline and measure PEIs used in the SWWP004-03 measure package are the same as those in Version 2.

Table 2: SWWP004-03 Base Case Descriptions and Comparison of Baseline and Measure PEIs

Pump Motor HP Range	Baseline PEI	Measure PEI Range	Control Strategy	Measure ID	Existing/Standard Description
1-15	0.47	PEI <= 0.41	Variable Speed	R	Standard clean water pump, PEI 0.47, variable speed, 1 <= hp <= 15
1-15	0.47	PEI <= 0.43	Variable Speed	Q	Standard clean water pump, PEI 0.47, variable speed, 1 <= hp <= 15
1-15	0.47	PEI <= 0.45	Variable Speed	P	Standard clean water pump, PEI 0.47, variable speed, 1 <= hp <= 15
1-15	0.94	PEI <= 0.88	Constant Speed	I	Standard clean water pump, PEI 0.94, constant speed, 1 <= hp <= 15
1-15	0.94	PEI <= 0.90	Constant Speed	H	Standard clean water pump, PEI 0.94, constant speed, 1 <= hp <= 15
1-15	0.94	PEI <= 0.92	Constant Speed	G	Standard clean water pump, PEI 0.94, constant speed, 1 <= hp <= 15
>15-50	0.49	PEI <= 0.43	Variable Speed	U	Standard clean water pump, PEI 0.49, variable speed, 15 < hp <= 50
>15-50	0.49	PEI <= 0.45	Variable Speed	T	Standard clean water pump, PEI 0.49, variable speed, 15 < hp <= 50
>15-50	0.49	PEI <= 0.47	Variable Speed	S	Standard clean water pump, PEI 0.49, variable speed, 15 < hp <= 50
>15-50	0.94	PEI <= 0.88	Constant Speed	L	Standard clean water pump, PEI 0.94, constant speed, 15 < hp <= 50
>15-50	0.94	PEI <= 0.90	Constant Speed	K	Standard clean water pump, PEI 0.94, constant speed, 15 < hp <= 50
>15-50	0.94	PEI <= 0.92	Constant Speed	J	Standard clean water pump, PEI 0.94, constant speed, 15 < hp <= 50
>50-250	0.49	PEI <= 0.45	Variable	W	Standard clean water pump, PEI 0.49,

Pump Motor HP Range	Baseline PEI	Measure PEI Range	Control Strategy	Measure ID	Existing/Standard Description
			Speed		variable speed, 50 < hp <= 250
>50-250	0.49	PEI <= 0.47	Variable Speed	V	Standard clean water pump, PEI 0.49, variable speed, 50 < hp <= 250
>50-250	0.95	PEI <= 0.89	Constant Speed	O	Standard clean water pump, PEI 0.95, constant speed, 50 < hp <= 250
>50-250	0.95	PEI <= 0.91	Constant Speed	N	Standard clean water pump, PEI 0.95, constant speed, 50 < hp <= 250
>50-250	0.95	PEI <= 0.93	Constant Speed	M	Standard clean water pump, PEI 0.95, constant speed, 50 < hp <= 250

Source: eTRM. SWWP004-03 Water Pump Upgrade. Base Case Description.

There are issues with using the HI's database of tested pumps to determine the baseline PEI by horsepower range. This provides equal weighting to each pump's model within HI's tested pump database within specified pump motor horsepower ranges, which is a faulty assumption, and skews the baseline PEI results. This method does not consider what market these pumps are meant for, the pump classification differences, pump design flow and head, or which models are commonly being purchased without utility incentive support. Additionally, the process of getting a pump model listed in the HI's database is costly and takes one to two years, so while a pump may be compliant, there is a delay as to when the model ends up being listed, so pumps may be sold and installed, but do not have a listed PEI rating on their pump specifications until they have completed the listing process with HI. The pump manufacturers who completed the testing process first tended to be those with more compliant pump models, while other pump manufacturers needed to perform research and development of their pump models and to discontinue some pump models before they were ready to undergo HI testing. Therefore, the method for determining the baseline PEI in Version 2 and Version 3 of the measure package needs to be reassessed. Since it is unclear what PEI rating is ISP, a market-based study is needed.

Overall, this project will improve the deemed measure offerings by including wastewater pumps, provide a draft version of the Water Pump Updated measure package to extend the measure eligibility beyond 2024, and develop a market-based ISP study to support future versions of the measure package.

Objectives

This project has two primary objectives:

1. Conduct a market-based ISP study in accordance with the CPUC guidance to determine the baseline pumping PEI ratings for agricultural, municipal clean water and wastewater customers, commercial irrigators, and HVAC pumping systems such as chiller pumps, boiler plant hot water recycle pumps, and cooling tower systems.
2. The original plan for this study included utilizing the findings from the ISP study to update the SWWP004 – Water Pump Upgrade Measure Package for program year 2025 and beyond. However, based on recent CPUC guidance, the program year 2025 measure package will be updated using the PEI baseline used in the existing measure package. The findings from the above ISP study will be used for updating the same measure package for program year 2026 and beyond through the next phase of this study.

Methodology and Approach

Survey Questionnaire

The project team developed several ISP study survey questionnaires (see Appendix A: ISP Survey Questionnaire

) targeted for various stakeholders to collect data on pump purchase trends as it relates to the PEI ratings for both clean water and wastewater pumps. The survey questions were curated based on the participant types such as subject matter experts, end-use customers, pump manufacturers, and pump and VFD vendors. The survey questions were also carefully prepared to capture typical current trends in purchasing or practice without directly asking or leading the interviewees toward specific responses. The questionnaire covers a range of topics, from participants' experiences regarding the pumping systems and various market segments to more specific questions on typical purchasing practices based on pump size, market segments, PEI ratings, controls, and more. Additionally, the questionnaire included important criteria influencing pump selection and the availability of high-efficiency pumps. The survey instrument was reviewed and approved by the lead utility (SCE) and the CPUC.

Survey Participants

The project team engaged a range of stakeholders for this study, including water and wastewater customers, pump and VFD manufacturers, vendors, pump testers, installers, and subject matter experts. Interviewees were carefully selected from diverse backgrounds, ensuring they were well-qualified to provide valuable insights into current trends in the purchase, installation, and operation of clean water and wastewater pumps.

Participant Outreach

The primary data collection method consisted of telephone or video calls, with email offered as an alternative if preferred by survey participants. Initial contact with potential candidates was made via email, offering a complimentary $50 gift card as an incentive for participation. While this outreach generated some responses, a follow-up effort through personal phone calls significantly increased the response rate. Additionally, some interviewees provided referrals to other potential participants,

which further supported recruitment efforts. Table 3 below summarizes the number of participants contacted and recruited from each stakeholder group.

Table 3: Survey Participants' Characteristics

Stakeholder Type	Number Contacted	Selected for Interview	Completed Interviews
End-use customer	5	3	3
Subject Matter Expert/Consultant	28	6	5
Manufacturer	21	4	4
Distributor	9	2	2
Vendor	59	4	3
Totals	**122**	**19**	**17**

Source: ISP survey responses of 17 participants.

ISP Study

Participant Demographics

The survey aimed to understand participants' experience with relevant pump systems and how their expertise aligned with the survey objectives. The participants were asked general questions about their work with pump systems, including:

1. Their years of experience with pump systems.
2. The specific "clean water pump" classes their company sells.
3. The market sectors they serve.

The survey included five distinct pump classes: end suction close coupled (ESCC), end suction frame mounted (ESFM), in-line close coupled and split coupled pumps (IL), radially split multistage vertical in-line casing diffuser pumps (RSV), and submersible vertical turbines (ST).

The six market sectors specified in the survey are: agricultural, commercial, industrial, municipal, residential, and wastewater.

Table 4 shows the average median, minimum, and maximum of the 15 survey participant responses, and Table 5 shows the various types of experience the participants have in pumping systems.

Table 4: Survey Participants' Characteristics

Demographics	Average	Median	Minimum	Maximum
Years of Experience	19.88	19	5	44
# of Pump Classes Sold	5	5	5	5
Sectors Served	5 of 6	6	4	6

Table 5: Survey Participants' Experience

Survey Participants	Experience	Years of Experience
1	Managing large municipalities, contracts with cities, design well pumps, booster stations, modifying and engineer new products, alternatives VFDs, improve efficiency	40
2	Testing pumps, irrigation systems, energy efficiency in pumping systems, vibration analysis, pump efficiency test	35
3	Production supervisor/manager, pumping plans, engineering work	44
4	Works with pump manufacturers, stakeholders to go through the HI testing process to add PEI ratings to their pump specifications and facilitates adding the products into the HI Database	7
5	Facilitates the training of the DOE pump conservation standards and collaborates with energy efficiency program offering	25
6	Oversees the team handling the HI testing process and stakeholder training	20
7	Systems integration/selection, component selection, and sales	7
8	Sales and consulting – food and beverage, chemical distribution, bio farm, sanitary, industrial	11
9	Sales – food and beverage	9
10	Sales – centrifugal pumps, wastewater pumps, positive displacement pump manufacturer for industry application	20
11	Consultant firm for energy sector, water treatment, business development, product management	15
12	Repairs, service work	32
13	Consulting for 13 yrs designing pump stations, water and wastewater systems, and currently focusing on optimization of said systems	19
14	Water treatment and pumping operations, extensively in groundwater wells, vertical turbines, booster pumps, inline and split case pumps. No experience in wastewater.	19
15	Developed a program for the Resource Technology Framework (RTF), managing data collection for 400 pumps in the Northwest, including pump characteristics, load profiles, and operational hours. The study was published by the Northwest Energy Efficiency Alliance (NEEA). Launched a midstream program, recruiting manufacturer reps, energy efficiency experts, and PEI professionals, and impact.	5
16	Supervising districts production, Management of pump operating systems including engineering, the repair and upgrade of both well pumps and booster pumps. Management of water treatment for pumping system involved with source water distribution.	15
17	Supervising districts production, Management of pump operating systems including engineering, the repair and upgrade of both well pumps and booster pumps.	15

Variation in Wastewater Pumps

Survey participants with experience in wastewater systems were asked about the differences between clean water and wastewater pumps. All respondents agreed that significant variations exist. These differences include the type of casing and impeller used, with wastewater systems often utilizing grinder pumps, while clean water systems typically rely on low-speed (RPM) vertical turbines. Additionally, participants noted that booster pumps are more commonly used in wastewater facilities than in clean water systems.

Participants also noted that wastewater pumps typically have a larger passthrough capacity and are designed with direct inlets, without the screening commonly found on vertical turbine pumps used in clean water applications. They mentioned that specialized wastewater pumps, such as chopper pumps designed for handling solids, would likely have higher, less efficient PEI ratings if tested. However, pumps used in primary and later stages of wastewater treatment would have PEI ratings similar to those of clean water pumps.

One participant added that their company deals with larger clean water pumps in the 50 to 250 HP range, while the wastewater pumps served are generally smaller, typically in the 15 to 50 HP range. Despite these differences, none of the variations in wastewater pumps were found to affect their PEI rating, as evaluated by the HI.

Key Criteria Considered by Customers When Purchasing New Pumps

The survey investigated the top five criteria customers prioritize when purchasing new pumps. These criteria included:

- Initial cost
- Operating cost/efficiency
- Availability, prior experience/spare parts consistency/manufacturer
- Type consistency, and reliability
- Other

Survey respondents were asked to rank purchasing criteria from 1 to 5 with a rank of 1 being the most important. One respondent noted that “form, fit and function” is a significant factor that falls under the “other” category. The results showed that the most important purchasing criterion was the **reliability** of the new pump, followed closely by the **initial cost**. Several participants noted that in cases of unexpected pump failure, the initial cost becomes the primary consideration. After reliability and initial cost, the remaining criteria were ranked in the following order: **operating cost/efficiency**, **availability**, and **prior experience**. These rankings are shown in Figure 2 below.

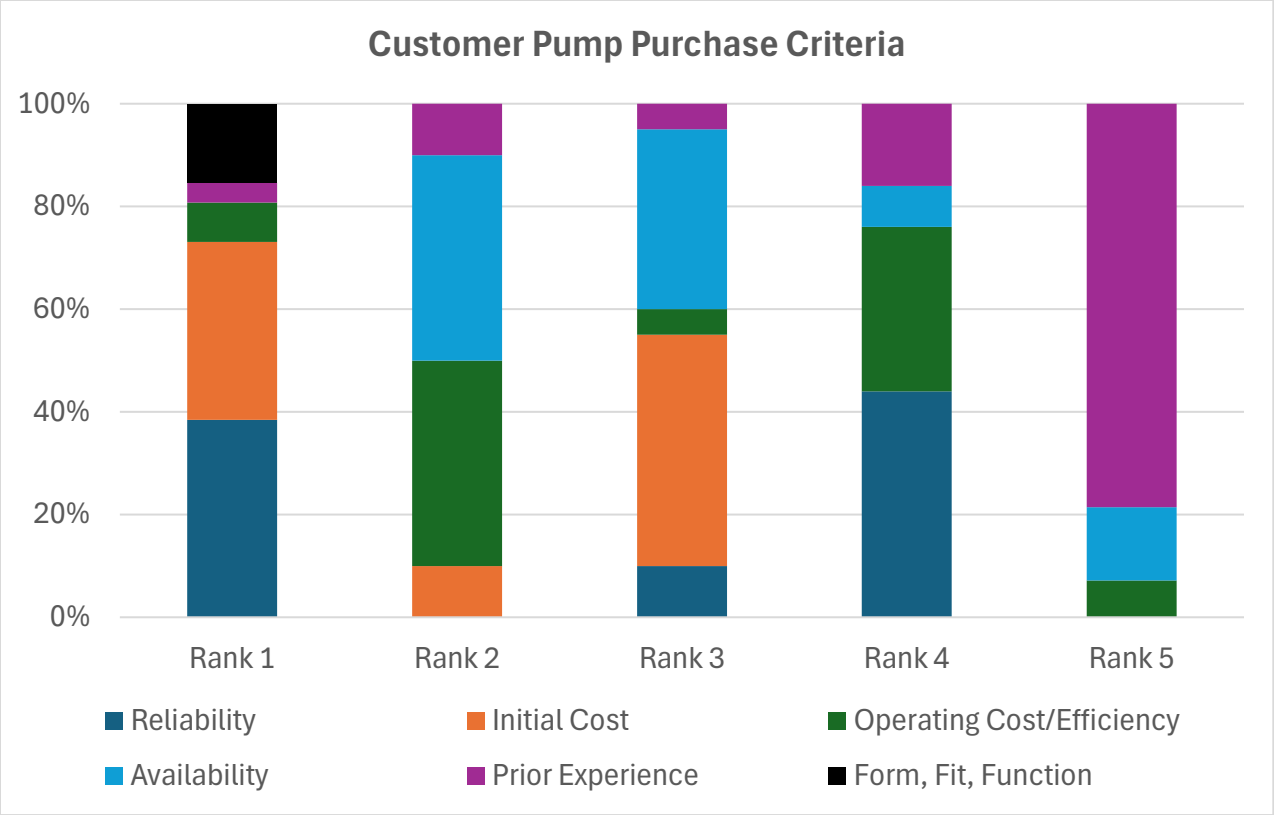

Figure 2: Key pump purchase criteria for customers

The survey results indicate that while customers place high value on the long-term performance and reliability of pumps, short-term financial considerations, such as upfront costs, become critical in urgent situations. Additionally, customers prioritize reliability to ensure the pump will function effectively in their specific applications. Some participants, particularly subject matter experts, emphasized that the most important factor is selecting a pump design that meets the form, fit, and function required to align with the customer's operational needs.

Operating cost and efficiency, which also ranked highly, indicate that while low maintenance costs and energy efficiency are important considerations, they are not the primary focus in purchasing decisions. Availability, ranked between 2 and 4 by different participants, reflects that while access to a pump is important, it is generally less critical since efficient pumps are widely available, according to the survey responses. However, availability becomes more significant when there is an urgent need for a pump. Prior experience with a specific pump type or manufacturer, though still a relevant factor, holds the least weight compared to the other criteria.

PEI Rating Awareness

The survey evaluated the awareness of PEI ratings among survey respondents, including pump/VFD vendors and end-use customers. Out of the 17 survey participants, 20 percent indicated they were not aware of PEI ratings, as illustrated in Figure 3 below. This lack of awareness was predominantly

observed among pump vendors and end-use customers. The 80 percent of respondents who were aware of PEI were subject matter experts and pump vendors.

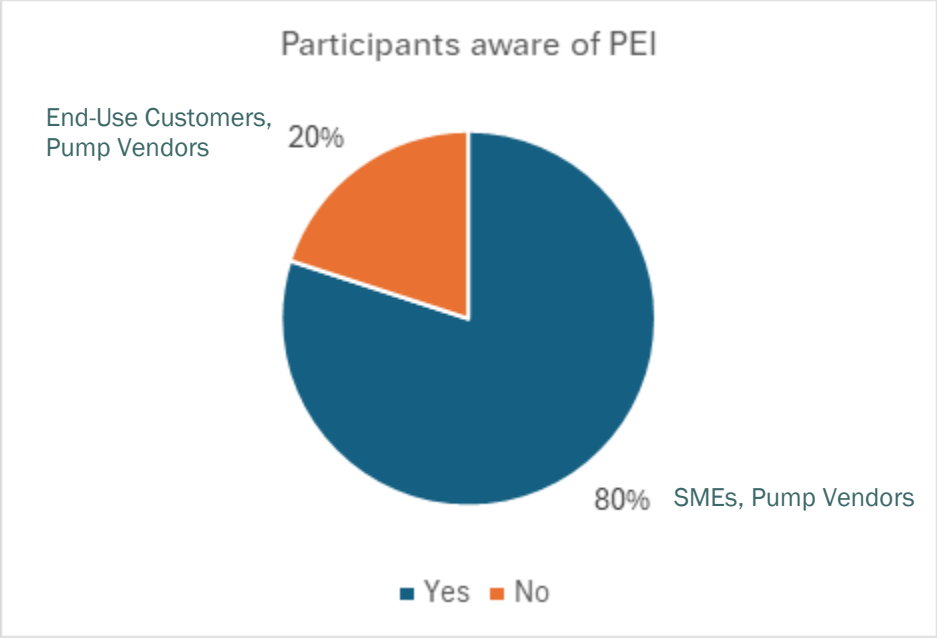

Figure 3: Percentage (%) of survey participants aware of PEI

The survey further explored the awareness of PEI ratings among pump/VFD vendors and end-use customers. Participants generally agreed that most pump vendors are knowledgeable about PEI ratings. However, this awareness is not widely shared with end-use customers. More than 70 percent of respondents indicated that less than 25 percent of end-use customers are aware of the PEI ratings for the pumps they purchase. A visual representation of awareness of PEI rating in vendors and customers is shown below in Figure 4.

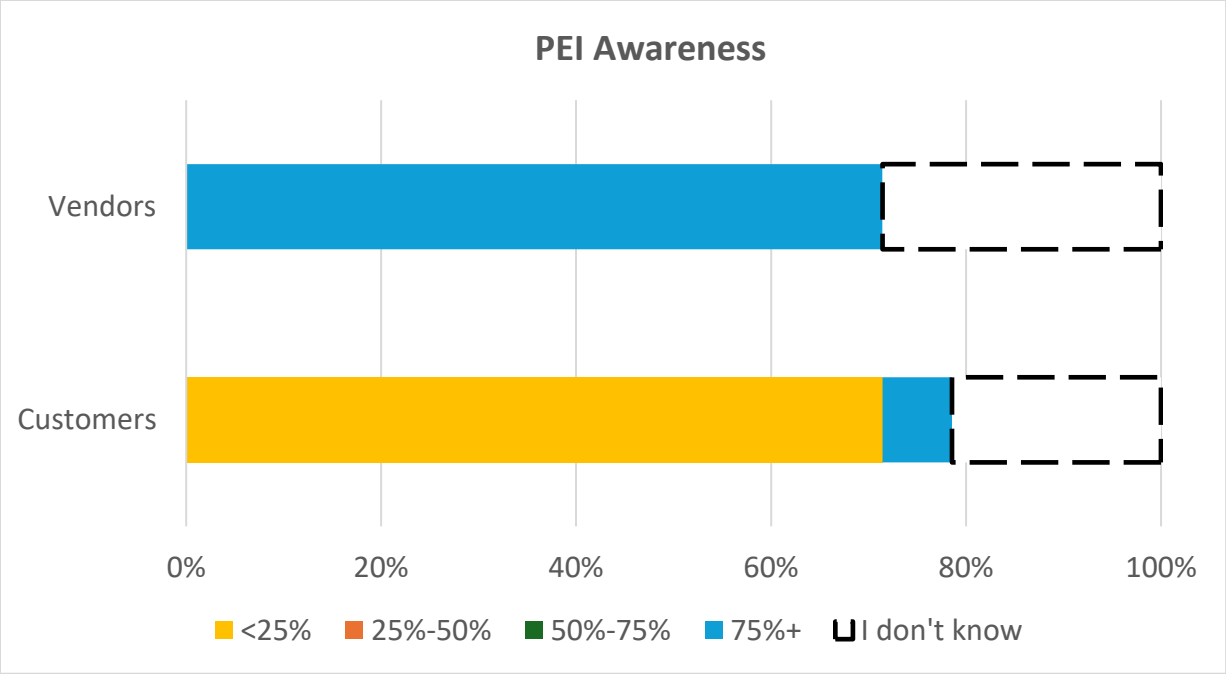

Figure 4: PEI rating awareness

The survey included additional questions regarding the usage of PEI ratings when advising customers on pump models and whether these ratings influence the decision-making process.

While some responses indicated that customers are aware of PEI ratings and that these ratings play a role in their purchasing decisions, the majority of responses suggested the opposite. See results in Figure 5, below.

In fact, interviewees #8 through #12 noted that while PEI is a term known widely in the energy efficiency world, they emphatically said they would **not** use that term to sell a pump because only ten percent of customers would know what it means. Instead, they would talk about the efficiency of the pump in general. For example, Interviewee #1 noted he would use the term Overall Plant Efficiency (OPE) to describe the efficiency of a pump or pumping system. Participants #8 through #12 also said that customers expect their vendors to recommend efficient pumps, so customers do not ask about pump efficiency ratings because it is inherently expected that recommended pumps are efficient.

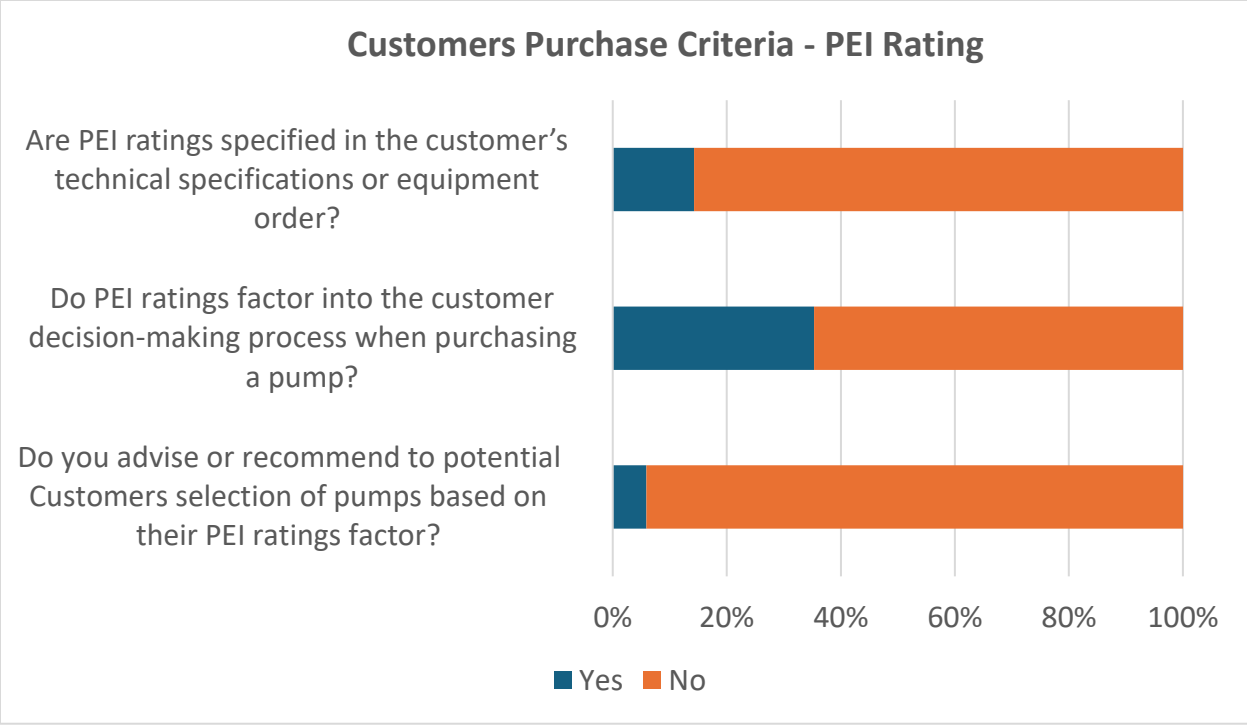

Figure 5: Customer purchase criteria based on PEI rating

The findings suggest a significant gap in the communication of PEI rating information from vendors to end-use customers. While vendors may be informed, the lack of awareness among customers highlights an opportunity for improved education and outreach. This disconnect could hinder customers' ability to make informed purchasing decisions based on energy efficiency, ultimately affecting their operational costs and sustainability goals. As such, there may be an opportunity for vendors to enhance customer education about the benefits of PEI ratings, potentially leading to more informed choices and increased demand for energy-efficient pump options.

Common Pumps in the Market

Pump Size

The survey explored the most commonly-sold pump sizes among the pool of pump manufacturers and vendors who participated. The majority of participants indicated that pumps in the 15 to 50 HP[8] range are the most frequently sold, with five out of eight participants selecting this category, as illustrated in Figure 6 below.

[8] While most pump vendors surveyed offer a range of pump sizes, only the most common sizes are included in this study.

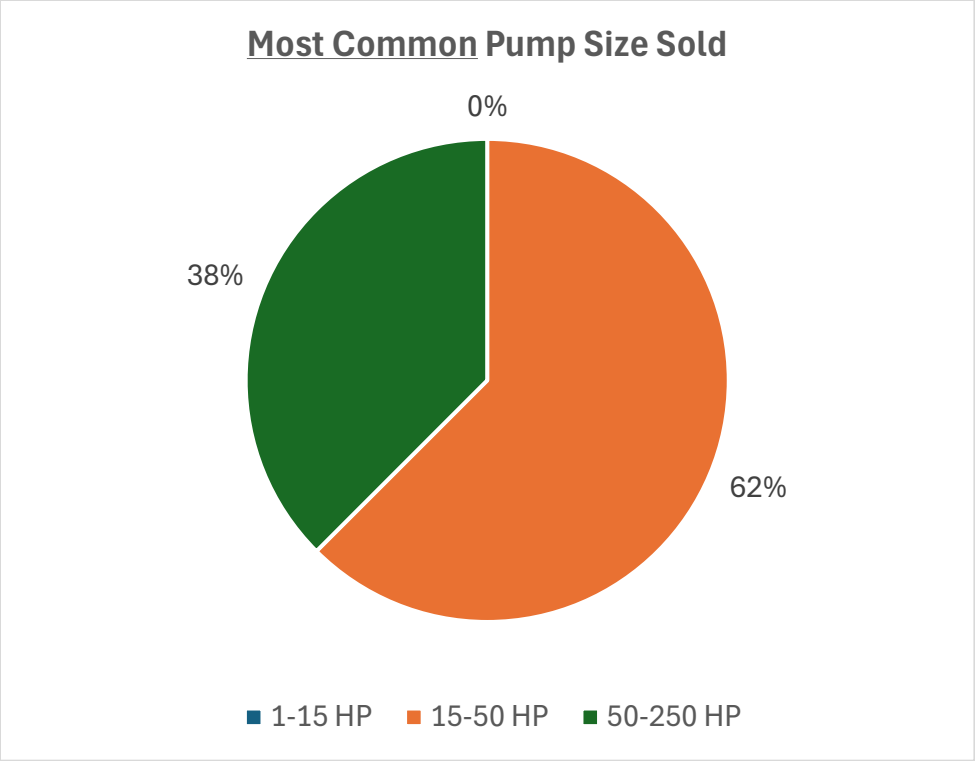

Figure 6: Most common pump size sold

Common Pump PEI Rating

The survey sought to determine the most common PEI ratings observed by participants. Manufacturers and vendors were asked to provide the top three most common pump models sold, enabling the PEI ratings to be looked up or calculated using the Hydraulic Institute (HI) Energy Ratings database if the participants were not familiar with the ratings themselves.

While some manufacturers and vendors expressed willingness to share the most common pump models at a later date, they were unable to share that information with the project team. Also, the majority of participants were unaware of the typical PEI ratings for pumps sold.

One participant was able to provide PEI ratings for commonly sold pumps, which are detailed in Table 6 below. This participant was from Northwest Energy Efficiency Alliance (NEEA) and provided the PEI ratings, based on a database of sales data collected from firms selling pumps in the Northwest. This data is not shareable, as it is protected by various non-disclosure agreements (NDAs), and so has not been validated by the project team. Later on, this same participant provided some public-facing documents that could validate the PEI ratings in Table 6. This data is discussed in a later section.

Table 6: Common PEI Ratings

Pump Size	Constant Speed Pumps	Variable Speed Pumps
1–15 HP	0.90–0.93	0.48–0.50
15–50 HP	0.94–0.98	0.48–0.50
50–250 HP	-	-

Number of Pumps Sold

The survey addressed the number of pumps sold within each pump size category. While no actual sales data were shared during the survey, it was estimated through ranges of tens, hundreds, or thousands of pumps sold annually over the previous three years. It was noted that the pumps within the 1 to 15 HP and 15 to 50 HP ranges were predominantly sold in the thousands across multiple pump manufacturers and vendors. The 50 to 250 HP sized pumps were sold in the hundreds, as shown in Figure 7.

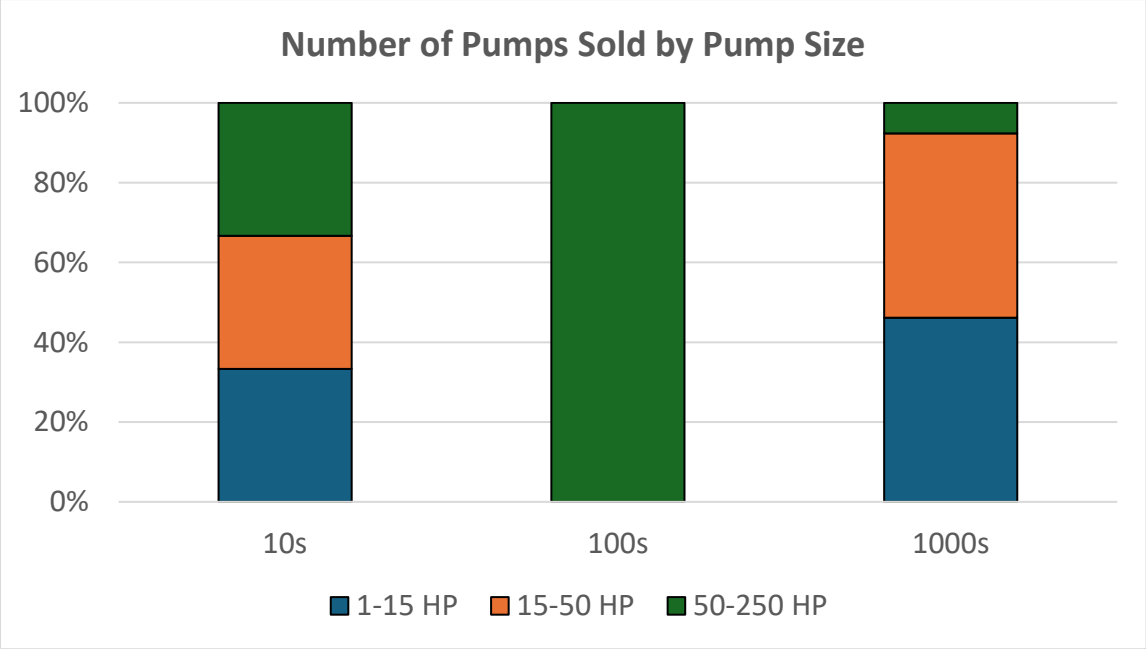

Figure 7: Number of pumps sold by pump size

These findings indicate that small- to medium-sized pumps (1 to 15 HP) and (15 to 50 HP) have a significantly larger market presence, likely due to their versatility and applicability across a wide range of industries and applications. The lower sales figures for larger pumps (50 to 250 HP) suggest a more specialized market, where demand may be influenced by specific industrial requirements or project-based needs.

Availability of Efficient Pumps

When asked about the availability and accessibility of energy-efficient pumps, the majority of survey participants agreed that such pumps are readily available. One respondent mentioned that although

there were supply chain issues during the pandemic, the process of acquiring efficient pumps has significantly improved in recent years. Figure 8 below illustrates the current availability of energy-efficient pumps in the market.

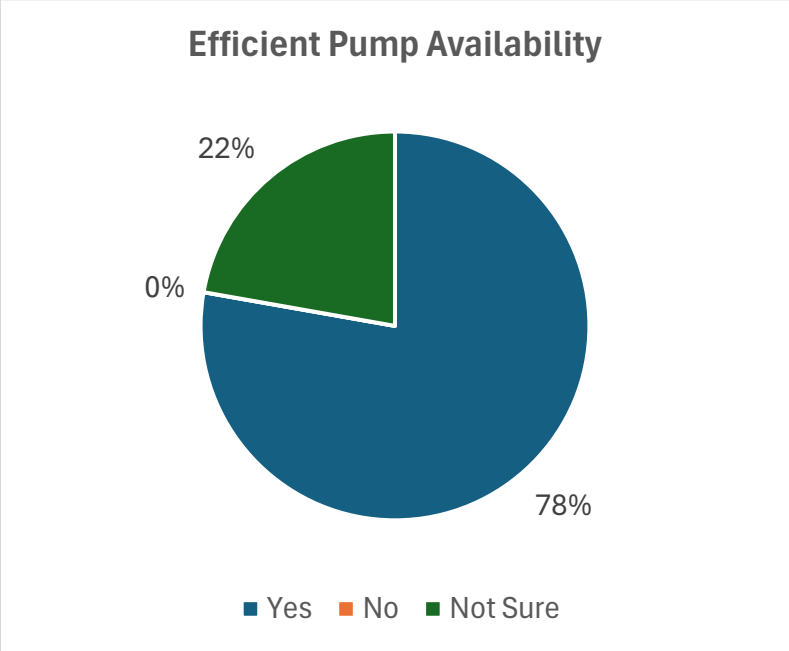

Figure 8: Availability of efficient pumps

Market Data

The project team received a summary of sales data from six pump manufacturers in the Northwest region from the 2021 and 2022 period (Northwest Energy Efficiency Alliance (NEEA) 2023). This data, collected from distributors participating in NEEA's Extended Motor Products (XMP) program, includes average PEIs for all pumps sold by these manufacturers. The project team could not find publicly-available data from 2023 or 2024 from the XMP program. The data is categorized by pump types and maximum pump speed for constant speed pumps. The following manufacturers' sales data was included in the database:

- Armstrong
- Bell & Gosset – Xylem
- Goulds Water Technology – Xylem
- Grundfos
- PACO
- Taco

NEEA provided the Northwest Regional Technical Forum (RTF) with this public-facing sales data in a spreadsheet, where the data was aggregated and anonymized. Table 7 summarizes the PEIs by

pump type, size, and control method. NEEA estimates that the pump sales data collected through the XMP program represents 70 percent of the clean water pumping market in the region. If a cell in Table 7 indicates "insufficient data," it means there was either not enough sales data to anonymize it or no data available for that particular pump type and speed combination.

Table 7: XMP Sales Data Provided to RTF

Pump Type	Control	Pump Speed (RPM)	1 to 9.9 HP	10 to 49.9 HP	50 to 200 HP	Market Average
End Suction Close Coupled (ESCC)	Constant Speed	1800	0.89	0.95	insufficient data	0.91
End Suction Close Coupled (ESCC)	Constant Speed	3600	0.93	0.9	insufficient data	0.93
End Suction Frame Mounted (ESFM)	Constant Speed	1800	0.88	0.92	0.94	0.9
End Suction Frame Mounted (ESFM)	Constant Speed	3600	0.92	insufficient data	insufficient data	0.91
In-Line (IL)	Constant Speed	1800	0.9	0.94	insufficient data	0.91
In-Line (IL)	Constant Speed	3600	insufficient data	0.89	insufficient data	insufficient data
Radially split, multi-stage, vertical, in-line casing diffuser (RSV)	Constant Speed	1800	insufficient data	insufficient data	insufficient data	0.92
Radially split, multi-stage, vertical, in-line casing diffuser (RSV)	Constant Speed	3600	0.92	0.91	insufficient data	0.92

Incorporating the NEEA data into the standard practice baseline for measure package SWWP004 presents several challenges. The first challenge is that the NEEA data is categorized into different horsepower bins than those used in SWWP004, as shown in Table 8 below.

Table 8: XMP Sales Data vs. SWWP005 HP Bins

XMP Bin	SWWP004 Bin
1–9.9 HP	1–14.9 HP
10–49.9 HP	15–49.9 HP
50–200 HP	50–249.9 HP

The second challenge is that the sales data is categorized by pump type (ESCC, ESFM, IL, RSV) and pump speed, while the bins in SWWP004 are categorized only by horsepower. The sales data does include the PEI weightage for each pump type, so calculating a simple average PEI of all pumps by horsepower may not accurately reflect the market.

The third challenge is that the sales data only covers constant speed clean water pumps. It does not include data for variable speed and wastewater pumps. Additionally, there is not sufficient data for pumps above 50 HP, except for ESFM pumps operating at 1800 RPM.

The fourth challenge is that the 70 percent market share estimate remains unvalidated. NEEA conducted a study in 2022 to verify the estimate, but the results were inconclusive (Albers 2022). Moreover, the 70 percent market share of these six manufacturers in the Northwest does not necessarily imply the same market share in California, adding another layer of uncertainty.

The final and perhaps most critical challenge is that the sales data collected through the XMP program may be skewed toward more efficient pumps, as data is limited to manufacturers who participate in the XMP program.

To determine if specific manufacturers would skew PEI data, the project team counted the total number of pumps from each pump manufacturer listed in the DOE Pump Compliance Certification database which was included in the spreadsheet file provided to RTF. The total number of pumps for the six participating manufacturers are shown in Table 9 below, and Figure 9 shows a histogram of the total number of pumps in the DOE Pump Compliance Certification Database by manufacturer with the six participating manufacturers called out.

Table 9: Number of Pumps in DOE Pump Compliance Certification Database

Manufacturer	Total Number of Pumps
Armstrong	1280
Bell & Gosset – Xylem	852
Goulds Water Technology – Xylem	966
Grundfos	2015
PACO	0
Taco	502

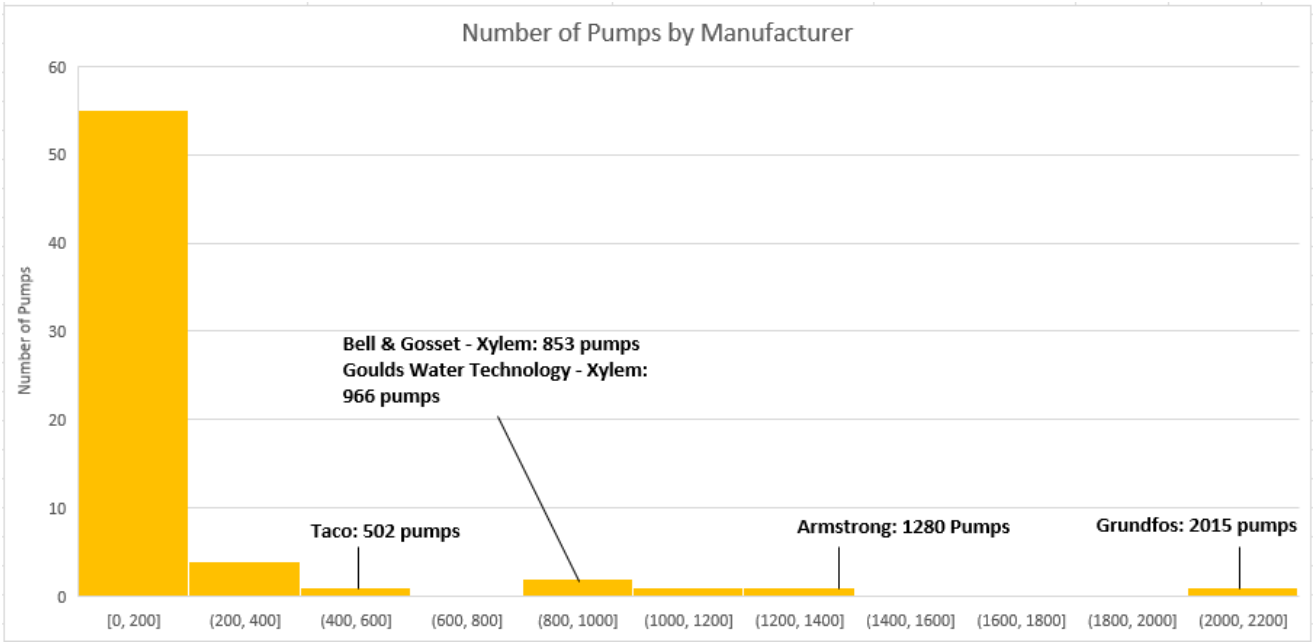

Figure 9: Number of pumps in DOE Compliance Certification Database by manufacturer

Most pump manufacturers in the DOE Pump Compliance Database have less than 650 pumps listed. Three of the six participating manufacturers have more pumps than other manufacturers. If the average PEI of the six participating manufacturers is lower than that of the non-participating manufacturers (meaning their pumps are more efficient), the XMP sales data could be skewed toward a more efficient PEI value. Table 10 shows the comparison between the average PEI data for participating and the non-participating manufacturers.

Table 10: Comparison of Average PEIs for Participating and Non-Participating Pump Manufacturers

Motor Size	Pump Category	Avg PEI: Non-Participating Manufacturers	Avg PEI: Participating Manufacturers	Participating Manufacturer More Efficient Than Non-Participating? [Y/N]
1 to 9.9 HP	ESCC 1800	0.90	0.91	Y
1 to 9.9 HP	ESCC 3600	0.82	0.89	N
1 to 9.9 HP	ESFM 1800	0.93	0.92	Y
1 to 9.9 HP	ESFM 3600	0.95	0.89	N
1 to 9.9 HP	IL 1800	0.95	0.92	Y
1 to 9.9 HP	RSV 3600	0.93	0.92	N
10 to 49.9 HP	ESCC 1800	0.93	0.93	N
10 to 49.9 HP	ESCC 3600	0.95	0.91	Y
10 to 49.9 HP	ESFM 1800	0.94	0.93	N
10 to 49.9 HP	IL 1800	0.97	0.95	N
10 to 49.9 HP	IL 3600	0.96	0.91	Y

Motor Size	Pump Category	Avg PEI: Non-Participating Manufacturers	Avg PEI: Participating Manufacturers	Participating Manufacturer More Efficient Than Non-Participating? [Y/N]
10 to 49.9 HP	RSV 3600	0.96	0.92	Y
50 to 200 HP	ESFM 1800	0.96	0.96	Y

Error! Reference source not found. shows that half of the time the average PEI rating of the participating manufacturers is more efficient than that of the non-participating manufacturers. Therefore, these results do not show that the XMP sales data is skewed toward higher PEIs.

The project team also determined at what percentile the XMP sales data PEIs landed, based on the DOE Pump Compliance Database. The results are summarized in Table 11 and Figure 10. In **Error! Reference source not found.**, the average PEI from the XMP sales data for an ESCC pump at 1800 RPM is 0.89, which lies at the 67th percentile of all pumps from the DOE Compliance Certification Database that are ESCC and 1800 RPM. This means that only 27 percent of all pumps of that type and speed in the DOE Pump Compliance Certification Database are more efficient than the XMP sales data average PEI.

Table 11: XMP Sales Data Percentiles

Motor Size	Pump Category	XMP Sales Data PEI	Percentile
1 to 9.9 HP	ESCC 1800	0.89	67th
1 to 9.9 HP	ESCC 3600	0.93	49th
1 to 9.9 HP	ESFM 1800	0.88	88th
1 to 9.9 HP	ESFM 3600	0.92	92nd
1 to 9.9 HP	IL 1800	0.90	84th
1 to 9.9 HP	RSV 3600	0.92	50th
10 to 49.9 HP	ESCC 1800	0.95	61st
10 to 49.9 HP	ESCC 3600	0.90	78th
10 to 49.9 HP	ESFM 1800	0.92	87th
10 to 49.9 HP	IL 1800	0.94	85th
10 to 49.9 HP	IL 3600	0.89	81st
10 to 49.9 HP	RSV 3600	0.91	88th
50 to 200 HP	ESFM 1800	0.94	76th
Average			**76th**

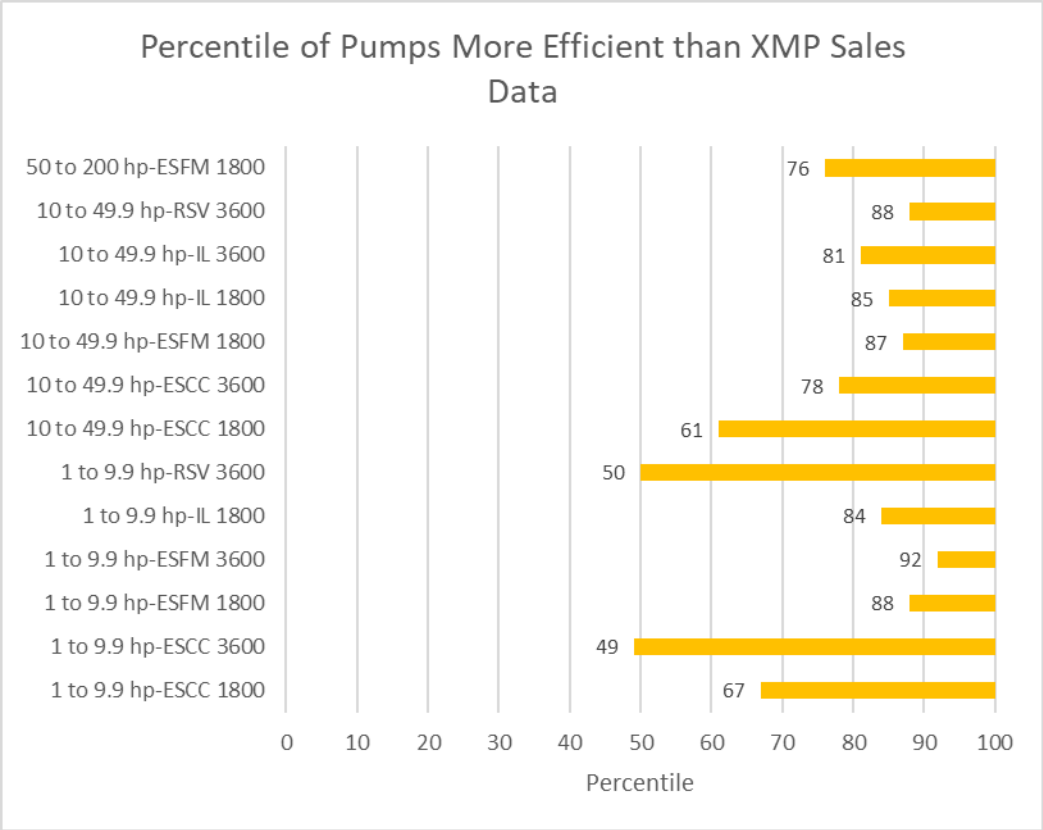

Figure 10: XMP sales data percentiles

The average PEIs from the XMP sales data fell between the 49th and 92nd percentile of pumps in the DOE Compliance Certification Database, with an average at the 76th percentile. In other words, only about 25 percent of all pumps (for which there was sufficient XMP sales data) are more efficient than those sold by participating manufacturers in the XMP program. This suggests that the XMP sales data reflects the program's influence on shifting the pumping market toward more efficient pumps. Consequently, this data is not a reliable indicator of ISP in the absence of an incentive program and in other markets.

Hydraulic Institute Pump Database vs. DOE Compliance Certification Database

The program team also reviewed the HI's pump database. Likewise, the program team noted that NEEA's XMP program used the DOE Compliance Certification Database[9] for insufficient data. Upon further investigation, the requirements for 10 CFR 431.464, 10 CFR 431.465, and 10 CFR 431 Subpart Y do not require third-party testing or certification.

A major differentiation between the HI Energy Rating Database and complying with DOE's database is that HI requires third-party certification of the testing. The HI program requires laboratories to be

9 CCMS - Public Database (doe.gov)

approved through their Pump Test Laboratory Approval Program. While comparing the datasets of both databases, it was clear there is overlap between both datasets and each dataset has pump technology that is unique to each dataset.

Both datasets required some cleaning because they had erroneous records. The following records were cleaned out of both datasets:

- PEI if it was <0.2 or >0.95
- PEI if it was >0.4 for a constant load pump and >0.2 for a variable load pump
- Bowl diameter if it was >6 inches for a submersible turbine pump[10]
- gpm if it was <25[11]
- Head if it was >459 Feet[12]
- Specific speed >5,000[13]

The project team had to remove 297 records from the DOE database (three percent of the records) and 279 records from the HI database (two percent of the records). Once the databases were cleaned up by removing erroneous records, the 25th percentile PEI was calculated for each pump horsepower range and control type.

The existing baseline PEI values in SWWP004 were determined using the average PEI from a database of performance data collected from major manufacturers and the HI (California Energy Efficiency Measure Data 2023). The CPUC directed that the measure package should use the most commonly available PEI (mode) in the dataset for each control strategy and pump size range. The existing baseline PEI values in SWWP004 and the 25th percentiles of the DOE Compliance Certification database and HI database using this analysis are shown in

[10] DOE standards do not apply to submersible turbine pumps with bowl diameters greater than six inches.

[11] DOE standards do not apply to pumps with flow less than 25 gpm.

[12] DOE standards do not apply to pumps with head greater than 459 feet.

[13] DOE standards do not apply to pumps with specific speed that is greater than 5,000.

Table 12 below.

Table 12: Comparison of PEI values

Pump Size	Control Strategy	SWWP004 Baseline PEI	DOE Compliance Certification Database PEI	Hydraulic Institute Database PEI
1 to 14.9 HP	Variable Speed	0.47	0.62	0.50
	Constant Speed	0.94	0.97	0.96
15 to 49.9 HP	Variable Speed	0.49	0.52	0.49
	Constant Speed	0.94	0.97	0.97
50 to 250 HP	Variable Speed	0.49	0.51	0.57
	Constant Speed	0.95	0.97	0.98

The baseline PEI values between the DOE Compliance Certification Database and the HI Energy Rating Database are similar for constant speed pumps, but there is more of a difference among the variable speed pump permutations. The project team recommends that the baseline PEI in SWWP004 be based upon the 25th percentile of the most up-to-date DOE Compliance Certification Database to better align with the findings of the ISP surveys.

ISP Findings

By and large, end-use customers are not aware of PEI ratings, and vendors do not use PEI ratings to sell pumps to them. When vendors talk to customers about pump efficiency, they do not use the term PEI. Survey results also indicate that customers consider pump efficiency as a secondary criteria to make pump purchasing decisions after reliability and initial cost.

Participants indicated that “efficient” pumps are readily available for purchase but could not provide PEI ratings of “efficient” pumps, with the exception of a single participant. The single participant who could provide PEI ratings of efficient pumps was from NEEA, and provided this information based on market data collected by NEEA. This market data shows the influence of NEEAs XMP program to move the market toward efficient pumps, and it is not a good indicator of what would happen absent incentive programs.

1 to 50 HP pumps have more market share than 50 to 250 HP pumps, but since no PEI ratings were given for different pump sizes with the exception of the NEEA participant, the project team cannot use the survey data alone to determine if ISP PEI is different for various pump sizes.

Survey participants indicated differences between clean water and wastewater pumps, but none of the differences would affect the rated PEI of pumps sold into each sector.

The project team recommends that the baseline PEI in SWWP004 be based upon the most up-to-date DOE Compliance Certification Database, and that the baseline PEI be set at the 25th percentile

in each pump size range and control strategy combination. The 25th percentile strikes a balance between the survey results, which show that customers are not aware of PEI and value efficiency after reliability and cost. Further, DOE's 1.0 minimum PEI represents the extreme end of the dataset and most pumps are more efficient than this minimum.

This recommendation will go into the draft ISP study that will be reviewed by SCE's measure package team and may be reviewed by the CPUC at their discretion. If the CPUC or SCE's measure package team have additional data that is recommended to be included, the project team will respond to those recommendations and update the ISP study.

Measure Package Update

As advised by the CPUC, measure package development for SWWP004 Water Pump Upgrade is being updated for 2025 without incorporating the baseline PEI findings of the market-based ISP study. This is to prevent a gap in the measure offering while the ISP study wraps up. However, the updated measure package does include addition of wastewater pumps based on the findings from the Wastewater Pump Measure Development Study (ET23SWE0039) and a cost update to reflect 2024 costs for pump replacement.

The following sections come from the "Measure Characterization" eTRM. The draft measure package is complete and will require reviews by SCE, the California Technical Forum (Cal TF), and the CPUC to be finalized.

Technology Summary

The U.S. Department of Energy (DOE) defines a "pump" as equipment used to move liquids (which may contain entrained gases, free solids, and totally dissolved solids) by physical or mechanical action. A pump includes a bare pump and mechanical equipment, driver, and controls.

Water pumps are the second most commonly-sought equipment after the motor and are found across all sectors. In addition, nearly one-fifth of electricity generated in California supports water-related uses.

In California, over 900 wastewater treatment plants (WWTPs) manage approximately four billion gallons of wastewater daily. It is estimated that up to 19 percent of the state's total electricity consumption is dedicated to the pumping, treatment, collection, and discharge of water and wastewater, which can constitute 30 to 40 percent of a municipality's energy expenses (Copeland). Specifically, pumping operations in wastewater facilities account for roughly 14.8 percent of a typical site's energy use, including wastewater pumping and return sludge pumping. Depending on the plant's design, various pumps are used in the treatment process. These pumps include process influent pumps, return activated sludge (RAS) pumps, waste activated sludge (WAS) pumps, sump pumps, and collection system conveyance pumps, all of which handle materials ranging from raw wastewater to thickened sludge. The most common types of pumps include centrifugal, progressive cavity, and positive displacement pumps. The WWTP site's terrain and the influent sanitary sewer depth determine the need for and placement of pumping applications, ensuring continuous and cost-effective treatment through the plant's unit processes.

To standardize pump efficiency requirements and move the market towards minimally efficient pumps, DOE developed the Energy Conservation Standard (ECS) for commercial, industrial, and agricultural clean water pumps. The HI and DOE developed the pump energy efficiency rating system, PEI, to achieve this goal. The PEI is the weighted average performance of the rated pump at specific load points and normalized with respect to the performance of a minimally compliant pump. Since 2016, pumps have been sold with ECS labels that include PEI.

Per the HI Program Guide, "the constant-load pump will not vary the speed and the system head will vary to achieve the variable flow points and the variable-load pump will vary the speed to achieve the variable flow points." Therefore, this measure package uses "load" and "speed" interchangeably, such as constant load and constant speed.

The California utility customers funded one Emerging Technologies (ET) Program study to develop the necessary data for creating a deemed measure offering for the replacement of wastewater pumps, for eventual application within the statewide program, as indicated in Table 13 below.

Table 13: Emerging Technologies Study

Project Number	Program Funding Year	Year Introduced to Programs
ET23SWE0039	2023	N/A

Measure Case Description

This measure is defined as the installation of a clean water pump or wastewater pump with PEI as specified below. The measure case PEI tiers were set by incrementally improving the PEIs by values of 0.02 for each tier. These efficiency tiers were selected based on a review of the PEI distribution of eligible pumps in the HI pump database. Note that only two tiers were approved for the largest horsepower variable speed bin because no products currently exist in the highest PEI bin for that size and control combination. As shown, measure offerings (and therefore measure impacts) vary by load type (variable or constant) and by pump motor horsepower range.

Table 14: Measure Case Description

Pump Motor Horsepower	Measure PEI Range	Application Type	Control Strategy	Statewide Measure Offering ID (text)	Measure Offering Description (text)
1 ≤ HP ≤ 15	PEI ≤ 0.41	Clean water	Variable Speed	R	Clean water pump, PEI ≤ 0.41, variable speed, 1 ≤ HP ≤ 15
1 ≤ HP ≤ 15	PEI ≤ 0.41	Wastewater	Variable Speed	AA	Wastewater pump, PEI ≤ 0.41, variable speed, 1 ≤ HP ≤ 15
1 ≤ HP ≤ 15	PEI ≤ 0.43	Clean water	Variable Speed	Q	Clean water pump, PEI ≤ 0.43, variable speed, 1 ≤ HP ≤ 15
1 ≤ HP ≤ 15	PEI ≤ 0.43	Wastewater	Variable Speed	AB	Wastewater pump, PEI ≤ 0.43, variable speed, 1 ≤ HP ≤ 15
1 ≤ HP ≤ 15	PEI ≤ 0.45	Clean water	Variable Speed	P	Clean water pump, PEI ≤ 0.45, variable speed, 1 ≤ HP ≤ 15
1 ≤ HP ≤ 15	PEI ≤ 0.45	Wastewater	Variable Speed	AC	Wastewater pump, PEI ≤ 0.45, variable speed, 1 ≤ HP ≤ 15
1 ≤ HP ≤ 15	PEI ≤ 0.88	Clean water	Constant Speed	I	Clean water pump, PEI ≤ 0.88, constant speed, 1 ≤ HP ≤ 15
1 ≤ HP ≤ 15	PEI ≤ 0.88	Wastewater	Constant Speed	AD	Wastewater pump, PEI ≤ 0.88, constant speed, 1 < HP ≤ 15
1 ≤ HP ≤ 15	PEI ≤ 0.90	Clean water	Constant Speed	H	Clean water pump, PEI ≤ 0.90, constant speed, 1 ≤ HP ≤ 15
1 ≤ HP ≤ 15	PEI ≤ 0.90	Wastewater	Constant Speed	AE	Wastewater pump, PEI ≤ 0.90, constant speed, 1 < HP ≤ 15
1 ≤ HP ≤ 15	PEI ≤ 0.92	Clean water	Constant Speed	G	Clean water pump, PEI ≤ 0.92, constant speed, 1 ≤ HP ≤ 15

Pump Motor Horsepower	Measure PEI Range	Application Type	Control Strategy	Statewide Measure Offering ID (text)	Measure Offering Description (text)
1 ≤ HP ≤ 15	PEI ≤ 0.92	Wastewater	Constant Speed	AF	Wastewater pump, PEI ≤ 0.92, constant speed, 1 < HP ≤ 15
15 < HP ≤ 50	PEI ≤ 0.43	Clean water	Variable Speed	U	Clean water pump, PEI ≤ 0.43, variable speed, 15 < HP ≤ 50
15 < HP ≤ 50	PEI ≤ 0.43	Wastewater	Variable Speed	AG	Wastewater pump, PEI ≤ 0.43, variable speed, 15 < HP ≤ 50
15 < HP ≤ 50	PEI ≤ 0.45	Clean water	Variable Speed	T	Clean water pump, PEI ≤ 0.45, variable speed, 15 < HP ≤ 50
15 < HP ≤ 50	PEI ≤ 0.45	Wastewater	Variable Speed	AH	Wastewater pump, PEI ≤ 0.45, variable speed, 15 < HP ≤ 50
15 < HP ≤ 50	PEI ≤ 0.47	Clean water	Variable Speed	S	Clean water pump, PEI ≤ 0.47, variable speed, 15 < HP ≤ 50
15 < HP ≤ 50	PEI ≤ 0.47	Wastewater	Variable Speed	AI	Wastewater pump, PEI ≤ 0.47, variable speed, 15 < HP ≤ 50
15 < HP≤ 50	PEI ≤ 0.88	Clean water	Constant Speed	L	Clean water pump, PEI ≤ 0.88, constant speed, 15 < HP ≤ 50
15 < HP ≤ 50	PEI ≤ 0.88	Wastewater	Constant Speed	AJ	Wastewater pump, PEI ≤ 0.88, constant speed, 15 < HP ≤ 50
15 < HP ≤ 50	PEI ≤ 0.90	Clean water	Constant Speed	K	Clean water pump, PEI ≤ 0.90, constant speed, 15 < HP ≤ 50
15 < HP ≤ 50	PEI ≤ 0.90	Wastewater	Constant Speed	AK	Wastewater pump, PEI ≤ 0.90, constant speed, 15 < HP ≤ 50

Pump Motor Horsepower	Measure PEI Range	Application Type	Control Strategy	Statewide Measure Offering ID (text)	Measure Offering Description (text)
15 < HP ≤ 50	PEI ≤ 0.92	Clean water	Constant Speed	J	Clean water pump, PEI ≤ 0.92, constant speed, 15 < HP ≤ 50
15 < HP ≤ 50	PEI ≤ 0.92	Wastewater	Constant Speed	AL	Wastewater pump, PEI ≤ 0.92, constant speed, 15 < HP ≤ 50
50 < HP ≤ 250	PEI ≤ 0.45	Clean water	Variable Speed	W	Clean water pump, PEI ≤ 0.45, variable speed, 50 < HP ≤ 250
50 < HP ≤ 250	PEI ≤ 0.45	Wastewater	Variable Speed	AM	Wastewater pump, PEI ≤ 0.45, variable speed, 50 < HP ≤ 250
50 < HP ≤ 250	PEI ≤ 0.47	Clean water	Variable Speed	V	Clean water pump, PEI ≤ 0.47, variable speed, 50 < HP ≤ 250
50 < HP ≤ 250	PEI ≤ 0.47	Wastewater	Variable Speed	AN	Wastewater pump, PEI ≤ 0.47, variable speed, 50 < HP ≤ 250
50 < HP ≤ 250	PEI ≤ 0.89	Clean water	Constant Speed	O	Clean water pump, PEI ≤ 0.89, constant speed, 50 < HP ≤ 250
50 < HP ≤ 250	PEI ≤ 0.89	Wastewater	Constant Speed	AO	Wastewater pump, PEI ≤ 0.89, constant speed, 50 < HP ≤ 250
50 < HP ≤ 250	PEI ≤ 0.91	Clean water	Constant Speed	N	Clean water pump, PEI ≤ 0.91, constant speed, 50 < HP ≤ 250
50 < HP ≤ 250	PEI ≤ 0.91	Wastewater	Constant Speed	AP	Wastewater pump, PEI ≤ 0.91, constant speed, 50 < HP ≤ 250
50 < HP ≤ 250	PEI ≤ 0.93	Clean water	Constant Speed	M	Clean water pump, PEI ≤ 0.93, constant speed, 50 < HP ≤ 250

Pump Motor Horsepower	Measure PEI Range	Application Type	Control Strategy	Statewide Measure Offering ID (text)	Measure Offering Description (text)
50 < HP ≤ 250	PEI ≤ 0.93	Wastewater	Constant Speed	AQ	Wastewater pump, PEI ≤ 0.93, constant speed, 50 < HP≤ 250

Base Case Description

The base case for this measure is a clean water pump or wastewater pump with a PEI rating specified below. These baseline values were calculated from a database of performance data collected from major manufacturers and the HI. Per direction from the CPUC, the baseline PEI ratings are representative of the most commonly available (mode) of the dataset for each control strategy and pump motor horsepower range. Note that the federal standard requires a clean water pump system to have a PEI rating ≤ 1.0 (see Code Requirements section).

Table 15: Base Case Description

Pump Motor Horsepower	Measure PEI Range	Application Type	Control Strategy	Statewide Measure Offering ID (text)	Existing Description (text)	Standard Description (text)
1 ≤ HP ≤ 15	≤ 0.41	Clean water	Variable Speed	R	Standard clean water pump, PEI 0.47, variable speed, 1 ≤ HP ≤ 15	Standard clean water pump, PEI 0.47, variable speed, 1 ≤ HP ≤ 15
1 ≤ HP ≤ 15	≤ 0.41	Wastewater	Variable Speed	AA	Standard wastewater pump, PEI 0.47, variable speed, 1 ≤ HP ≤ 15	Standard wastewater pump, PEI 0.47, variable speed, 1 ≤ HP ≤ 15
1 ≤ HP ≤ 15	≤ 0.43	Clean water	Variable Speed	Q	Standard clean water pump, PEI 0.47, variable speed, 1 ≤ HP ≤ 15	Standard clean water pump, PEI 0.47, variable speed, 1 ≤ HP ≤ 15

Pump Motor Horsepower	Measure PEI Range	Application Type	Control Strategy	Statewide Measure Offering ID (text)	Existing Description (text)	Standard Description (text)
1 ≤ HP ≤ 15	≤ 0.43	Wastewater	Variable Speed	AB	Standard wastewater pump, PEI 0.47, variable speed, 1 ≤ HP ≤ 15	Standard wastewater pump, PEI 0.47, variable speed, 1 ≤ HP ≤ 15
1 ≤ HP ≤ 15	≤ 0.45	Clean water	Variable Speed	P	Standard clean water pump, PEI 0.47, variable speed, 1 ≤ HP ≤ 15	Standard clean water pump, PEI 0.47, variable speed, 1 ≤ HP ≤ 15
1 ≤ HP ≤ 15	≤ 0.45	Wastewater	Variable Speed	AC	Standard wastewater pump, PEI 0.47, variable speed, 1 ≤ HP ≤ 15	Standard wastewater pump, PEI 0.47, variable speed, 1 ≤ HP ≤ 15
1 ≤ HP ≤ 15	≤ 0.88	Clean water	Constant Speed	I	Standard clean water pump, PEI 0.94, constant speed, 1 ≤ HP ≤ 15	Standard clean water pump, PEI 0.94, constant speed, 1 ≤ HP ≤ 15
1 ≤ HP ≤ 15	≤ 0.88	Wastewater	Constant Speed	AD	Standard wastewater pump, PEI 0.94, constant speed, 1 ≤ HP ≤ 15	Standard wastewater pump, PEI 0.94, constant speed, 1 ≤ HP ≤ 15
1 ≤ HP≤ 15	≤ 0.90	Clean water	Constant Speed	H	Standard clean water pump, PEI 0.94, constant speed, 1 ≤ HP ≤ 15	Standard clean water pump, PEI 0.94, constant speed, 1 ≤ HP ≤ 15
1 ≤ HP ≤ 15	≤ 0.90	Wastewater	Constant Speed	AE	Standard wastewater pump, PEI 0.94, constant speed, 1 ≤ HP ≤ 15	Standard wastewater pump, PEI 0.94, constant speed, 1 ≤ HP ≤ 15

Pump Motor Horsepower	Measure PEI Range	Application Type	Control Strategy	Statewide Measure Offering ID (text)	Existing Description (text)	Standard Description (text)
1 ≤ HP ≤ 15	≤ 0.92	Clean water	Constant Speed	G	Standard clean water pump, PEI 0.94, constant speed, 1 ≤ HP ≤ 15	Standard clean water pump, PEI 0.94, constant speed, 1 ≤ HP ≤ 15
1 ≤ HP ≤ 15	≤ 0.92	Wastewater	Constant Speed	AF	Standard wastewater pump, PEI 0.94, constant speed, 1 ≤ HP ≤ 15	Standard wastewater pump, PEI 0.94, constant speed, 1 ≤ HP ≤ 15
15 < HP ≤ 50	≤ 0.43	Clean water	Variable Speed	U	Standard clean water pump, PEI 0.49, variable speed, 15 < HP ≤ 50	Standard clean water pump, PEI 0.49, variable speed, 15 < HP ≤ 50
15 < HP ≤ 50	≤ 0.43	Wastewater	Variable Speed	AG	Standard wastewater pump, PEI 0.49, variable speed, 15 ≤ HP ≤ 50	Standard wastewater pump, PEI 0.49, variable speed, 15 ≤ HP ≤ 50
15 < HP ≤ 50	≤ 0.45	Clean water	Variable Speed	T	Standard clean water pump, PEI 0.49, variable speed, 15 < HP ≤ 50	Standard clean water pump, PEI 0.49, variable speed, 15 < HP ≤ 50
15 < HP ≤ 50	≤ 0.45	Wastewater	Variable Speed	AH	Standard wastewater pump, PEI 0.49, variable speed, 15 ≤ HP ≤ 50	Standard wastewater pump, PEI 0.49, variable speed, 15 ≤ HP ≤ 50
15 < HP ≤ 50	≤ 0.47	Clean water	Variable Speed	S	Standard clean water pump, PEI 0.49, variable speed, 15 < HP ≤ 50	Standard clean water pump, PEI 0.49, variable speed, 15 < HP ≤ 50

Pump Motor Horsepower	Measure PEI Range	Application Type	Control Strategy	Statewide Measure Offering ID (text)	Existing Description (text)	Standard Description (text)
15 < HP ≤ 50	≤ 0.47	Wastewater	Variable Speed	AI	Standard wastewater pump, PEI 0.49, variable speed, 15 ≤ HP ≤ 50	Standard wastewater pump, PEI 0.49, variable speed, 15 ≤ HP ≤ 50
15 < HP ≤ 50	≤ 0.88	Clean water	Constant Speed	L	Standard clean water pump, PEI 0.94, constant speed, 15 < HP ≤ 50	Standard clean water pump, PEI 0.94, constant speed, 15 < HP ≤ 50
15 < HP ≤ 50	≤ 0.88	Wastewater	Constant Speed	AJ	Standard wastewater pump, PEI 0.94, constant speed, 15 ≤ HP ≤ 50	Standard wastewater pump, PEI 0.94, constant speed, 15 ≤ HP ≤ 50
15 < HP ≤ 50	≤ 0.90	Clean water	Constant Speed	K	Standard clean water pump, PEI 0.94, constant speed, 15 < HP ≤ 50	Standard clean water pump, PEI 0.94, constant speed, 15 < HP ≤ 50
15 < HP ≤ 50	≤ 0.90	Wastewater	Constant Speed	AK	Standard wastewater pump, PEI 0.94, constant speed, 15 ≤ HP ≤ 50	Standard wastewater pump, PEI 0.94, constant speed, 15 ≤ HP ≤ 50
15 < HP ≤ 50	≤ 0.92	Clean water	Constant Speed	J	Standard clean water pump, PEI 0.94, constant speed, 15 < HP ≤ 50	Standard clean water pump, PEI 0.94, constant speed, 15 < HP ≤ 50
15 < HP ≤ 50	≤ 0.92	Wastewater	Constant Speed	AL	Standard wastewater pump, PEI 0.94, constant speed, 15 ≤ HP ≤ 50	Standard wastewater pump, PEI 0.94, constant speed, 15 ≤ HP ≤ 50

Pump Motor Horsepower	Measure PEI Range	Application Type	Control Strategy	Statewide Measure Offering ID (text)	Existing Description (text)	Standard Description (text)
50 < HP ≤ 250	≤ 0.45	Clean water	Variable Speed	W	Standard clean water pump, PEI 0.49, variable speed, 50 < HP≤ 250	Standard clean water pump, PEI 0.49, variable speed, 50 < HP≤ 250
50 < HP ≤ 250	≤ 0.45	Wastewater	Variable Speed	AM	Standard wastewater pump, PEI 0.49, variable speed, 50 ≤ HP ≤ 250	Standard wastewater pump, PEI 0.49, variable speed, 50 ≤ HP ≤ 250
50 < HP ≤ 250	≤ 0.47	Clean water	Variable Speed	V	Standard clean water pump, PEI 0.49, variable speed, 50 < HP ≤ 250	Standard clean water pump, PEI 0.49, variable speed, 50 < HP ≤ 250
50 < HP ≤ 250	≤ 0.47	Wastewater	Variable Speed	AN	Standard wastewater pump, PEI 0.49, variable speed, 50 ≤ HP ≤ 250	Standard wastewater pump, PEI 0.49, variable speed, 50 ≤ HP ≤ 250
50 < HP ≤ 250	≤ 0.89	Clean water	Constant Speed	O	Standard clean water pump, PEI 0.95, constant speed, 50 < HP ≤ 250	Standard clean water pump, PEI 0.95, constant speed, 50 < HP ≤ 250
50 < HP ≤ 250	≤ 0.89	Wastewater	Constant Speed	AO	Standard wastewater pump, PEI 0.95, constant speed, 50 ≤ HP ≤ 250	Standard wastewater pump, PEI 0.95, constant speed, 50 ≤ HP ≤ 250
50 < HP ≤ 250	≤ 0.91	Clean water	Constant Speed	N	Standard clean water pump, PEI 0.95, constant speed, 50 < HP ≤ 250	Standard clean water pump, PEI 0.95, constant speed, 50 < HP ≤ 250

Pump Motor Horsepower	Measure PEI Range	Application Type	Control Strategy	Statewide Measure Offering ID (text)	Existing Description (text)	Standard Description (text)
50 < HP ≤ 250	≤ 0.91	Wastewater	Constant Speed	AP	Standard wastewater pump, PEI 0.95, constant speed, 50 ≤ HP ≤ 250	Standard wastewater pump, PEI 0.95, constant speed, 50 ≤ HP ≤ 250
50 < HP ≤ 250	≤ 0.93	Clean water	Constant Speed	M	Standard clean water pump, PEI 0.95, constant speed, 50 < HP ≤ 250	Standard clean water pump, PEI 0.95, constant speed, 50 < HP ≤ 250
50 < HP ≤ 250	≤ 0.93	Wastewater	Constant Speed	AQ	Standard wastewater pump, PEI 0.95, constant speed, 50 ≤ HP ≤ 250	Standard wastewater pump, PEI 0.95, constant speed, 50 ≤ HP ≤ 250

Code Requirements

This measure is not governed by California state codes and standards. Under Title 10 Section 431.462, the U.S. Department of Energy (DOE) developed the Energy Conservation Standard (ECS) for commercial, industrial, and agricultural clean water pumps. As of January 2020, all clean water pumps sold are required to have an ECS label with a PEI rating ≤ 1.0.

Table 16: Applicable State and Federal Codes and Standards

Code	Applicable Code Reference	Effective Date
CA Appliance Efficiency Regulations – Title 20	None	N/A
CA Building Energy Efficiency Standards – Title 24	None	N/A
Federal Standards	Title 10 Section 431.462	January 27, 2020

Program Requirements

Measure Implementation Eligibility

All combinations of measure application type, delivery type, and sector that are established for this measure are specified in Table 17 below. Measure application type is a categorization based on the circumstances and timing of the measure installation. Each measure application type is distinguished by its baseline determination, cost basis, eligibility, and documentation requirements. Delivery type is the broad categorization of the delivery channel through which the market intervention strategy (financial incentives or other services) is targeted. This table also designates the broad market sector(s) that are applicable for this measure.

Note that some of the implementation combinations below may not be allowed for some measure offerings by all program administrators.

Table 17: Measure Implementation Eligibility

Measure Application Type	Sector	Delivery Type
NC	Ag	DnDeemDI
NC	Ag	DnDeemed
NC	Ag	UpDeemed
NC	Com	DnDeemDI
NC	Com	DnDeemed
NC	Com	UpDeemed
NC	Ind	DnDeemDI
NC	Ind	DnDeemed
NC	Ind	UpDeemed
NR	Ag	DnDeemDI
NR	Ag	DnDeemed
NR	Ag	UpDeemed
NR	Com	DnDeemDI
NR	Com	DnDeemed
NR	Com	UpDeemed
NR	Ind	DnDeemDI
NR	Ind	DnDeemed
NR	Ind	UpDeemed

Guidance for Measure Application Types

Per the CPUC's New Construction Measure Application Type Definition and Best Practices guidance, the following nontraditional installation scenarios differentiate the eligibility between new construction (NC) and normal replacement (NR) measure application types (including their respective

building vintages). For guidance on which delivery types are applicable to NC, please see the Measure Implementation Eligibility table above.

- Installing equipment where one was not installed previously (i.e. non-replacement project) - NR and Ex
- Installing equipment in an alteration or expansion project that increases footprint by less than 30 percent - NR and Ex
- Installing equipment in an alteration or expansion project that increases footprint by 30 percent or more - NC and New

Title 24 and Permitting Requirements

Pursuant to Senate Bill SB1414 California Public Utilities Code Section 399.4 (b)(1), there are requirements on certification by the customer or contractor, indicating that the improvement or installation has complied with any applicable permitting requirements, including any applicable specifications or requirements set forth in the California Building Standards Code (Title 24 of the California Code of Regulations). Additionally, these requirements state that, if the contractor performed the installation or improvement, that the contractor hold the appropriate license for the work performed, in compliance with this measure application.

Eligible Products

Clean water pumps and wastewater pumps that are intended for agricultural, commercial, and industrial sectors are required to have a nominal pump motor horsepower rating of ≤ 250 and meet the PEI requirements specified in the Measure Case Description section. The selection of offering IDs and incentivized units will be based on the rated pump motor horsepower. Additionally, the PEI should be confirmed on the HI database (https://er.pumps.org/ratings/searchv).

Any of the following clean water rotodynamic pump classes are eligible:

- End suction frame mount (ESFM)
- End suction close coupled (ESCC)
- In-line (IL)
- Radially split multi-stage vertical in-line diffuser casing (RSV)
- Vertical turbine submersible (ST)

For variable speed pumps, programs must verify that the pumps are operating at variable speed to achieve variable flow. The verification process includes providing photographs of the pump controls, pump management system, and/or a written description of the pump control strategy.

Eligible Building Types and Vintages

This measure is applicable for the following agricultural, commercial, or industrial building types of "New" and "Existing" vintages. Note that savings values for “Existing” vintage is also eligible for “Rec” and “Old” vintages. The "Commercial" building type (Com) is ineligible for downstream delivery types.

Table 18: Eligible Building Types and Sectors

Building Type	Sector
AgOth	Ag
Asm	Com
Cnc	Com
Com	Com
CRe	Com
Dat	Com
ECC	Com
EPr	Com
ERC	Com
ESe	Com
EUD	Com
EUn	Com
Fhc	Com
Gro	Com
Gst	Com
HGR	Com
Hsp	Com
Htl	Com
IndOth	Ind
Mtl	Com
Nrs	Com
OfL	Com
OfS	Com
RFF	Com
RSD	Com
Rt3	Com
RtL	Com
RtS	Com
s_Cli	Com
s_FSt	Com
s_MiC	Com
s_TCU	Com
SCn	Com
SUn	Com
Sup	Com
WRf	Com

Eligible Climate Zones

This measure is applicable in all California climate zones.

Data Collection Requirements

Data collection requirements are described in Database for Energy Efficient Resources (DEER) Resolutions E-5152, E-5221, and the Final Impact Evaluation Non-Residential Deemed Pump and Food Service Program Year 2020, with the following objectives:

1. Better tracking of the installed equipment that received a rebate,
2. Ensuring that eligible measures are submitted in applications,
3. Ensuring that proper evaluation and application of savings are performed per California evaluation, measurement, and verification (EM&V) protocols, and
4. Ensuring that cost-effectiveness values are properly/correctly applied for each application/project.

Therefore, at a minimum, the following data must be collected:

Table 19: Data Collection Requirements for Incentived Heat Pump Equipment

Data Collection Requirements	Required for Upstream	Required for Downstream and Direct Install
Site ID - A unique identifier for the shipping destination (upstream) or installed location (Midstream/Downstream/DI) of the incentivized equipment (e.g., site address). In addition, include service account ID for the site.	Yes	Yes
Quantity per site - Total units of incentivized equipment located at the site or project (HP)	Yes	Yes
Measure equipment ID 14 A unique identifier for each unit of incentivized equipment (e.g., serial number)	Yes	Yes
Measure equipment model number	Yes	Yes
Measure equipment manufacturer	Yes	Yes
Measure equipment rated efficiency (PEI)	Yes	Yes
Measure equipment control strategy (constant speed or variable speed)	Yes	Yes
Measure equipment class (i.e., end suction frame mount, end suction close coupled, in-line, radially split multi-stage vertical in-line diffuser casing, vertical turbine submersible)	Yes	Yes
Measure equipment motor horsepower (HP)	Yes	Yes
Invoices	Provide if available	Yes
Climate zone	Yes	Yes
Building type	Yes	Yes
Building vintage	Yes	Yes

Electric Savings (kWh)

This unit energy savings (UES) analysis was adopted from the pump savings analysis approved by the Regional Technical Forum (RTF) for NEEA's Efficient Commercial and Industrial Pumps (ECIP) project. This analysis was approved in April 2022, and included extensive pump modeling, DOE database information, and customer and vendor field data.

The UES from retrofitting an existing pump to a more efficient measure case pump is based on the NEEA modification of the HI pump energy savings calculation. The HI energy savings calculation assumes a conservative base case efficiency scenario and does not include adjustment factors to

[14] Exemptions to the equipment identifier requirement will be made for measure package offerings where leveraging a serial number or other practical unique identifier is infeasible. Exemptions will need to be approved by the CPUC in advance.

account for pump nominal power and actual pump performance variances. The NEEA modifications of the HI calculation considered baseline market average pump efficiencies and adjustment factors that reflect nominal versus actual power draw and actual pump system curves.

Per Final Impact Evaluation Non-Residential Deemed Pump and Food Service Program Year 2020, this measure package has been revised to reflect the most accurate and up-to-date PEI values available in the HI database. The base case PEI values were found by determining the most common PEI values for each speed control and pump motor horsepower bin. The measure case PEI tiers were set by incrementally improving the PEIs by values of 0.02 for each tier. These efficiency tiers were selected based on a review of the PEI distribution of eligible pumps in the HI pump database. Only two tiers were approved for the largest horsepower variable speed bin because no products currently exist in the highest PEI bin for that size and control combination.

The energy savings analysis NEEA was streamlined for this measure. The electric unit energy consumption (UEC) and UES for installing high-efficiency pumps were calculated using the calculations below. An identical measure case UEC calculation can be viewed on the Calculations tab.

Table 20: Annual Unit Energy Consumption – Electric, Baseline

Equation (kWh/Yr)
$\frac{(opHrs\_\_opHrsYr \cdot opHrs\_\_adjFactor \cdot pumps\_\_size \cdot pumps\_\_PEIBase \cdot const\_\_kW\_HP)}{pumps\_\_mtrSize}$

opHrs__opHrsYr = Annual operating hours (hr)
opHrs__adjFactor = Final load profile adjustment factors by application and speed control case
pumps__size = Representative pump size (HP)
pumps__PEIBase = Base PEIconst__kW_HP= Conversion factor of 0.746 (kW/HP)
pumps__mtrSize = Representative motor size (HP)

Table 21: Annual Unit Energy Savings – Electric

Equation (kWh/Yr)
UEC_*YrkWhBase* – *UEC_Y rkWhMeas*

UEC_YrkWhBase = Annual unit energy consumption – electric, baseline (kWh/y)
UEC_YrkWhMeas = Annual unit energy consumption – electric, measure case (kWh/y)

The inputs for the UEC calculations are specified below. Annual hours of operation and adjustment factors for differing pumping applications were adopted directly from the RTF analysis.

Table 22: Constants – Annual Operating Hours and Adjustment Factors

Application Type	Control Strategy	Sector	Annual Operation Hours (Hr/Year)	Adjustment Factors (Ratio)
Clean water	Constant Speed	Ag	2358	1.3250
Clean water	Constant Speed	Com	3753	1.2500
Clean water	Constant Speed	Ind	6175	1.3100
Clean water	Variable Speed	Ag	2358	1.8450
Clean water	Variable Speed	Com	3753	1.0000
Clean water	Variable Speed	Ind	6175	1.2140
Wastewater	Constant Speed	Ag	4014	1.3100
Wastewater	Constant Speed	Com	1925	1.3100
Wastewater	Constant Speed	Ind	1690	1.3100
Wastewater	Variable Speed	Ag	4014	1.2140
Wastewater	Variable Speed	Com	1925	1.2140
Wastewater	Variable Speed	Ind	1690	1.2140

Pump parameters were derived using the same strategies as those in the RTF analysis but calculated specifically for this measure's horsepower bins. Pump motor oversizing values were taken as the average of oversizing percentages per relevant pump motor horsepower bins from the RTF workbook, originally sourced from the NEEA report, Extended Motor Products Savings Validation Research on Clean Water Pumps and Circulators. The motor oversizing percentage is the difference between the pump input power at the most efficient operating point and the rated motor horsepower. Representative horsepower values were calculated as the midpoint for each horsepower bin. The average oversizing percentage was then applied to the representative motor horsepower to derive the representative pump horsepower used for the calculations.

Table 23: Pump Parameters

Pump Motor Horsepower	Measure PEI Range	Control Strategy	Average Oversize (%)	Representative Motor Size (HP)	Representative Pump Size (HP)	Base PEI (Ratio)	Measure PEI (Ratio)
1 ≤ HP ≤ 15	≤ 0.41	Variable Speed	0.3137	8	5.49	0.47	0.41
1 ≤ HP ≤ 15	≤ 0.43	Variable Speed	0.3137	8	5.49	0.47	0.43
1 ≤ HP ≤ 15	≤ 0.45	Variable Speed	0.3137	8	5.49	0.47	0.45
1 ≤ HP ≤ 15	≤ 0.88	Constant Speed	0.3137	8	5.49	0.94	0.88
1 ≤ HP ≤ 15	≤ 0.90	Constant Speed	0.3137	8	5.49	0.94	0.9
1 ≤ HP ≤ 15	≤ 0.92	Constant Speed	0.3137	8	5.49	0.94	0.92
15 < HP ≤ 50	≤ 0.43	Variable Speed	0.2184	32.5	25.4	0.49	0.43
15 < HP ≤ 50	≤ 0.45	Variable Speed	0.2184	32.5	25.4	0.49	0.45
15 < HP ≤ 50	≤ 0.47	Variable Speed	0.2184	32.5	25.4	0.49	0.47
15 < HP ≤ 50	≤ 0.88	Constant Speed	0.2184	32.5	25.4	0.94	0.88
15 < HP ≤ 50	≤ 0.90	Constant Speed	0.2184	32.5	25.4	0.94	0.9
15 < HP ≤ 50	≤ 0.92	Constant Speed	0.2184	32.5	25.4	0.94	0.92
50 < HP ≤ 250	≤ 0.45	Variable Speed	0.1662	150	125.07	0.49	0.45
50 < HP ≤ 250	≤ 0.47	Variable Speed	0.1662	150	125.07	0.49	0.47
50 < HP ≤ 250	≤ 0.89	Constant Speed	0.1662	150	125.07	0.95	0.89
50 < HP ≤ 250	≤ 0.91	Constant Speed	0.1662	150	125.07	0.95	0.91
50 < HP ≤ 250	≤ 0.93	Constant Speed	0.1662	150	125.07	0.95	0.93

Peak Electric Demand Reduction (kW)

Some peak demand reduction is expected to be associated with pump efficiency improvements. However, the project team was unable to find any studies regarding sector-specific peak demand reductions in California. Therefore, no peak demand reduction is being claimed for this measure.

Gas Savings (Therms)

Not applicable.

Life Cycle

Effective useful life (EUL) is an estimate of the median number of years that a measure installed through a program is still in place and operable. EUL is often, but not always, derived from measure persistence or retention studies. Remaining useful life (RUL) is an estimate of the median number of years that a technology or piece of equipment replaced or altered by an energy efficiency program would have remained in service and operational, had the program intervention not caused the replacement or alteration.

The EUL and RUL for this measure are specified below. This EUL was adopted for the 2008 DEER and is based on estimates reported in several California-based retention studies. Note that RUL is only applicable for add-on equipment and accelerated replacement measures and is not applicable for this measure.

Table 24: Effective Useful Life and Remaining Useful Life

Effective Useful Life ID	EUL Description (Text)	Sector (Text)	EUL Years (Yr)	Start Date (Text)	Expire Date (Text)
Motors-pump	Water Loop Pumps	Com	15	41275	

Base Case Material Cost ($/Unit)

See the Measure Case Material Cost ($/Unit) section.

Measure Case Material Cost ($/Unit)

Material cost for this measure was determined from the incremental cost (IMC) analysis developed by the Lincus team. The measure developer developed a clean water pump cost curve to calculate the incremental pump cost per both pump motor horsepower and PEI. This cost curve was used with the representative pump size values associated with this measure. Subsequently, the cost was multiplied by the delta PEI values for each measure tier to arrive at the normalized cost per pump motor horsepower for each measure. The IMC for wastewater pumps is considered to be the same as clean water pumps, as the motor horsepower and PEI are consistent across both applications. The incremental costs were calculated based on the following equation:

Table 25: Incremental Cost

Equation (USD)
$(costCalcInputs\_\_a \cdot pumps\_\_mtrSize^{costCalcInputs\_\_b}) \cdot (pumps\_\_PEIBase - pumps\_\_PEIMeas)$

costCalc__a = Coefficient a from 2024 pump cost curve
costCalc__b = Coefficient b from 2024 pump cost curve
pumps__mtrSize = Representative motor size (HP)
pumps__PEIBase = Base PEI
pumps__PEIMeas = Measure PEI

The inputs for the IMC calculations are specified below.

Table 26: Costs – Calculation Inputs

Pump Motor Horsepower	Measure PEI Range	Application Type	Control Strategy	A (number)	B (number)
1 ≤ HP ≤ 15	PEI ≤ 0.41	Clean water	Variable Speed	2092.3	-0.71
1 ≤ HP ≤ 15	PEI ≤ 0.41	Wastewater	Variable Speed	2092.3	-0.71
1 ≤ HP ≤ 15	PEI ≤ 0.43	Clean water	Variable Speed	2092.3	-0.71
1 ≤ HP ≤ 15	PEI ≤ 0.43	Wastewater	Variable Speed	2092.3	-0.71
1 ≤ HP ≤ 15	PEI ≤ 0.45	Clean water	Variable Speed	2092.3	-0.71
1 ≤ HP ≤ 15	PEI ≤ 0.45	Wastewater	Variable Speed	2092.3	-0.71
1 ≤ HP ≤ 15	PEI ≤ 0.88	Clean water	Constant Speed	3006.9	-0.64
1 ≤ HP ≤ 15	PEI ≤ 0.88	Wastewater	Constant Speed	3006.9	-0.64
1 ≤ HP ≤ 15	PEI ≤ 0.90	Clean water	Constant Speed	3006.9	-0.64
1 ≤ HP ≤ 15	PEI ≤ 0.90	Wastewater	Constant Speed	3006.9	-0.64
1 ≤ HP ≤ 15	PEI ≤ 0.92	Clean water	Constant Speed	3006.9	-0.64
1 ≤ HP ≤ 15	PEI ≤ 0.92	Wastewater	Constant Speed	3006.9	-0.64
15 < HP ≤ 50	PEI ≤ 0.43	Clean water	Variable Speed	2092.3	-0.71
15 < HP ≤ 50	PEI ≤ 0.43	Wastewater	Variable Speed	2092.3	-0.71
15 < HP ≤ 50	PEI ≤ 0.45	Clean water	Variable Speed	2092.3	-0.71
15 < HP ≤ 50	PEI ≤ 0.45	Wastewater	Variable Speed	2092.3	-0.71
15 < HP ≤ 50	PEI ≤ 0.47	Clean water	Variable Speed	2092.3	-0.71
15 < HP ≤ 50	PEI ≤ 0.47	Wastewater	Variable Speed	2092.3	-0.71
15 < HP ≤ 50	PEI ≤ 0.88	Clean water	Constant Speed	3006.9	-0.64
15 < HP ≤ 50	PEI ≤ 0.88	Wastewater	Constant Speed	3006.9	-0.64
15 < HP ≤ 50	PEI ≤ 0.90	Clean water	Constant Speed	3006.9	-0.64
15 < HP ≤ 50	PEI ≤ 0.90	Wastewater	Constant Speed	3006.9	-0.64
15 < HP ≤ 50	PEI ≤ 0.92	Clean water	Constant Speed	3006.9	-0.64
15 < HP ≤ 50	PEI ≤ 0.92	Wastewater	Constant Speed	3006.9	-0.64
50 < HP ≤ 250	PEI ≤ 0.45	Clean water	Variable Speed	2092.3	-0.71

50 < HP ≤ 250	PEI ≤ 0.45	Wastewater	Variable Speed	2092.3	-0.71
50 < HP ≤ 250	PEI ≤ 0.47	Clean water	Variable Speed	2092.3	-0.71
50 < HP ≤ 250	PEI ≤ 0.47	Wastewater	Variable Speed	2092.3	-0.71
50 < HP ≤ 250	PEI ≤ 0.89	Clean water	Constant Speed	3006.9	-0.64
50 < HP ≤ 250	PEI ≤ 0.89	Wastewater	Constant Speed	3006.9	-0.64
50 < HP ≤ 250	PEI ≤ 0.91	Clean water	Constant Speed	3006.9	-0.64
50 < HP ≤ 250	PEI ≤ 0.91	Wastewater	Constant Speed	3006.9	-0.64
50 < HP ≤ 250	PEI ≤ 0.93	Clean water	Constant Speed	3006.9	-0.64
50 < HP ≤ 250	PEI ≤ 0.93	Wastewater	Constant Speed	3006.9	-0.64

Base Case Labor Cost ($/Unit)

See the Measure Case Labor Cost ($/Unit) section.

Measure Case Labor Cost ($/Unit)

There is no incremental labor cost assumed between the base and measure case equipment because both are similarly sized clean water pumps, only with different efficiencies. Therefore, no labor cost calculations were conducted for this measure.

Net-to-Gross

The net-to-gross (NTG) ratio represents the portion of gross impacts that are determined to be directly attributed to a specific program intervention. These NTG values are based upon the average of all NTG ratios for all evaluated 2006 to 2008 nonresidential sector programs, as documented in the 2011 DEER Update Study conducted by Itron, Inc. These sector average NTGs ("default NTGs") are applicable to all energy efficiency measures that have been offered through agriculture, commercial, and industrial sector programs for more than two years and for which impact evaluation results are not available.

Table 27: Net-to-Gross Ratio – Nonresidential

Net-to-Gross Ratio ID	NTGRKWH (RATIO)	NTGRTHERM (RATIO)
Agric-Default>2yrs	0.6	0.6
Com-Default>2yrs	0.6	0.6
Ind-Default>2yrs	0.6	0.6

Gross Savings Installation Adjustment

The gross savings installation adjustment (GSIA) rate represents the ratio of the number of verified installations of the measure to the number of claimed installations reported by the utility. This factor varies by end use, sector, technology, application, and delivery method. This GSIA rate is the current "default" rate specified for measures for which an alternative GSIA has not been estimated and approved.

Table 28: Gross Savings Installation Adjustments – Default

GSIA ID	GSIA (Ratio)
Def-GSIA	1.0000

Non-Energy Impacts

Non-energy impacts for this measure have not been quantified.

DEER Differences Analysis

This section provides a summary of DEER-based inputs and methods, and the rationale for inputs and methods that are not DEER-based.

Table 29: DEER Difference Summary

DEER Item	Comment
Modified DEER methodology	No
Scaled DEER measure	No
DEER base case	No
DEER measure case	No
DEER building types	No
DEER operating hours	No
DEER eQUEST prototypes	No
DEER version	N/A
Reason for deviation from DEER	DEER does not contain this type of measure.
DEER measure IDs used	N/A

Stakeholder Feedback

The ISP study request form and questionnaire was sent to the CPUC for their feedback. CPUC provided feedback on both documents on 7/26/2024. Revisions of the documents were resubmitted to the CPUC on 7/29/2024.

A representative from Motion Industries sent an inquiry about this CalNEXT Market Study (ET24SWE0038). Following the inquiry, ISP surveys were conducted to obtain stakeholder feedback from Motion Industries and Grundfos through this program inquiry. Stakeholder feedback was gathered through performing the ISP surveys.

Next Steps

1. ISP Study Report – The project team has submitted the ISP study report to SCE for review. Any revisions will be addressed and the report will be submitted to the CPUC for review.
2. Measure Package Update Program Year 2025 – Cal TF has reviewed the draft measure package and it is now with SCE for review. The project team will coordinate with SCE to address comments and move the measure package through the CPUC review process.
3. Measure Package Update Program Year 2026 – The project team will coordinate with SCE's measure package team and CalNEXT to get approval on the ISP study report and update SWWP004 for Program Year 2026 with the recommended ISP baseline from the finalized ISP study report.

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Appendix A: ISP Survey Questionnaire

Water Pump Upgrade ISP Survey Questionnaire

Subject Matter Experts/Consulting Firms/Customer Facility Personnel:

1. What is your current title/role?

2. How many years of experience do you have in pumping systems?

3. What types of experience do you have in pumping systems? *[Note: If response to (2) and (3) shows no/limited experience to provide input for the survey, thank the interviewee and terminate the call].*

4. Which specific customer types/segments purchase "clean water pumps" as defined above? (Check all that apply)

- ☐ Agricultural
- ☐ Commercial
- ☐ Industrial
- ☐ Municipal
- ☐ Residential
- ☐ Wastewater
- ☐ Other: Click or tap here to enter text.

[If response to Question 4 indicates this interviewee is familiar with wastewater customer segment, ask Question 5, if not, skip Question 5 and proceed to Question 6]

5. Are there variations in pump types sold in the wastewater customer segment versus other segments?

- ☐ Yes
- ☐No

[If answer to question 5 is Yes, then ask questions 6-11 for both non-wastewater and wastewater segments.]

6. What percentage of customers are aware of the Department of Energy's pump efficiency index (PEI) rating for Pump Energy Conservation Standards:

- ☐ Less than 25%
- ☐ 25%–50%
- ☐ 50%–75%
- ☐ 75%+
- ☐ Don't know
- ☐ Can provide later

7. What is the most commonly purchased PEI rating for constant speed pumps by rated motor HP range (e.g., 0.5–1.0)?
Responses may be specific PEI rating or one of the following ranges <0.8, 0.81–0.89, 0.90–0.93, 0.94–0.98, 0.98–1.0, I don't know

a. 1–15 horsepower: Click or tap here to enter text.
☐ <0.8 ☐ 0.81–0.89 ☐ 0.90–0.93 ☐ 0.94–0.98 ☐ 0.98–1.0 ☐ I don't know

b. 15–50 horsepower: Click or tap here to enter text.
☐ <0.8 ☐ 0.81–0.89 ☐ 0.90–0.93 ☐ 0.94–0.98 ☐ 0.98–1.0 ☐ I don't know

c. 50–250 horsepower: Click or tap here to enter text.
☐ <0.8 ☐ 0.81–0.89 ☐ 0.90–0.93 ☐ 0.94–0.98 ☐ 0.98–1.0 ☐ I don't know

8. What is the most commonly purchased PEI rating for variable speed pumps by rated motor HP range (e.g., 0.3-0.50)?
Responses may be specific PEI rating or one of the following ranges <0.3, 0.31–0.39, 0.40–0.43, 0.44–0.48, 0.48–0.50, I don't know

a. 1–15 horsepower: Click or tap here to enter text.
☐ <0.3 ☐ 0.31–0.39 ☐ 0.40–0.43 ☐ 0.44–0.48 ☐ 0.48–0.50 ☐ I don't know

b. 15–50 horsepower: Click or tap here to enter text.
☐ <0.3 ☐ 0.31–0.39 ☐ 0.40–0.43 ☐ 0.44–0.48 ☐ 0.48–0.50 ☐ I don't know

c. 50–250 horsepower: Click or tap here to enter text.
☐ <0.3 ☐ 0.31–0.39 ☐ 0.40–0.43 ☐ 0.44–0.48 ☐ 0.48–0.50 ☐ I don't know
[Note: Probe to see if they consider anything with PEI as 1.0 as efficient. If they do, probe to define what is the PEI rating that goes above and beyond DOE baseline that they would define as "efficient."]

9. If you specify pumps for customers, what are the key technical factors considered?
Do you specify pump PEI ratings in selecting pumps for the customer?
☐ Yes ☐ No

10. When deciding on purchasing new or replacing pumps, what are the key factors considered?
Does pump PEI rating affect the customer's decision–making process when selecting a pump?
☐ Yes ☐ No ☐ I don't know

11. What are the criteria customers consider when purchasing a pump? (e.g., initial cost, operating cost, reliability, past experience, efficiency, utility savings, product availability). *[Note: Ask to see if they can provide ranking from most important to least important]*
☐ Initial Cost
☐ Operating Cost/Efficiency
☐ Reliability
☐ Prior Experience/Spare parts consistency/Manufacturer or type consistency
☐ Availability
☐ Other: Click or tap here to enter text.

12. Are pump vendors you work with aware of PEI ratings of pumps?
If so, what percent of their recommendations are efficient pumps?
☐ Less than 25%
☐ 25%–50%
☐ 50%–75%
☐ 75%+

☐ I don't know

Are efficient pumps readily available for purchase?

☐ Yes ☐ No ☐ Not Sure

Pump Manufacturers:

1. What is your current title/role?

2. How many years of experience do you have in pumping systems?

3. What types of experience do you have in pumping systems? *[Note: If response to (2) and (3) shows no/limited experience to provide input for the survey, thank the interviewee and terminate the call]*

4. Which of the following pump equipment classes does your company sell? (Check all that apply)

☐ ESCC: end suction close coupled pump
☐ ESFM: end suction frame mounted pump
☐ IL: in-line close coupled and split coupled pumps
☐ RSV: radially split, multistage, vertical, in-line casing diffuser pump
☐ Submersible vertical turbines pump

[If response to Question 4 indicates this interviewee is familiar with wastewater customer segment, ask Question 5, if not, skip Question 5 and proceed to Question 6]

5. Are there variations in pump types sold in the wastewater customer segment versus other segments?

☐ Yes
☐ No

[If answer to question 5 is Yes, then ask questions 6–13 for both non-wastewater and wastewater segments.]

6. Which sector(s) does your company sell "clean water pumps" to, as defined above? (Check all that apply)

☐ Agricultural
☐ Commercial
☐ Industrial
☐ Municipal
☐ Residential
☐ Wastewater
☐ Other: Click or tap here to enter text.

7. What range of pump sizes (in rated-motor horsepower) does your company typically sell? What is the most common size? *[Note: Last three years is the preferred time period]*

☐ 1–15 horsepower
☐ 15–50 horsepower
☐ 50–250 horsepower

Most common size sold – Click or tap here to enter text.

8. Are you aware of the Department of Energy's established metric, pump efficiency index (PEI) rating for Pumping System Energy Standards?

☐ Yes ☐ No

9. Do you advise or recommend to potential customers selection of pumps based on their PEI ratings factor?

☐ Yes ☐ No

10. Do PEI ratings factor into the customer decision-making process when purchasing a pump?

☐ Yes ☐ No ☐ I don't know

11. Are PEI ratings specified in the customer's technical specifications or equipment order?

☐ Yes ☐ No ☐ I don't know

12. What are the most commonly sold pump models in the last 12 months within the following ranges (up to three):

a. 1–15 horsepower

Click or tap here to enter text.
Click or tap here to enter text.
Click or tap here to enter text.

b. 15–50 horsepower

Click or tap here to enter text.
Click or tap here to enter text.
Click or tap here to enter text.

c. 50–250 horsepower

Click or tap here to enter text.
Click or tap here to enter text.
Click or tap here to enter text.

13. What is the relative quantity of pumps sold annually by rated HP range? *[Note: Last three years is the preferred time period]*

a. 1–15 horsepower

☐ 10s ☐ 100s ☐ 1000s

b. 15–50 horsepower

☐ 10s ☐ 100s ☐ 1000s

c. 50–250 horsepower

☐ 10s ☐ 100s ☐ 1000s

Pump Vendors (Installation Contractors, Distributors):

1. What is your current title/role?

2. How many years of experience do you have in pumping systems?

3. What types of experience do you have in pumping systems? *[Note: If response to (2) and (3) shows no/limited experience to provide input for the survey, thank the interviewee and terminate the call].*

4. Which of the following pump equipment classes does your company sell/install? (Check all that apply)

☐ ESCC: end suction close coupled pump
☐ ESFM: end suction frame mounted pump
☐ IL: in-line close coupled and split coupled pumps

☐ RSV: radially split, multistage, vertical, in-line casing diffuser pump
☐ Submersible vertical turbines pump

5. Which sector(s) does your company sell/install "clean water pumps" to, as defined above? (Check all that apply)
☐ Agricultural
☐ Commercial
☐ Industrial
☐ Municipal
☐ Residential
☐ Wastewater
☐ Other: Click or tap here to enter text.

[If response to Question 5 indicates this interviewee is familiar with wastewater customer segment, ask Question 6, if not, skip Question 6 and proceed to Question 7]

6. Are there variations in pump types sold in the wastewater customer segment versus other segments?
☐ Yes
☐No

[If answer to question 6 is Yes, then ask questions 7–16 for both non-wastewater and wastewater segments.]

7. What range of pump sizes (in rated-motor horsepower) does your company typically sell? What is the most common size? *[Note: Last three years is the preferred time period]*
☐ 1–15 HP
☐ 15–50 HP
☐ 50–250 HP
Most common size sold – Click or tap here to enter text.

8. Are you aware of the Department of Energy's established metric, pump efficiency index (PEI) rating for Pumping System Energy Standards?
☐ Yes ☐ No

9. Do you advise or recommend to potential customers selection of pumps based on their PEI ratings factor?
☐ Yes ☐ No

10. Do PEI ratings factor into the customer decision-making process when purchasing a pump?
☐ Yes ☐ No ☐ I don't know

11. Are PEI ratings specified in the customer's technical specifications or equipment order?
☐ Yes ☐ No ☐ I don't know

12. What are the most common sold/installed pump manufacturer and models in the last three years within the following ranges (up to three):
a. 1-15 horsepower
Click or tap here to enter text.
Click or tap here to enter text.

Click or tap here to enter text.

b. 15–50 horsepower

Click or tap here to enter text.
Click or tap here to enter text.
Click or tap here to enter text.

c. 50–250 horsepower

Click or tap here to enter text.
Click or tap here to enter text.
Click or tap here to enter text.

13. What is the relative quantity of pumps sold annually by rated HP range? *[Note: Last three years is the preferred time period]*

a. 1–15 horsepower

☐ 10s ☐ 100s ☐ 1000s ☐ Click or tap here to enter text.

b. 15–50 horsepower

☐ 10s ☐ 100s ☐ 1000s ☐ Click or tap here to enter text.

c. 50–250 horsepower

☐ 10s ☐ 100s ☐ 1000s ☐ Click or tap here to enter text.

14. If yes, to the above question, what is the PEI rating customer consider as efficient for constant and variable speed pumps by rated HP range.

a. Constant Speed 1–15 horsepower – Click or tap here to enter text.
b. Constant Speed 15–50 horsepower – Click or tap here to enter text.
c. Constant Speed 50–250 horsepower – Click or tap here to enter text.
d. Variable Speed 1–15 horsepower – Click or tap here to enter text.
e. Variable Speed 15–50 horsepower – Click or tap here to enter text.
f. Variable Speed 50–250 horsepower – Click or tap here to enter text.

15. What percentage of sales do efficient pumps account for in the last three years?

☐ Less than 25%
☐ 25%–50%
☐ 50%–75%
☐ 75+%
☐ I don't know

16. What are the main factors that a customer considers when choosing a pump for installation? (E.g., Initial cost, operating cost, reliability, past experience, efficiency, utility savings, etc.)

☐ Initial Cost
☐ Operating Cost/Efficiency
☐ Reliability
☐ Prior Experience/Spare parts consistency/Manufacturer or type consistency
☐ Efficiency
☐ Availability
☐ Other: Click or tap here to enter text.

VFD Vendors (Installation Contractors, Distributors):

1. What is your current title/role?

2. How many years of experience do you have in pumping systems?

3. What types of experience do you have in pumping systems? *[Note: If response to (2) and (3) shows no/limited experience to provide input for the survey, thank the interviewee and terminate the call].*

4. Which of the following pump equipment classes does your company sell/or for which you install VFDs to? (Check all that apply)

- ☐ ESCC: end suction close coupled pump
- ☐ ESFM: end suction frame mounted pump
- ☐ IL: in-line close coupled and split coupled pumps
- ☐ RSV: radially split, multistage, vertical, in-line casing diffuser pump
- ☐ Submersible vertical turbines pump

5. Which sector(s) does your company sell/install VFDs for "clean water pumps" to, as defined above? (Check all that apply)

- ☐ Agricultural
- ☐ Commercial
- ☐ Industrial
- ☐ Municipal
- ☐ Residential
- ☐ Wastewater
- ☐ Other: Click or tap here to enter text.

[If response to Question 5 indicates this interviewee is familiar with wastewater customer segment, ask Question 6, if not, skip Question 6 and proceed to Question 7]

6. Are there variations in pump types in the wastewater customer segment versus other segments?

- ☐ Yes
- ☐No

[If answer to question 6 is Yes, then ask questions 7–16 for both non-wastewater and wastewater segments.]

7. What range of pump sizes (in rated-motor horsepower) does your company typically sell VFDs for? What is the most common size? *[Note: Last three years is the preferred time period]*

- ☐ 1–15 HP
- ☐ 15–50 HP
- ☐ 50–250 HP

Most common size sold – Click or tap here to enter text.

8. Are you aware of the Department of Energy's established metric, pump efficiency index (PEI) rating for Pumping System Energy Standards?

☐ Yes ☐ No

9. Do you advise or recommend to potential customers selection of VFDs, and motors based on how it would affect their PEI ratings factor?

☐ Yes ☐ No

10. Do PEI ratings factor into the customer decision-making process when purchasing a VFD for their pump?

☐ Yes ☐ No ☐ I don't know

11. Are PEI ratings specified in the customer's technical specifications or equipment order?
☐ Yes ☐ No ☐ I don't know

12. What are the most common pump manufacturer and models associated with the VFD sold/installed to projects completed in the last three years within the following ranges (up to three):
a. 1–15 horsepower
Click or tap here to enter text.
Click or tap here to enter text.
Click or tap here to enter text.
b. 15–50 horsepower
Click or tap here to enter text.
Click or tap here to enter text.
Click or tap here to enter text.
c. 50–250 horsepower
Click or tap here to enter text.
Click or tap here to enter text.
Click or tap here to enter text.

13. What is the relative quantity of VFDs sold to pumps annually by pump rated HP range? *[Note: This is not the rated HP of the VFD, but of the pump motor. Last three years is the preferred time period]*
a. 1–15 horsepower
☐ 10s ☐ 100s ☐ 1000s ☐ Click or tap here to enter text.
b. 15–50 horsepower
☐ 10s ☐ 100s ☐ 1000s ☐ Click or tap here to enter text.
c. 50–250 horsepower
☐ 10s ☐ 100s ☐ 1000s ☐ Click or tap here to enter text.

14. What is the PEI rating customers consider as efficient for variable speed pumps by rated HP range.
Variable Speed 1–15 horsepower – Click or tap here to enter text.
Variable Speed 15–50 horsepower – Click or tap here to enter text.
Variable Speed 50–250 horsepower – Click or tap here to enter text.

15. What percentage of sales do efficient pumps with variable load account for in the last three years?
☐ Less than 25%
☐ 25%–50%
☐ 50%–75%
☐ 75+%
☐ I don't know

16. What are the main factors that a customer considers when choosing a pump with VFD for installation? (E.g., Initial cost, operating cost, reliability, past experience, efficiency, utility savings, etc.)
☐ Initial Cost
☐ Operating Cost/Efficiency

☐ Reliability
☐ Prior Experience/Spare parts consistency/Manufacturer or type consistency
☐ Efficiency
☐ Availability
☐ Other: Click or tap here to enter text.

Appendix B: ISP Survey Responses

Interview 1: Pump Vendor

1. What is your current title/role?
   Director of Engineering, previous owner, president; semi-retired

2. How many years of experience do you have in pumping systems?
   40 years

3. What types of experience you have in pumping systems?
   Experience in managing large municipalities and contracts with cities, designing well pumps, booster stations, modify and engineer new products, VFDs, pump efficiency

4. Which of the following pump equipment classes does your company sell/install? (Check all that apply)
   ☒ **ESCC: end suction close coupled pump**
   ☒ **ESFM: end suction frame mounted pump**
   ☒ **IL: in-line close coupled and split coupled pumps**
   ☒ **RSV: radially split, multistage, vertical, in-line casing diffuser pump**
   ☒ **Submersible vertical turbines pump**

5. Which sector(s) does your company sell/install "clean water pumps" to, as defined above? (Check all that apply)
   ☒ **Agricultural**
   ☐ Commercial
   ☒ **Industrial**
   ☒ **Municipal**
   ☐ Residential
   ☒ **Wastewater**
   ☐ Other: Click or tap here to enter text.

6. Are there variations in pump types sold in the wastewater customer segment versus other segments?
   ☒ **Yes**
   ☐No

7. What range of pump sizes (in rated-motor horsepower) does your company typically sell? What is the most common size? *[Note: Last three years is the preferred time period]*
   ☐ 1–15 HP
   ☐ 15–50 HP
   ☒ **50–250 HP**
   Most common size sold – **300 HP – bigger pumps; WW-mixed flow propeller type pumps – smaller than typical – OCSD has big pumps – 500 HP**

8. Are you aware of the Department of Energy's established metric, pump efficiency index (PEI) rating for Pumping System Energy Standards?
   ☐ Yes ☒ **No**

9. Do you advise or recommend to potential customers selection of pumps based on their PEI ratings factor?
   ☒ **Yes** ☐ No

10. Do PEI ratings factor into the customer decision-making process when purchasing a pump?
    ☒ **Yes** ☐ No ☐ I don't know

11. Are PEI ratings specified in the customer's technical specifications or equipment order?
    ☒ **Yes** ☐ No ☐ I don't know

12. What are the most common sold/installed pump manufacturer and models in the last three years within the following ranges (up to three):
    a. 1–15 horsepower
    i. Click or tap here to enter text.
    ii. Click or tap here to enter text.
    iii. Click or tap here to enter text.
    b. 15–50 horsepower
    i. Click or tap here to enter text.
    ii. Click or tap here to enter text.
    iii. Click or tap here to enter text.
    c. 50–250 horsepower
    i. Click or tap here to enter text.
    ii. Click or tap here to enter text.
    iii. Click or tap here to enter text.

    Vertical Turbines – multistage deep set for well, shallow for booster – Goulds, Hydroflow, Flowserve are most common brands.

13. What is the relative quantity of pumps sold annually by rated HP range? [Note: Last three years is the preferred time period]
    a. 1–15 horsepower
    ☐ 10s ☐ 100s ☒ **1000s** ☐ Click or tap here to enter text.
    b. 15–50 horsepower
    ☐ 10s ☐ 100s ☒ **1000s** ☐ Click or tap here to enter text.
    c. 50–250 horsepower
    ☐ 10s ☐ 100s ☒ **1000s** ☐ Click or tap here to enter text.

14. If yes, to the above question, what is the PEI rating customer consider as efficient for constant and variable speed pumps by rated HP range.
    Constant Speed 1–15 horsepower – Click or tap here to enter text.
    Constant Speed 15–50 horsepower – Click or tap here to enter text.
    Constant Speed 50–250 horsepower –**70% OPE, no input on PEI rating**
    Variable Speed 1–15 horsepower – Click or tap here to enter text.
    Variable Speed 15–50 horsepower – Click or tap here to enter text.
    Variable Speed 50–250 horsepower – Click or tap here to enter text.

15. What percentage of sales do efficient pumps account for in the last three years?

☐ Less than 25%
☐ 25%–50%
☐ 50%–75%
☒ **75+% [90% of sales are efficient pumps – large pumps municipalities]**
☐ I don't know

16. What are the main factors that a customer considers when choosing a pump for installation? (E.g. Initial cost, operating cost, reliability, past experience, efficiency, utility savings, etc.)
☒ **Initial Cost – 3**
☐ Operating Cost/Efficiency
☒ **Reliability – 1**
☐ Prior Experience/Spare parts consistency/Manufacturer or type consistency
☒ **Efficiency – 2**
☐ Availability
☐ Other: Click or tap here to enter text.

Interview 2: Pump Vendor

1. What is your current title/role?
Vice President

2. How many years of experience do you have in pumping systems?
35 years of experience

3. What types of experience you have in pumping systems?
Testing pumps, irrigation systems, energy efficiency in pumping systems, vibration analysis, pump efficiency test

4. Which of the following pump equipment classes does your company sell/install? (Check all that apply)
☒ **ESCC: end suction close coupled pump**
☒ **ESFM: end suction frame mounted pump**
☒ **IL: in-line close coupled and split coupled pumps**
☒ **RSV: radially split, multistage, vertical, in-line casing diffuser pump**
☒ **Submersible vertical turbines pump**

5. Which sector(s) does your company sell/install "clean water pumps" to, as defined above? (Check all that apply)
☒ **Agricultural – 50%**
☒ **Commercial**
☒ **Industrial**
☒ **Municipal –50%**
☒ **Residential**
☒ **Wastewater**
☐ Other: Click or tap here to enter text.

6. Are there variations in pump types sold in the wastewater customer segment versus other segments?

☒ **Yes – grinder pumps in ww vs turbines, lower rpm in clean water**
☐No

7. What range of pump sizes (in rated-motor horsepower) does your company typically sell? What is the most common size? *[Note: Last three years is the preferred time period]*

   a. Clean Water Pumps
   ☐ 1–15 HP
   ☐ 15–50 HP
   ☒ **50–250 HP**
   Most common size sold – Click or tap here to enter text.

   b. Wastewater Pumps
   ☐ 1–15 HP
   ☒ **15–50 HP**
   ☐ 50–250 HP
   Most common size sold – Click or tap here to enter text.

8. Are you aware of the Department of Energy's established metric, pump efficiency index (PEI) rating for Pumping System Energy Standards?
   ☐ Yes ☒ **No**

9. Do you advise or recommend to potential customers selection of pumps based on their PEI ratings factor?
   ☐ Yes ☒ **No**

10. Do PEI ratings factor into the customer decision-making process when purchasing a pump?
    ☐ Yes ☒ **No** ☐ I don't know

11. Are PEI ratings specified in the customer's technical specifications or equipment order?
    ☐ Yes ☒ **No** ☐ I don't know

12. What are the most common sold/installed pump manufacturer and models in the last three years within the following ranges (up to three):
    a. 1–15 horsepower
       i. Click or tap here to enter text.
       ii. Click or tap here to enter text.
       iii. Click or tap here to enter text.
    b. 15–50 horsepower
       i. Click or tap here to enter text.
       ii. Click or tap here to enter text.
       iii. Click or tap here to enter text.
    c. 50–250 horsepower
       i. Click or tap here to enter text.
       ii. Click or tap here to enter text.
       iii. Click or tap here to enter text.

13. What is the relative quantity of pumps sold annually by rated HP range? *[Note: Last three years is the preferred time period]*

a. 1–15 horsepower
☐ 10s ☐ 100s ☐ 1000s ☐ Click or tap here to enter text.
b. 15–50 horsepower
☐ 10s ☐ 100s ☐ 1000s ☐ Click or tap here to enter text.
c. 50–250 horsepower
☐ 10s ☐ 100s ☐ 1000s ☐ Click or tap here to enter text.

14. If yes, to the above question, what is the PEI rating customer consider as efficient for constant and variable speed pumps by rated HP range.
    a. Constant Speed 1–15 horsepower – Click or tap here to enter text.
    b. Constant Speed 15–50 horsepower – Click or tap here to enter text.
    c. Constant Speed 50–250 horsepower – Click or tap here to enter text.
    d. Variable Speed 1–15 horsepower – Click or tap here to enter text.
    e. Variable Speed 15–50 horsepower – Click or tap here to enter text.
    f. Variable Speed 50–250 horsepower – Click or tap here to enter text.

15. What percentage of sales do efficient pumps account for in the last three years?
    ☐ Less than 25%
    ☐ 25%–50%
    ☐ 50%–75%
    ☐ 75+%
    ☐ I don't know

16. What are the main factors that a customer considers when choosing a pump for installation? (E.g. Initial cost, operating cost, reliability, past experience, efficiency, utility savings, etc.)
    ☐ Initial Cost
    ☐ Operating Cost/Efficiency
    ☐ Reliability
    ☐ Prior Experience/Spare parts consistency/Manufacturer or type consistency
    ☐ Efficiency
    ☐ Availability
    ☐ Other: Click or tap here to enter text.

17. Can we reach out to you to follow up if we have further questions?
    Yes

18. Could you refer us to anyone knowledgeable about pumps that would be willing to participate in this survey? If so, could you share their contact information?

Interview 3: Subject Matter Expert

1. What is your current title/role?
   Consultant in the water industry – specializing in Energy Efficiency, water operations, SCADA, compliance

2. How many years of experience do you have in pumping systems?
   44 years of experience

3. What types of experience do you have in pumping systems?
   Production supervisor/manager – 15–20 years, pumping plans, engineering work

4. Which specific customer types/segments purchase "clean water pumps" as defined above? (Check all that apply)
   ☒ **Agricultural**
   ☒ **Commercial**
   ☒ **Industrial**
   ☒ **Municipal**
   ☒ **Residential**
   ☐ Wastewater
   ☐ Other: Click or tap here to enter text.

5. Are there variations in pump types sold in the wastewater customer segment versus other segments?
   ☐ Yes
   ☐No

6. What percentage of customers are aware of the Department of Energy's pump efficiency index (PEI) rating for Pump Energy Conservation Standards:
   ☒ **Less than 25%**
   ☐ 25%–50%
   ☐ 50%–75%
   ☐ 75%+
   ☐ Don't know
   ☐ Can provide later

7. What is the most commonly purchased PEI rating for constant speed pumps by rated motor HP range (e.g., 0.5–1.0)?
   Responses may be specific PEI rating or one of the following ranges <0.8, 0.81–0.89, 0.90–0.93, 0.94–0.98, 0.98–1.0, I don't know

   a. 1–15 horsepower: Click or tap here to enter text.
      ☐ <0.8 ☐ 0.81–0.89 ☐ 0.90–0.93 ☐ 0.94–0.98 ☐ 0.98–1.0 ☒ **I don't know**
   b. 15–50 horsepower: Click or tap here to enter text.
      ☐ <0.8 ☐ 0.81–0.89 ☐ 0.90–0.93 ☐ 0.94–0.98 ☐ 0.98–1.0 ☒ **I don't know**
   c. 50–250 horsepower: Click or tap here to enter text.
      ☐ <0.8 ☐ 0.81–0.89 ☐ 0.90–0.93 ☐ 0.94–0.98 ☐ 0.98–1.0 ☒ **I don't know**

8. What is the most commonly purchased PEI rating for variable speed pumps by rated motor HP range (e.g., 0.3–0.50)?
   Responses may be specific PEI rating or one of the following ranges <0.3, 0.31–0.39, 0.40–0.43, 0.44–0.48, 0.48–0.50, I don't know

   a. 1–15 horsepower:
      ☐ <0.3 ☐ 0.31–0.39 ☐ 0.40–0.43 ☐ 0.44–0.48 ☐ 0.48–0.50 ☒ **I don't know**
   b. 15–50 horsepower:
      ☐ <0.3 ☐ 0.31–0.39 ☐ 0.40–0.43 ☐ 0.44–0.48 ☐ 0.48–0.50 ☒ **I don't know**

c. 50–250 horsepower:
☐ <0.3 ☐ 0.31–0.39 ☐ 0.40–0.43 ☐ 0.44–0.48 ☐ 0.48–0.50 ☒ **I don't know**

9. If you specify pumps for customers, what are the key technical factors considered?
   a. Do you specify pump PEI ratings in selecting pumps for the customer?
   ☐ Yes ☒ **No**

10. When deciding on purchasing new or replacing pumps, what are the key factors considered?
   a. Does pump PEI rating affect the customer's decision-making process when selecting a pump?
   ☐ Yes ☒ **No** ☐ I don't know

   b. What are the criteria customers consider when purchasing a pump? (e.g., initial cost, operating cost, reliability, past experience, efficiency, utility savings, product availability).
   ☒ **Initial Cost – 1**
   ☒ **Operating Cost/Efficiency – 1**
   ☒ **Reliability – 3**
   ☒ **Prior Experience/Spare parts consistency/Manufacturer or type consistency – 2**
   ☒ **Availability – 4**
   ☐ Other: Click or tap here to enter text.

11. Are pump vendors you work with aware of PEI ratings of pumps?
   a. If so, what percent of their recommendations are efficient pumps?
   ☐ Less than 25%
   ☐ 25%–50%
   ☐ 50% – 75%
   ☐ 75%+
   ☒ **I don't know**
   b. Are efficient pumps readily available for purchase?
   ☒ **Yes** ☐ No ☐ Not Sure

Interview 4: Subject Matter Expert

1. What is your current title/role?
   Manager of Technical Programs

2. How many years of experience do you have in pumping systems?
   7 years

3. What types of experience do you have in pumping systems?

4. Which specific customer types/segments purchase "clean water pumps" as defined above? (Check all that apply)
   ☒ **Agricultural**
   ☒ **Commercial**
   ☒ **Industrial**
   ☒ **Municipal**

☒ **Residential – multifamily**
☒ **Wastewater**
☐ Other: Click or tap here to enter text.

5. Are there variations in pump types sold in the wastewater customer segment versus other segments?
   ☒ **Yes** – different casing, different impeller
   ☐No

6. What percentage of customers are aware of the Department of Energy's pump efficiency index (PEI) rating for Pump Energy Conservation Standards:
   ☒ **Less than 25% – End user / Contractor (installer)**
   ☐ 25%–50%
   ☐ 50%–75%
   ☒ **75%+–Distributor**
   ☐ Don't know
   ☐ Can provide later

7. What is the most commonly purchased PEI rating for constant speed pumps by rated motor HP range (e.g., 0.5–1.0)?
   Responses may be specific PEI rating or one of the following ranges <0.8, 0.81–0.89, 0.90–0.93, 0.94–0.98, 0.98–1.0, I don't know – **Northwest Energy Efficiency Alliance (NEEA) would have some data on this**

   a. 1–15 horsepower: Click or tap here to enter text.
   ☐ <0.8 ☐ 0.81–0.89 ☐ 0.90–0.93 ☐ 0.94–0.98 ☐ 0.98–1.0 ☒ **I don't know**
   b. 15–50 horsepower: Click or tap here to enter text.
   ☐ <0.8 ☐ 0.81–0.89 ☐ 0.90–0.93 ☐ 0.94–0.98 ☐ 0.98–1.0 ☒ **I don't know**
   c. 50–250 horsepower: Click or tap here to enter text.
   ☐ <0.8 ☐ 0.81–0.89 ☐ 0.90–0.93 ☐ 0.94–0.98 ☐ 0.98–1.0 ☒ **I don't know**

8. What is the most commonly purchased PEI rating for variable speed pumps by rated motor HP range (e.g., 0.3–0.50)?
   Responses may be specific PEI rating or one of the following ranges <0.3, 0.31–0.39, 0.40–0.43, 0.44–0.48, 0.48–0.50, I don't know

   a. 1–15 horsepower: Click or tap here to enter text.
   ☐ <0.3 ☐ 0.31–0.39 ☐ 0.40–0.43 ☐ 0.44–0.48 ☐ 0.48–0.50 ☒ **I don't know**
   b. 15–50 horsepower: Click or tap here to enter text.
   ☐ <0.3 ☐ 0.31–0.39 ☐ 0.40–0.43 ☐ 0.44–0.48 ☐ 0.48–0.50 ☒ **I don't know**
   c. 50–250 horsepower: Click or tap here to enter text.
   ☐ <0.3 ☐ 0.31–0.39 ☐ 0.40–0.43 ☐ 0.44–0.48 ☐ 0.48–0.50 ☒ **I don't know**

9. If you specify pumps for customers, what are the key technical factors considered?
   Selection based on duty point, then compare PEI or energy rating
   a. Do you specify pump PEI ratings in selecting pumps for the customer?

☐ Yes ☒ **No**

10. When deciding on purchasing new or replacing pumps, what are the key factors considered? **Availability**
    a. Does pump PEI rating affect the customer's decision-making process when selecting a pump?
    ☐ Yes ☒ **No** ☐ I don't know **[DoE posted a motor market assessment that give %]**

11. What are the criteria customers consider when purchasing a pump? (e.g., initial cost, operating cost, reliability, past experience, efficiency, utility savings, product availability).
    ☒ **Initial Cost – 3**
    ☒ **Operating Cost/Efficiency – 4**
    ☒ **Reliability – 4**
    ☒ **Prior Experience/Spare parts consistency/Manufacturer or type consistency – 4**
    ☒ **Availability – 2**
    ☒ **Other: Form, fit, and function – 1**

12. Are pump vendors you work with aware of PEI ratings of pumps?
    a. If so, what percent of their recommendations are efficient pumps?
    ☐ Less than 25%
    ☐ 25%–50%
    ☐ 50%–75%
    ☒ **75%+**
    ☐ I don't know
    b. Are efficient pumps readily available for purchase?
    ☒ **Yes** ☐ No ☐ Not Sure

Interview 5: Subject Matter Expert

1. What is your current title/role?
   Manager of Business development / education/ training / energy efficiency resource

2. How many years of experience do you have in pumping systems?
   25 years

3. What types of experience do you have in pumping systems?

4. Which specific customer types/segments purchase "clean water pumps" as defined above? (Check all that apply)
   ☒ **Agricultural**
   ☒ **Commercial**
   ☒ **Industrial**
   ☒ **Municipal**
   ☒ **Residential – multifamily**
   ☒ **Wastewater**
   ☐ Other: Click or tap here to enter text.

5. Are there variations in pump types sold in the wastewater customer segment versus other segments?
   ☒ **Yes** – different casing, different impeller
   ☐No

6. What percentage of customers are aware of the Department of Energy's pump efficiency index (PEI) rating for Pump Energy Conservation Standards:
   ☒ **Less than 25% - End user / Contractor (installer)**
   ☐ 25%–50%
   ☐ 50%–75%
   ☒ **75%+ – Distributor**
   ☐ Don't know
   ☐ Can provide later

7. What is the most commonly purchased PEI rating for constant speed pumps by rated motor HP range (e.g., 0.5–1.0)?
   Responses may be specific PEI rating or one of the following ranges <0.8, 0.81–0.89, 0.90–0.93, 0.94–0.98, 0.98–1.0, I don't know

   a. 1–15 horsepower: Click or tap here to enter text.
   ☐ <0.8 ☐ 0.81–0.89 ☐ 0.90–0.93 ☐ 0.94–0.98 ☐ 0.98–1.0 ☒ **I don't know**
   b. 15–50 horsepower: Click or tap here to enter text.
   ☐ <0.8 ☐ 0.81–0.89 ☐ 0.90–0.93 ☐ 0.94–0.98 ☐ 0.98–1.0 ☒ **I don't know**
   c. 50–250 horsepower: Click or tap here to enter text.
   ☐ <0.8 ☐ 0.81–0.89 ☐ 0.90–0.93 ☐ 0.94–0.98 ☐ 0.98–1.0 ☒ **I don't know**

8. What is the most commonly purchased PEI rating for variable speed pumps by rated motor HP range (e.g., 0.3–0.50)?
   Responses may be specific PEI rating or one of the following ranges <0.3, 0.31–0.39, 0.40–0.43, 0.44–0.48, 0.48–0.50, I don't know
   a. 1–15 horsepower: Click or tap here to enter text.
   ☐ <0.3 ☐ 0.31–0.39 ☐ 0.40–0.43 ☐ 0.44–0.48 ☐ 0.48–0.50 ☒ **I don't know**
   b. 15–50 horsepower: Click or tap here to enter text.
   ☐ <0.3 ☐ 0.31–0.39 ☐ 0.40–0.43 ☐ 0.44–0.48 ☐ 0.48–0.50 ☒ **I don't know**
   c. 50–250 horsepower: Click or tap here to enter text.
   ☐ <0.3 ☐ 0.31–0.39 ☐ 0.40–0.43 ☐ 0.44–0.48 ☐ 0.48–0.50 ☒ **I don't know**

9. If you specify pumps for customers, what are the key technical factors considered?
   Selection based on duty point, then compare PEI or energy rating
   a. Do you specify pump PEI ratings in selecting pumps for the customer?
   ☐ Yes ☒ **No**

10. When deciding on purchasing new or replacing pumps, what are the key factors considered? **Availability**
    a. Does pump PEI rating affect the customer's decision-making process when selecting a pump?

☐ Yes ☒ **No** ☐ I don't know **[DoE posted a motor market assessment that give %]**

11. What are the criteria customers consider when purchasing a pump? (e.g., initial cost, operating cost, reliability, past experience, efficiency, utility savings, product availability).
    ☒ **Initial Cost – 3**
    ☒ **Operating Cost/Efficiency – 4**
    ☒ **Reliability – 4**
    ☒ **Prior Experience/Spare parts consistency/Manufacturer or type consistency – 4**
    ☒ **Availability – 2**
    ☒ **Other: Form, fit, and function – 1**

12. Are pump vendors you work with aware of PEI ratings of pumps?
    b. If so, what percent of their recommendations are efficient pumps?
       ☐ Less than 25%
       ☐ 25%–50%
       ☐ 50% – 75%
       ☒ **75%+**
       ☐ I don't know
    c. Are efficient pumps readily available for purchase?
       ☒ **Yes** ☐ No ☐ Not Sure

Interview 6: Subject Matter Expert

1. What is your current title/role?
   Deputy executive director

2. How many years of experience do you have in pumping systems?
   20 years

3. What types of experience do you have in pumping systems?

4. Which specific customer types/segments purchase "clean water pumps" as defined above? (Check all that apply)
   ☒ **Agricultural**
   ☒ **Commercial**
   ☒ **Industrial**
   ☒ **Municipal**
   ☒ **Residential – multifamily**
   ☒ **Wastewater**
   ☐ Other: Click or tap here to enter text.

5. Are there variations in pump types sold in the wastewater customer segment versus other segments?
   ☒ **Yes** – different casing, different impeller
   ☐No

6. What percentage of customers are aware of the Department of Energy's pump efficiency index (PEI) rating for Pump Energy Conservation Standards:
   ☒ **Less than 25% – End user / Contractor (installer)**
   ☐ 25%–50%
   ☐ 50% – 75%
   ☒ **75%+ – Distributor**
   ☐ Don't know
   ☐ Can provide later

7. What is the most commonly purchased PEI rating for constant speed pumps by rated motor HP range (e.g., 0.5–1.0)?
   Responses may be specific PEI rating or one of the following ranges <0.8, 0.81–0.89, 0.90–0.93, 0.94–0.98, 0.98–1.0, I don't know

   a. 1–15 horsepower: Click or tap here to enter text.
   ☐ <0.8 ☐ 0.81–0.89 ☐ 0.90–0.93 ☐ 0.94–0.98 ☐ 0.98–1.0 ☒ **I don't know**
   b. 15–50 horsepower: Click or tap here to enter text.
   ☐ <0.8 ☐ 0.81–0.89 ☐ 0.90–0.93 ☐ 0.94–0.98 ☐ 0.98–1.0 ☒ **I don't know**
   c. 50–250 horsepower: Click or tap here to enter text.
   ☐ <0.8 ☐ 0.81–0.89 ☐ 0.90–0.93 ☐ 0.94–0.98 ☐ 0.98–1.0 ☒ **I don't know**

8. What is the most commonly purchased PEI rating for variable speed pumps by rated motor HP range (e.g., 0.3–0.50)?
   Responses may be specific PEI rating or one of the following ranges <0.3, 0.31–0.39, 0.40–0.43, 0.44–0.48, 0.48–0.50, I don't know
   a. 1–15 horsepower: Click or tap here to enter text.
   ☐ <0.3 ☐ 0.31–0.39 ☐ 0.40–0.43 ☐ 0.44–0.48 ☐ 0.48–0.50 ☒ **I don't know**
   b. 15–50 horsepower: Click or tap here to enter text.
   ☐ <0.3 ☐ 0.31–0.39 ☐ 0.40–0.43 ☐ 0.44–0.48 ☐ 0.48–0.50 ☒ **I don't know**
   c. 50–250 horsepower: Click or tap here to enter text.
   ☐ <0.3 ☐ 0.31–0.39 ☐ 0.40–0.43 ☐ 0.44–0.48 ☐ 0.48–0.50 ☒ **I don't know**

9. If you specify pumps for customers, what are the key technical factors considered?
   Selection based on duty point, then compare PEI or energy rating
   a. Do you specify pump PEI ratings in selecting pumps for the customer?
      ☐ Yes ☒ **No**

10. When deciding on purchasing new or replacing pumps, what are the key factors considered? **Availability**
    a. Does pump PEI rating affect the customer's decision-making process when selecting a pump?
    ☐ Yes ☒ **No** ☐ I don't know **[DoE posted a motor market assessment that give %]**

11. What are the criteria customers consider when purchasing a pump? (e.g., initial cost, operating cost, reliability, past experience, efficiency, utility savings, product availability).
    ☒ **Initial Cost – 3**
    ☒ **Operating Cost/Efficiency – 4**
    ☒ **Reliability – 4**

☒ **Prior Experience/Spare parts consistency/Manufacturer or type consistency – 4**
☒ **Availability – 2**
☒ **Other: Form, fit, and function – 1**

12. Are pump vendors you work with aware of PEI ratings of pumps?
    c. If so, what percent of their recommendations are efficient pumps?
    ☐ Less than 25%
    ☐ 25%–50%
    ☐ 50% – 75%
    ☒ **75%+**
    ☐ I don't know
    d. Are efficient pumps readily available for purchase?
    ☒ **Yes** ☐ No ☐ Not Sure

Interview 7: VFD Vendor

1. What is your current title/role?
   Product manager / application engineer

2. How many years of experience do you have in pumping systems?
   6–7years

3. What types of experience do you have in pumping systems?
   Systems integration/selection, component selection, and sales

4. Which of the following pump equipment classes does your company sell or for which you install VFDs? (Check all that apply)
   ☒ **ESCC: end suction close coupled pump**
   ☒ **ESFM: end suction frame mounted pump**
   ☒ **IL: in-line close coupled and split coupled pumps**
   ☒ **RSV: radially split, multistage, vertical, in-line casing diffuser pump**
   ☒ **Submersible vertical turbines pump**

5. Which sector(s) does your company sell/install VFDs for "clean water pumps", as defined above? (Check all that apply)
   ☒ **Agricultural –1**
   ☒ **Commercial –2**
   ☒ **Industrial – 3**
   ☒ **Municipal – 4**
   ☐ **Residential**
   ☒ **Wastewater –5**
   ☐ Other: Click or tap here to enter text.

6. Are there variations in pump types in the wastewater customer segment versus other segments?
   ☒ **Yes – wastewater – vertical turbines to submersible vert. pumps**
   ☐No

7. What range of pump sizes (in rated-motor horsepower) does your company typically sell VFDs for? What is the most common size? [Note: Last three years is the preferred time period]
   ☒ **1–15 HP – famers imperial valley uses this range**
   ☒ **15–50 HP – farmers big pump stations**
   ☒ **50–250 HP**
   Most common size sold **– 50 – 250HP**

8. Are you aware of the Department of Energy's established metric, pump efficiency index (PEI) rating for Pumping System Energy Standards?
   ☒ **Yes** ☐ No

9. Do you advise or recommend to potential customers selection of VFDs, and motors based on how it would affect their PEI ratings factor?
   ☐ Yes ☒ **No**

10. Do PEI ratings factor into the customer decision-making process when purchasing a VFD for their pump?
    ☐ Yes ☒ **No** ☐ I don't know

11. Are PEI ratings specified in the customer's technical specifications or equipment order?
    ☐ Yes ☒ **No** ☐ I don't know

12. What are the most common pump manufacturer and models associated with the VFD projects completed in the last three years within the following ranges (up to three):
    a. 1–15 horsepower
       i. **Gorman-rupp – will follow up with models**
       ii. Click or tap here to enter text.
       iii. Click or tap here to enter text.
    b. 15–50 horsepower
       i. Click or tap here to enter text.
       ii. Click or tap here to enter text.
       iii. Click or tap here to enter text.
    c. 50–250 horsepower
       i. Click or tap here to enter text.
       ii. Click or tap here to enter text.
       iii. Click or tap here to enter text.
       i.

13. What is the relative quantity of VFDs sold annually by pump rated HP range? [Note: This is not the rated HP of the VFD, but of the pump motor. Last three years is the preferred time period]
    a. 1–15 horsepower
    ☒ **10s** ☐ 100s ☐ 1000s ☐ Click or tap here to enter text.
    b. 15–50 horsepower
    ☒ **10s** ☐ 100s ☐ 1000s ☐ Click or tap here to enter text.
    c. 50–250 horsepower
    ☒ **10s** ☐ 100s ☐ 1000s ☐ Click or tap here to enter text.

14. What is the PEI rating customers consider as efficient for variable speed pumps by rated HP range.
    Variable Speed 1–15 horsepower – **Will follow up with model numbers**
    Variable Speed 15–50 horsepower – Click or tap here to enter text.
    Variable Speed 50–250 horsepower – Click or tap here to enter text.

15. What percentage of sales do efficient pumps with variable load account for in the last three years?
    ☐ Less than 25%
    ☐ 25%–50%
    ☐ 50%–75%
    ☒ **75+%**
    ☐ I don't know

16. What are the main factors that a customer considers when choosing a pump with VFD for installation? (E.g. Initial cost, operating cost, reliability, past experience, efficiency, utility savings, etc.)
    ☒ **Initial Cost – 3**
    ☐ Operating Cost/Efficiency
    ☒ **Reliability – 2**
    ☒ **Prior Experience/Spare parts consistency/Manufacturer or type consistency – 1**
    ☐ Efficiency
    ☒ **Availability –4**
    ☐ Other: Click or tap here to enter text.

17. Can we reach out to you to follow up if we have further questions?
    Yes

18. Could you refer us to anyone knowledgeable about pumps that would be willing to participate in this survey? If so, could you share their contact information?
    Yes, provided

Interview 8: Pump Vendor

1. What is your current title/role?
   Industry segment specialist

2. How many years of experience do you have in pumping systems?
   11 years

3. What types of experience do you have in pumping systems?
   sales and consulting – food and beverage, chemical distribution, bio farm, sanitary, industrial

4. Which of the following pump equipment classes does your company sell/install? (Check all that apply)
   ☐ ESCC: end suction close coupled pump
   ☐ ESFM: end suction frame mounted pump

☐ IL: in-line close coupled and split coupled pumps
☐ RSV: radially split, multistage, vertical, in-line casing diffuser pump
☐ Submersible vertical turbines pump

5. Which sector(s) does your company sell/install "clean water pumps" to, as defined above? (Check all that apply)
   ☐ Agricultural
   ☐ Commercial
   ☐ Industrial
   ☐ Municipal
   ☐ Residential
   ☐ Wastewater
   ☐ Other: Click or tap here to enter text.

6. Are there variations in pump types sold in the wastewater customer segment versus other segments?
   ☐ Yes
   ☐No

7. What range of pump sizes (in rated-motor horsepower) does your company typically sell? What is the most common size? *[Note: Last three years is the preferred time period]*
   ☐ 1–15 HP
   ☐ 15–50 HP
   ☐ 50–250 HP
   Most common size sold – Click or tap here to enter text.

8. Are you aware of the Department of Energy's established metric, pump efficiency index (PEI) rating for Pumping System Energy Standards?
   ☐ Yes ☐ No

9. Do you advise or recommend to potential customers selection of pumps based on their PEI ratings factor?
   ☐ Yes ☐ No

10. Do PEI ratings factor into the customer decision-making process when purchasing a pump?
    ☐ Yes ☐ No ☐ I don't know

11. Are PEI ratings specified in the customer's technical specifications or equipment order?
    ☐ Yes ☐ No ☐ I don't know

12. What are the most common sold/installed pump manufacturer and models in the last three years within the following ranges (up to three):
    a. 1–15 horsepower
       i. Click or tap here to enter text.
       ii. Click or tap here to enter text.
       iii. Click or tap here to enter text.
    b. 15–50 horsepower
       i. Click or tap here to enter text.

ii. Click or tap here to enter text.
iii. Click or tap here to enter text.

c. 50–250 horsepower
i. Click or tap here to enter text.
ii. Click or tap here to enter text.
iii. Click or tap here to enter text.

13. What is the relative quantity of pumps sold annually by rated HP range? *[Note: Last three years is the preferred time period]*
    a. 1–15 horsepower
       ☐ 10s ☐ 100s ☒ **1000s** ☐ Click or tap here to enter text.
    b. 15–50 horsepower
       ☐ 10s ☐ 100s ☒ **1000s** ☐ Click or tap here to enter text.
    c. 50–250 horsepower
       ☐ 10s ☒ **100s** ☐ 1000s ☐ Click or tap here to enter text.

14. If yes, to the above question, what is the PEI rating customer consider as efficient for constant and variable speed pumps by rated HP range.
    a. Constant Speed 1–15 horsepower – Will follow up with Tommy
    b. Constant Speed 15–50 horsepower – Click or tap here to enter text.
    c. Constant Speed 50–250 horsepower – Click or tap here to enter text.
    d. Variable Speed 1–15 horsepower – Click or tap here to enter text.
    e. Variable Speed 15–50 horsepower – Click or tap here to enter text.
    f. Variable Speed 50–250 horsepower – Click or tap here to enter text.

15. What percentage of sales do efficient pumps account for in the last three years?
    ☐ Less than 25%
    ☐ 25%–50%
    ☐ 50%–75%
    ☐ 75+%
    ☐ I don't know

16. What are the main factors that a customer considers when choosing a pump for installation? (E.g. Initial cost, operating cost, reliability, past experience, efficiency, utility savings, etc.)

    ☒ **Initial Cost – 3**
    ☒ **Operating Cost/Efficiency – 5**
    ☒ **Reliability – 1**
    ☒ **Prior Experience/Spare parts consistency/Manufacturer or type consistency – 6**
    ☒ **Efficiency – 4**
    ☒ **Availability – 2**

    If they have time to plan out:

    ☒ **Initial Cost – 1**
    ☒ **Operating Cost/Efficiency – 2**
    ☒ **Reliability – 4**
    ☒ **Prior Experience/Spare parts consistency/Manufacturer or type consistency – 6**

☒ **Efficiency – 5**
☒ **Availability – 3**
☐ Other: Click or tap here to enter text.

Interview 9: Pump Manufacturer

1. What is your current title/role?
   Regional Sales Manager

2. How many years of experience do you have in pumping systems?
   20 years

3. What types of experience do you have in pumping systems?
   Centrifugal pumps, wastewater pumps, positive displacement pump manufacturer for industrial application

4. Which of the following pump equipment classes does your company sell? (Check all that apply)
   ☒ **ESCC: end suction close coupled pump**
   ☒ **ESFM: end suction frame mounted pump**
   ☒ **IL: in-line close coupled and split coupled pumps**
   ☒ **RSV: radially split, multistage, vertical, in-line casing diffuser pump**
   ☒ **Submersible vertical turbines pump – motion industry also sells this one**

5. Are there variations in pump types sold in the wastewater customer segment versus other segments?
   ☒ **Yes – food industry, oil and gas industry, FM approved pumps, chemical feed pumps**
   ☐ No

6. Which sector(s) does your company sell "clean water pumps" to, as defined above? (Check all that apply)
   ☒ **Agricultural**
   ☒ **Commercial**
   ☒ **Industrial**
   ☒ **Municipal**
   ☒ **Residential**
   ☒ **Wastewater**
   ☐ Other: Click or tap here to enter text.

7. What range of pump sizes (in rated-motor horsepower) does your company typically sell? What is the most common size? *[Note: Last three years is the preferred time period]*
   ☒ **1–15 horsepower – 2**
   ☒ **15–50 horsepower – 1**
   ☒ **50–250 horsepower – 3**
   Most common size sold – Click or tap here to enter text.

8. Are you aware of the Department of Energy's established metric, pump efficiency index (PEI) rating for Pumping System Energy Standards?

☒ **Yes** ☐ No

9. Do you advise or recommend to potential customers selection of pumps based on their PEI ratings factor?
   ☐ Yes ☒ **No** **– sometimes an engineer might have it in a spec**

10. Do PEI ratings factor into the customer decision–making process when purchasing a pump?
    ☒ **Yes** ☐ No ☐ I don't know – varies by municipality and budget size

11. Are PEI ratings specified in the customer's technical specifications or equipment order?
    ☐ Yes ☒ **No** ☐ I don't know

12. What are the most commonly sold pump models in the last 12 months within the following ranges (up to three):
    a. 1–15 horsepower
       i. Tommy from motion will follow up
       ii. Click or tap here to enter text.
       iii. Click or tap here to enter text.
    b. 15–50 horsepower
       i. Click or tap here to enter text.
       ii. Click or tap here to enter text.
       iii. Click or tap here to enter text.
    c. 50–250 horsepower
       i. Click or tap here to enter text.
       ii. Click or tap here to enter text.
       iii. Click or tap here to enter text.

13. What is the relative quantity of pumps sold annually by rated HP range? *[Note: Last three years is the preferred time period]*
    a. 1–15 horsepower
       ☐ 10s ☐ 100s ☒ **1000s**
    b. 15–50 horsepower
       ☐ 10s ☐ 100s ☒ **1000s**
    c. 50–250 horsepower
       ☐ 10s ☒ **100s** ☐ 1000s

Interview 10: Pump Manufacturer

1. What is your current title/role?
   Regional Sales Manager

2. How many years of experience do you have in pumping systems?
   15 years

3. What types of experience do you have in pumping systems?
   Consultant firm for energy sector, water treatment, business development, product management

4. Which of the following pump equipment classes does your company sell? (Check all that apply)

☒ **ESCC: end suction close coupled pump**
☒ **ESFM: end suction frame mounted pump**
☒ **IL: in-line close coupled and split coupled pumps**
☒ **RSV: radially split, multistage, vertical, in-line casing diffuser pump**
☒ **Submersible vertical turbines pump – motion industry also sells this one**

5. Are there variations in pump types sold in the wastewater customer segment versus other segments?
   ☒ **Yes – food industry, oil and gas industry, FM approved pumps, chemical feed pumps**
   ☐ No

6. Which sector(s) does your company sell "clean water pumps" to, as defined above? (Check all that apply)
   ☒ **Agricultural**
   ☒ **Commercial**
   ☒ **Industrial**
   ☒ **Municipal**
   ☒ **Residential**
   ☒ **Wastewater**
   ☐ Other: Click or tap here to enter text.

7. What range of pump sizes (in rated-motor horsepower) does your company typically sell? What is the most common size? *[Note: Last three years is the preferred time period]*
   ☒ **1–15 horsepower – 2**
   ☒ **15–50 horsepower – 1**
   ☒ **50–250 horsepower – 3**
   Most common size sold – Click or tap here to enter text.

8. Are you aware of the Department of Energy's established metric, pump efficiency index (PEI) rating for Pumping System Energy Standards?
   ☒ **Yes** ☐ No

9. Do you advise or recommend to potential customers selection of pumps based on their PEI ratings factor?
   ☐ Yes ☒ **No – sometimes an engineer might have it in a spec**

10. Do PEI ratings factor into the customer decision-making process when purchasing a pump?
    ☒ **Yes** ☐ No ☐ I don't know – varies by municipality and budget size

11. Are PEI ratings specified in the customer's technical specifications or equipment order?
    ☐ Yes ☒ **No** ☐ I don't know

12. What are the most commonly sold pump models in the last 12 months within the following ranges (up to three):
    a. 1–15 horsepower
       ii. Tommy from motion will follow up
       iii. Click or tap here to enter text.

iv. Click or tap here to enter text.

b. 15–50 horsepower
   ii. Click or tap here to enter text.
   iii. Click or tap here to enter text.
   iv. Click or tap here to enter text.

c. 50–250 horsepower
   ii. Click or tap here to enter text.
   iii. Click or tap here to enter text.
   iv. Click or tap here to enter text.

13. What is the relative quantity of pumps sold annually by rated HP range? *[Note: Last three years is the preferred time period]*

b. 1–15 horsepower
   ☐ 10s ☐ 100s ☒ **1000s**

c. 15–50 horsepower
   ☐ 10s ☐ 100s ☒ **1000s**

d. 50–250 horsepower
   ☐ 10s ☒ **100s** ☐ 1000s

Interview 11: Pump Vendor

1. What is your current title/role?
   Industry Initiatives specialist

2. How many years of experience do you have in pumping systems?
   9 years

3. What types of experience do you have in pumping systems?
   Sales – food and beverage

5. Which of the following pump equipment classes does your company sell/install? (Check all that apply)
   ☐ ESCC: end suction close coupled pump
   ☐ ESFM: end suction frame mounted pump
   ☐ IL: in-line close coupled and split coupled pumps
   ☐ RSV: radially split, multistage, vertical, in-line casing diffuser pump
   ☐ Submersible vertical turbines pump

6. Which sector(s) does your company sell/install “clean water pumps” to, as defined above? (Check all that apply)
   ☐ Agricultural
   ☐ Commercial
   ☐ Industrial
   ☐ Municipal
   ☐ Residential
   ☐ Wastewater
   ☐ Other: Click or tap here to enter text.

7. Are there variations in pump types sold in the wastewater customer segment versus other segments?
   ☐ Yes
   ☐ No

8. What range of pump sizes (in rated-motor horsepower) does your company typically sell? What is the most common size? *[Note: Last three years is the preferred time period]*
   ☐ 1–15 HP
   ☐ 15–50 HP
   ☐ 50–250 HP
   Most common size sold – Click or tap here to enter text.

9. Are you aware of the Department of Energy's established metric, pump efficiency index (PEI) rating for Pumping System Energy Standards?
   ☐ Yes ☐ No

10. Do you advise or recommend to potential customers selection of pumps based on their PEI ratings factor?
    ☐ Yes ☐ No

11. Do PEI ratings factor into the customer decision-making process when purchasing a pump?
    ☐ Yes ☐ No ☐ I don't know

12. Are PEI ratings specified in the customer's technical specifications or equipment order?
    ☐ Yes ☐ No ☐ I don't know

13. What are the most common sold/installed pump manufacturer and models in the last three years within the following ranges (up to three):
    b. 1–15 horsepower
       iv. Click or tap here to enter text.
       v.Click or tap here to enter text.
       vi.Click or tap here to enter text.
    c. 15–50 horsepower
       i. Click or tap here to enter text.
       ii. Click or tap here to enter text.
       iii. Click or tap here to enter text.
    d. 50–250 horsepower
       i. Click or tap here to enter text.
       ii. Click or tap here to enter text.
       iii. Click or tap here to enter text.

14. What is the relative quantity of pumps sold annually by rated HP range? *[Note: Last three years is the preferred time period]*
    b. 1–15 horsepower
       ☐ 10s ☐ 100s ☒ **1000s** ☐ Click or tap here to enter text.
    c. 15–50 horsepower
       ☐ 10s ☐ 100s ☒ **1000s** ☐ Click or tap here to enter text.
    c. 50–250 horsepower
       ☐ 10s ☒ **100s** ☐ 1000s ☐ Click or tap here to enter text.

15. If yes, to the above question, what is the PEI rating customer consider as efficient for constant and variable speed pumps by rated HP range.
    b. Constant Speed 1–15 horsepower – Will follow up with Tommy
    c. Constant Speed 15–50 horsepower – Click or tap here to enter text.
    d. Constant Speed 50–250 horsepower – Click or tap here to enter text.
    e. Variable Speed 1–15 horsepower – Click or tap here to enter text.
    f. Variable Speed 15–50 horsepower – Click or tap here to enter text.
    g. Variable Speed 50–250 horsepower – Click or tap here to enter text.

16. What percentage of sales do efficient pumps account for in the last three years?
    ☐ Less than 25%
    ☐ 25%–50%
    ☐ 50%–75%
    ☐ 75+%
    ☐ I don't know

17. What are the main factors that a customer considers when choosing a pump for installation? (E.g., Initial cost, operating cost, reliability, past experience, efficiency, utility savings, etc.)

    ☒ **Initial Cost – 3**
    ☒ **Operating Cost/Efficiency – 5**
    ☒ **Reliability – 1**
    ☒ **Prior Experience/Spare parts consistency/Manufacturer or type consistency – 6**
    ☒ **Efficiency – 4**
    ☒ **Availability – 2**

    If they have time to plan out:
    ☒ **Initial Cost – 1**
    ☒ **Operating Cost/Efficiency – 2**
    ☒ **Reliability – 4**
    ☒ **Prior Experience/Spare parts consistency/Manufacturer or type consistency – 6**
    ☒ **Efficiency – 5**
    ☒ **Availability – 3**
    ☐ Other: Click or tap here to enter text.

Interview 12: Pump Manufacturer

1. What is your current title/role?
   Regional Sales Manager

2. How many years of experience do you have in pumping systems?
   15 years

3. What types of experience do you have in pumping systems?
   Consultant firm for energy sector, water treatment, business development, product management

4. Which of the following pump equipment classes does your company sell? (Check all that
   ☒ **ESCC: end suction close coupled pump**
   ☒ **ESFM: end suction frame mounted pump**
   ☒ **IL: in-line close coupled and split coupled pumps**
   ☒ **RSV: radially split, multistage, vertical, in-line casing diffuser pump**
   ☒ **Submersible vertical turbines pump – motion industry also sells this one**

5. Are there variations in pump types sold in the wastewater customer segment versus other segments?
   ☒ **Yes – food industry, oil and gas industry, FM approved pumps, chemical feed pumps**
   ☐ No

6. Which sector(s) does your company sell "clean water pumps" to, as defined above? (Check all that apply)
   ☒ **Agricultural**
   ☒ **Commercial**
   ☒ **Industrial**
   ☒ **Municipal**
   ☒ **Residential**
   ☒ **Wastewater**
   ☐ Other: Click or tap here to enter text.

7. What range of pump sizes (in rated-motor horsepower) does your company typically sell? What is the most common size? *[Note: Last three years is the preferred time period]*
   ☒ **1–15 horsepower – 2**
   ☒ **15–50 horsepower – 1**
   ☒ **50–250 horsepower – 3**
   Most common size sold – Click or tap here to enter text.

8. Are you aware of the Department of Energy's established metric, pump efficiency index (PEI) rating for Pumping System Energy Standards?
   ☒ **Yes** ☐ No

9. Do you advise or recommend to potential customers selection of pumps based on their PEI ratings factor?
   ☐ Yes ☒ **No – sometimes an engineer might have it in a spec**

10. Do PEI ratings factor into the customer decision-making process when purchasing a pump?
    ☒ **Yes** ☐ No ☐ I don't know – varies by municipality and budget size

11. Are PEI ratings specified in the customer's technical specifications or equipment order?
    ☐ Yes ☒ **No** ☐ I don't know

12. What are the most commonly sold pump models in the last 12 months within the following ranges (up to three):
    b. 1–15 horsepower
       iii. **Tommy from motion will follow up**

iv. Click or tap here to enter text.
v. Click or tap here to enter text.

c. 15–50 horsepower
iii. Click or tap here to enter text.
iv. Click or tap here to enter text.
v. Click or tap here to enter text.

d. 50–250 horsepower
iii. Click or tap here to enter text.
iv. Click or tap here to enter text.
v. Click or tap here to enter text.

13. What is the relative quantity of pumps sold annually by rated HP range? *[Note: Last three years is the preferred time period]*
    c. 1–15 horsepower
    ☐ 10s ☐ 100s ☒ **1000s**
    d. 15–50 horsepower
    ☐ 10s ☐ 100s ☒ **1000s**
    e. 50–250 horsepower
    ☐ 10s ☒ **100s** ☐ 1000s

Interview 13: Subject Matter Expert

1. What is your current title/role?
   VP of Business Development

2. How many years of experience do you have in pumping systems?
   19 years

3. What types of experience do you have in pumping systems?
   Consultant for 13 yrs designing pumping stations, water and wastewater systems, currently focusing on optimization of those systems.

4. Which specific customer types/segments purchase "clean water pumps" as defined above? (Check all that apply)
   ☒ **Agricultural**
   ☒ **Commercial**
   ☒ **Industrial**
   ☒ **Municipal – experience lies here**
   ☒ **Residential**
   ☒ **Wastewater – experience lies here**
   ☐ Other: Click or tap here to enter text.

5. Are there variations in pump types sold in the wastewater customer segment versus other segments?
   ☒ **Yes – wastewater have a larger passthrough capacity, direct inlet (no screening) on vert turbine pump. At wastewater treatment plants, the effluent of the primary treatment process can be pumped with clean pumps.**
   ☐No

6. What percentage of customers are aware of the Department of Energy's pump efficiency index (PEI) rating for Pump Energy Conservation Standards:
   ☒ **Less than 25%**
   ☐ 25%–50%
   ☐ 50%–75%
   ☐ 75%+
   ☐ Don't know
   ☐ Can provide later

7. What is the most commonly purchased PEI rating for constant speed pumps by rated motor HP range (e.g., 0.5–1.0)?
   Responses may be specific PEI rating or one of the following ranges <0.8, 0.81–0.89, 0.90–0.93, 0.94–0.98, 0.98–1.0, I don't know
   a. 1–15 horsepower: Click or tap here to enter text.
   ☐ <0.8 ☐ 0.81–0.89 ☐ 0.90–0.93 ☐ 0.94–0.98 ☐ 0.98–1.0 ☒ **I don't know**
   b. 15–50 horsepower: Click or tap here to enter text.
   ☐ <0.8 ☐ 0.81–0.89 ☐ 0.90–0.93 ☐ 0.94–0.98 ☐ 0.98–1.0 ☒ **I don't know**
   c. 50–250 horsepower: Click or tap here to enter text.
   ☐ <0.8 ☐ 0.81–0.89 ☐ 0.90–0.93 ☐ 0.94–0.98 ☐ 0.98–1.0 ☒ **I don't know**

8. What is the most commonly purchased PEI rating for variable speed pumps by rated motor HP range (e.g., 0.3–0.50)?
   Responses may be specific PEI rating or one of the following ranges <0.3, 0.31–0.39, 0.40–0.43, 0.44–0.48, 0.48–0.50, I don't know

   a. 1–15 horsepower: Click or tap here to enter text.
   ☐ <0.3 ☐ 0.31–0.39 ☐ 0.40–0.43 ☐ 0.44–0.48 ☐ 0.48–0.50 ☒ **I don't know**
   b. 15–50 horsepower: Click or tap here to enter text.
   ☐ <0.3 ☐ 0.31–0.39 ☐ 0.40–0.43 ☐ 0.44–0.48 ☐ 0.48–0.50 ☒ **I don't know**
   c. 50–250 horsepower: Click or tap here to enter text.
   ☐ <0.3 ☐ 0.31–0.39 ☐ 0.40–0.43 ☐ 0.44–0.48 ☐ 0.48–0.50 ☒ **I don't know**

9. If you specify pumps for customers, what are the key technical factors considered?
   Preferred operating range should operate in the 70% to 120% of best efficiency point of the operation curve. Ensure the pump selection has sufficient coverage through the pump curve to be appropriate for adding a VFD.
   a. Do you specify pump PEI ratings in selecting pumps for the customer?
   ☐ Yes ☒ **No**

10. When deciding on purchasing new or replacing pumps, what are the key factors considered?
    Preferred operating range that will give flow and head that they need, hydraulic capacity, ROI
    a. Does pump PEI rating affect the customer's decision-making process when selecting a pump?
       ☐ Yes ☒ **No** ☐ I don't know

11. What are the criteria customers consider when purchasing a pump? (e.g., initial cost, operating cost, reliability, past experience, efficiency, utility savings, product availability). *[Note: Ask to see if they can provide ranking from most important to least important]*
    ☒ **Initial Cost – 2**
    ☒ **Operating Cost/Efficiency – 5**
    ☒ **Reliability – 4**
    ☒ **Prior Experience/Spare parts consistency/Manufacturer or type consistency – 1**
    ☒ **Availability – 3**
    ☒ **Other: Hydraulic modeling for system compatibility,**

12. Are pump vendors you work with aware of PEI ratings of pumps?
    a. If so, what percent of their recommendations are efficient pumps?
        ☐ Less than 25%
        ☐ 25%–50%
        ☐ 50% – 75%
        ☐ 75%+
        ☒ **I don't know**

    b. Are efficient pumps readily available for purchase?
        ☒ **Yes** ☐ No ☐ Not Sure

Interview 14: Subject Matter Expert

1. What is your current title/role?
   Chief Water Treatment Operator

2. How many years of experience do you have in pumping systems?
   19 years

3. What types of experience do you have in pumping systems?
   Water treatment and pumping operations, extensively in groundwater wells, vertical turbines, booster pumps, in-line and split case pumps. No experience in wastewater treatment.

4. Which specific customer types/segments purchase "clean water pumps" as defined above? (Check all that apply)
   ☐ Agricultural
   ☒ **Commercial**
   ☒ **Industrial**
   ☒ **Municipal**
   ☒ **Residential**
   ☐ Wastewater
   ☐ Other: Click or tap here to enter text.
   Customer does not have experience with Agricultural and Wastewater segments.

5. Are there variations in pump types sold in the wastewater customer segment versus other segments?
   ☐ Yes

☐ No
Not applicable

6. What percentage of customers are aware of the Department of Energy's pump Energy index (PEI) rating for Pump Energy Conservation Standards:
   ☐ Less than 25%
   ☐ 25%–50%
   ☐ 50%–75%
   ☐ 75%+
   ☒ **Don't know**
   ☐ Can provide later

7. What is the most commonly purchased PEI rating for constant speed pumps by rated motor HP range (e.g., 0.5–1.0)?
   Responses may be specific PEI rating or one of the following ranges <0.8, 0.81–0.89, 0.90–0.93, 0.94–0.98, 0.98–1.0, I don't know

   a. 1–15 horsepower: Click or tap here to enter text.
      ☐ <0.8 ☐ 0.81–0.89 ☐ 0.90–0.93 ☐ 0.94–0.98 ☐ 0.98–1.0 ☒ **I don't know**
   b. 15–50 horsepower: Click or tap here to enter text.
      ☐ <0.8 ☐ 0.81–0.89 ☐ 0.90–0.93 ☐ 0.94–0.98 ☐ 0.98–1.0 ☒ **I don't know**
   c. 50–250 horsepower: Click or tap here to enter text.
      ☐ <0.8 ☐ 0.81–0.89 ☐ 0.90–0.93 ☐ 0.94–0.98 ☐ 0.98–1.0 ☒ **I don't know**

8. What is the most commonly purchased PEI rating for variable speed pumps by rated motor HP range (e.g., 0.3–0.50)?
   Responses may be specific PEI rating or one of the following ranges <0.3, 0.31–0.39, 0.40–0.43, 0.44–0.48, 0.48–0.50, I don't know

   a. 1–15 horsepower: Click or tap here to enter text.
      ☐ <0.3 ☐ 0.31–0.39 ☐ 0.40–0.43 ☐ 0.44–0.48 ☐ 0.48–0.50 ☒ **I don't know**
   b. 15–50 horsepower: Click or tap here to enter text.
      ☐ <0.3 ☐ 0.31–0.39 ☐ 0.40–0.43 ☐ 0.44–0.48 ☐ 0.48–0.50 ☒ **I don't know**
   c. 50–250 horsepower: Click or tap here to enter text.
      ☐ <0.3 ☐ 0.31–0.39 ☐ 0.40–0.43 ☐ 0.44–0.48 ☐ 0.48–0.50 ☒ **I don't know**

9. If you specify pumps for customers, what are the key technical factors considered?
   a. Do you specify pump PEI ratings in selecting pumps for the customer?
      ☐ Yes ☒ **No** but looking to specify that in the future.

10. When deciding on purchasing new or replacing pumps, what are the key factors considered?
    a. Does pump PEI rating affect the customer's decision-making process when selecting a pump?
       ☐ Yes ☒ **No** ☐ I don't know

but looking to specify that in the future.

b. What are the criteria customers consider when purchasing a pump? (e.g., initial cost, operating cost, reliability, past experience, efficiency, utility savings, product availability).
   - ☒ **Initial Cost – 1**
   - ☒ **Operating Cost/Efficiency – 2**
   - ☒ **Reliability – 4**
   - ☒ **Prior Experience/Spare parts consistency/Manufacturer or type consistency – 5**
   - ☒ **Availability – 3**
   - ☐ Other: Click or tap here to enter text.

11. Are pump vendors you work with aware of PEI ratings of pumps?
    a. If so, what percent of their recommendations are efficient pumps?
       - ☐ Less than 25%
       - ☐ 25%–50%
       - ☐ 50%–75%
       - ☒ **75%+** ***(Typical pump contractors include General Pump Co.)***
       - ☐ I don't know

    b. Are efficient pumps readily available for purchase?
       ☒ **Yes** ☐ No ☐ Not Sure

    Faced some supply chain issues during the pandemic, but no longer an issue

12. Can we reach out to you to follow up if we have further questions?
    Yes

13. Could you refer us to anyone knowledgeable about pumps that would be willing to participate in this survey? If so, could you share their contact information?
    Yes, will refer to others.

Interview 15: Subject Matter Expert

1. What is your current title/role?
   Senior Program Manager

2. How many years of experience do you have in pumping systems?
   5 years

3. What types of experience do you have in pumping systems?
   Program development; RTF – research planning, operating info – 400 pumps in NW, data collection and record keeping; pump characteristic data, load profiles and operational hours. Study published in NEEA. Launched a midstream program; recruiting and engage man reps, EE, PEI, etc.

4. Which specific customer types/segments purchase "clean water pumps" as defined above? (Check all that apply)
   - ☒ **Agricultural**
   - ☒ **Commercial**

☒ **Industrial**
☒ **Municipal**
☒ **Residential**
☐ Wastewater *end of process
☐ Other: Click or tap here to enter text.

5. Are there variations in pump types sold in the wastewater customer segment versus other segments?
   ☒ **Yes**
   ☐No

6. What percentage of customers are aware of the Department of Energy's pump energy index (PEI) rating for Pump Energy Conservation Standards:
   ☐ Less than 25%
   ☐ 25%–50%
   ☐ 50%–75%
   ☒ **75%+**
   ☐ Don't know
   ☐ Can provide later

7. What is the most commonly purchased PEI rating for constant speed pumps by rated motor HP range (e.g., 0.5–1.0)?
   Responses may be specific PEI rating or one of the following ranges <0.8, 0.81–0.89, 0.90–0.93, 0.94–0.98, 0.98–1.0, I don't know
   a. 1–15 horsepower: Click or tap here to enter text.
      ☐ <0.8 ☐ 0.81–0.89 ☒ **0.90–0.93** ☐ 0.94–0.98 ☐ 0.98–1.0 ☐ I don't know
   b. 15–50 horsepower: Click or tap here to enter text.
      ☐ <0.8 ☐ 0.81–0.89 ☐ 0.90–0.93 ☒ **0.94–0.98** ☐ 0.98–1.0 ☐ I don't know
   c. 50–250 horsepower: Click or tap here to enter text.
      ☐ <0.8 ☐ 0.81–0.89 ☐ 0.90–0.93 ☐ 0.94–0.98 ☐ 0.98–1.0 ☒ **I don't know**

8. What is the most commonly purchased PEI rating for variable speed pumps by rated motor HP range (e.g., 0.3–0.50)?
   Responses may be specific PEI rating or one of the following ranges <0.3, 0.31–0.39, 0.40–0.43, 0.44–0.48, 0.48–0.50, I don't know

   a. 1–15 horsepower: Click or tap here to enter text.
      ☐ <0.3 ☐ 0.31–0.39 ☐ 0.40–0.43 ☐ 0.44–0.48 ☒ **0.48–0.50** ☐ I don't know
   b. 15–50 horsepower: Click or tap here to enter text.
      ☐ <0.3 ☐ 0.31–0.39 ☐ 0.40–0.43 ☐ 0.44–0.48 ☒ **0.48–0.50** ☐ I don't know
   c. 50–250 horsepower: Click or tap here to enter text.
      ☐ <0.3 ☐ 0.31–0.39 ☐ 0.40–0.43 ☐ 0.44–0.48 ☐ 0.48–0.50 ☒ **I don't know**

9. What are the most commonly sold pump models in the last 12 months within the following ranges (up to three):

a. 1–15 horsepower
    i. **TACO, Grundfos, Armstrong, Wilo, Bell & Gossett**
b. 15–50 horsepower
    i. **TACO, Grundfos, Armstrong, Wilo, Bell & Gossett**
c. 50–250 horsepower
    i.

10. If you specify pumps for customers, what are the key technical factors considered?
    a. Do you specify pump PEI ratings in selecting pumps for the customer?
        ☐ Yes ☒ **No** **operational specifications are priority**

11. When deciding on purchasing new or replacing pumps, what are the key factors considered?
    a. Does pump PEI rating affect the customer's decision-making process when selecting a pump?
        ☐ Yes ☒ **No** ☐ I don't know

    b. What are the criteria customers consider when purchasing a pump? (e.g., initial cost, operating cost, reliability, past experience, efficiency, utility savings, product availability).
        ☒ **Initial Cost – 2**
        ☒ **Operating Cost/Efficiency – 3**
        ☒ **Reliability – 1**
        ☒ **Prior Experience/Spare parts consistency/Manufacturer or type consistency – 4**
        ☒ **Availability – 5**
        ☐ Other: Click or tap here to enter text. **– Pump Fit, right pump for the job – 1**

12. Are pump vendors you work with aware of PEI ratings of pumps? 75+ aware
    a. If so, what percent of their recommendations are efficient pumps?
        ☐ Less than 25%
        ☒ **25%–50% – for constant speed pumps; 0.92 or better PEI**
        ☐ 50% – 75%
        ☒ **75%+ – for Variable; 0.48 or better PEI, all smart pumps**
        ☐ I don't know
    b. Are efficient pumps readily available for purchase?
        ☒ **Yes** ☐ No ☐ Not Sure

13. Can we reach out to you to follow up if we have further questions?
    Yes

14. Could you refer us to anyone knowledgeable about pumps that would be willing to participate in this survey? If so, could you share their contact information?
    Yes

Interview 16: Subject Matter Expert

1. What is your current title/role?
    Operations Manager – Water Treatment

2. How many years of experience do you have in pumping systems?
   15 years

4. What types of experience do you have in pumping systems?
   Supervising districts production, Management of pump operating systems including engineering, the repair and upgrade of both well pumps and booster pumps. Management of water treatment for pumping system involved with source water distribution.

5. Which specific customer types/segments purchase "clean water pumps" as defined above? (Check all that apply)
   ☒ **Agricultural**
   ☒ **Commercial**
   ☒ **Industrial**
   ☒ **Municipal**
   ☒ **Residential**
   ☐ Wastewater
   ☐ Other: Click or tap here to enter text.

6. Are there variations in pump types sold in the wastewater customer segment versus other segments?
   ☒ **Yes**
   ☐No

   I have less experience with wastewater pumping, but there are submersible chopper pumps for example that are more commonly used for sewage and wastewater.

7. What percentage of customers are aware of the Department of Energy's pump energy index (PEI) rating for Pump Energy Conservation Standards:
   ☐ Less than 25%
   ☐ 25%–50%
   ☐ 50%–75%
   ☐ 75%+
   ☒ **Don't know**
   ☐ Can provide later

8. What is the most commonly purchased PEI rating for constant speed pumps by rated motor HP range (e.g., 0.5–1.0)?
   Responses may be specific PEI rating or one of the following ranges <0.8, 0.81–0.89, 0.90–0.93, 0.94–0.98, 0.98–1.0, I don't know
   b. 1–15 horsepower: Click or tap here to enter text.
      ☐ <0.8 ☐ 0.81–0.89 ☐ 0.90–0.93 ☐ 0.94–0.98 ☐ 0.98–1.0 ☒ **I don't know**
   c. 15–50 horsepower: Click or tap here to enter text.
      ☐ <0.8 ☐ 0.81–0.89 ☐ 0.90–0.93 ☐ 0.94–0.98 ☐ 0.98–1.0 ☒ **I don't know**
   d. 50–250 horsepower: Click or tap here to enter text.
      ☐ <0.8 ☐ 0.81–0.89 ☐ 0.90–0.93 ☐ 0.94–0.98 ☐ 0.98–1.0 ☒ **I don't know**

9. What is the most commonly purchased PEI rating for variable speed pumps by rated motor HP range (e.g., 0.3–0.50)?

Responses may be specific PEI rating or one of the following ranges <0.3, 0.31–0.39, 0.40–0.43, 0.44–0.48, 0.48–0.50, I don't know

b. 1–15 horsepower: Click or tap here to enter text.
☐ <0.3 ☐ 0.31–0.39 ☐ 0.40–0.43 ☐ 0.44–0.48 ☐ 0.48–0.50 ☒ **I don't know**
c. 15–50 horsepower: Click or tap here to enter text.
☐ <0.3 ☐ 0.31–0.39 ☐ 0.40–0.43 ☐ 0.44–0.48 ☐ 0.48–0.50 ☒ **I don't know**
d. 50–250 horsepower: Click or tap here to enter text.
☐ <0.3 ☐ 0.31–0.39 ☐ 0.40–0.43 ☐ 0.44–0.48 ☐ 0.48–0.50 ☒ **I don't know**

11. If you specify pumps for customers, what are the key technical factors considered?
    b. Do you specify pump PEI ratings in selecting pumps for the customer?
    ☐ Yes ☒ **No**

12. When deciding on purchasing new or replacing pumps, what are the key factors considered?
    b. Does pump PEI rating affect the customer's decision-making process when selecting a pump?
    ☐ Yes ☒ **No** ☐ I don't know

    c. What are the criteria customers consider when purchasing a pump? (e.g., initial cost, operating cost, reliability, past experience, efficiency, utility savings, product availability).
    ☒ **Initial Cost – 1**
    ☒ **Operating Cost/Efficiency – 1**
    ☒ **Reliability – 3**
    ☒ **Prior Experience/Spare parts consistency/Manufacturer or type consistency – 2**
    ☒ **Availability – 4**
    ☐ Other: Click or tap here to enter text.

13. Are pump vendors you work with aware of PEI ratings of pumps? 75+ aware
    b. If so, what percent of their recommendations are efficient pumps?
    ☐ Less than 25%
    ☐ 25%–50%
    ☐ 50%–75%
    ☐ 75%+
    ☒ **I don't know**
    c. Are efficient pumps readily available for purchase?
    ☐ Yes ☐ No ☒ **Not Sure**

14. Can we reach out to you to follow up if we have further questions?
    Yes

15. Could you refer us to anyone knowledgeable about pumps that would be willing to participate in this survey? If so, could you share their contact information?

Yes

Interview 17: Subject Matter Expert

2. What is your current title/role?
   Operations Manager – Production

3. How many years of experience do you have in pumping systems?
   15 years

5. What types of experience do you have in pumping systems?
   Supervising districts production, Management of pump operating systems including engineering, the repair and upgrade of both well pumps and booster pumps.

6. Which specific customer types/segments purchase "clean water pumps" as defined above? (Check all that apply)
   ☒ **Agricultural**
   ☒ **Commercial**
   ☒ **Industrial**
   ☒ **Municipal**
   ☒ **Residential**
   ☐ Wastewater
   ☐ Other: Click or tap here to enter text.

7. Are there variations in pump types sold in the wastewater customer segment versus other segments?
   ☒ **Yes**
   ☐No

   I have less experience with wastewater pumping, but there are submersible chopper pumps for example that are more commonly used for sewage and wastewater.

8. What percentage of customers are aware of the Department of Energy's pump energy index (PEI) rating for Pump Energy Conservation Standards:
   ☐ Less than 25%
   ☐ 25%–50%
   ☐ 50%–75%
   ☐ 75%+
   ☒ **Don't know**
   ☐ Can provide later

9. What is the most commonly purchased PEI rating for constant speed pumps by rated motor HP range (e.g., 0.5–1.0)?
   Responses may be specific PEI rating or one of the following ranges <0.8, 0.81–0.89, 0.90–0.93, 0.94–0.98, 0.98–1.0, I don't know
   c. 1–15 horsepower: Click or tap here to enter text.
      ☐ <0.8 ☐ 0.81–0.89 ☐ 0.90–0.93 ☐ 0.94–0.98 ☐ 0.98–1.0 ☒ **I don't know**
   d. 15–50 horsepower: Click or tap here to enter text.

☐ <0.8 ☐ 0.81–0.89 ☐ 0.90–0.93 ☐ 0.94–0.98 ☐ 0.98–1.0 ☒ **I don't know**

e. 50–250 horsepower: Click or tap here to enter text.
☐ <0.8 ☐ 0.81–0.89 ☐ 0.90–0.93 ☐ 0.94–0.98 ☐ 0.98–1.0 ☒ **I don't know**

10. What is the most commonly purchased PEI rating for variable speed pumps by rated motor HP range (e.g., 0.3–0.50)?
Responses may be specific PEI rating or one of the following ranges <0.3, 0.31–0.39, 0.40–0.43, 0.44–0.48, 0.48–0.50, I don't know

c. 1–15 horsepower: Click or tap here to enter text.
☐ <0.3 ☐ 0.31–0.39 ☐ 0.40–0.43 ☐ 0.44–0.48 ☐ 0.48–0.50 ☒ **I don't know**

d. 15–50 horsepower: Click or tap here to enter text.
☐ <0.3 ☐ 0.31–0.39 ☐ 0.40–0.43 ☐ 0.44–0.48 ☐ 0.48–0.50 ☒ **I don't know**

e. 50–250 horsepower: Click or tap here to enter text.
☐ <0.3 ☐ 0.31–0.39 ☐ 0.40–0.43 ☐ 0.44–0.48 ☐ 0.48–0.50 ☒ **I don't know**

12. If you specify pumps for customers, what are the key technical factors considered?

c. Do you specify pump PEI ratings in selecting pumps for the customer?
☐ Yes ☒ **No**

13. When deciding on purchasing new or replacing pumps, what are the key factors considered?

c. Does pump PEI rating affect the customer's decision-making process when selecting a pump?
☐ Yes ☒ **No** ☐ I don't know

d. What are the criteria customers consider when purchasing a pump? (e.g., initial cost, operating cost, reliability, past experience, efficiency, utility savings, product availability).
☒ **Initial Cost – 1**
☒ **Operating Cost/Efficiency – 1**
☒ **Reliability – 3**
☒ **Prior Experience/Spare parts consistency/Manufacturer or type consistency – 2**
☒ **Availability – 4**
☐ Other: Click or tap here to enter text.

14. Are pump vendors you work with aware of PEI ratings of pumps? 75+ aware

c. If so, what percent of their recommendations are efficient pumps?
☐ Less than 25%
☐ 25%–50%
☐ 50%–75%
☐ 75%+
☒ **I don't know**

d. Are efficient pumps readily available for purchase?
☐ Yes ☐ No ☒ **Not Sure**

15. Can we reach out to you to follow up if we have further questions?
    Yes

16. Could you refer us to anyone knowledgeable about pumps that would be willing to participate in this survey? If so, could you share their contact information?
    Yes