CADMUS

# Irrigation Measure Market Research Report

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# Table of Contents



# Tables

## Figures

# Acknowledgements

This Irrigation Measure Market Research was made possible through the significant support of Energy Trust of Oregon evaluation and program staff, along with staff from the program management contractor. Their collective assistance with customer outreach, ensuring that the team had the necessary data and information, and the review of drafted surveys and interviews was a tremendous help with this research effort. We sincerely thank each and all for their support.

# Executive Summary

Energy Trust of Oregon (Energy Trust) is an independent nonprofit organization governed by a volunteer board of directors and accountable to the Oregon Public Utility Commission. Energy Trust delivers energy savings programs to Oregon customers of Portland General Electric, Pacific Power, NW Natural, Cascade Natural Gas, and Avista, and customers of NW Natural in southwest Washington. As part of Energy Trust's ongoing efforts to improve program performance, it regularly completes market research to refine its measures.

This report documents the market research Cadmus conducted on irrigation measures. Cadmus assessed irrigators' practices around gasket replacement and leakage prevention, sprinkler upgrade decisions, and irrigators' appetite for advanced controls offerings. This research will aid Energy Trust with its future Production Efficiency measure design.

## Evaluation Goals and Key Research Objectives

The research objectives for the Irrigation Measures Market Research Evaluation are listed below:

- Understand irrigation system and gasket market pricing, availability, and where these items are typically purchased.
- Investigate maintenance and leakage prevention practices of participant and non-participant irrigators with a focus on gasket replacement.
- Assess leakage rates from faulty gaskets among participant and non-participant irrigators.
- Understand irrigators' system upgrade decision-making and appetite for moisture monitoring controls offerings in the future.

## Market Research Summary

Cadmus summarizes findings and recommendations around the four research questions posed by this study. Please see the Conclusions and Recommendations section for more details on the findings. Results of the research activities through vendor interviews, surveys, and site visits are aggregated into the four key research categories:

- Irrigation System and Gasket Market Pricing, and Availability

Vendors report no significant issues with the availability of irrigation systems and gaskets. They have expressed strong interest in midstream offerings, agreeing with irrigators that increased incentives would drive higher sales of energy- and water-saving irrigation components and systems.

- Maintenance and Leakage Prevention Practices

Most irrigators report conducting regular maintenance on their systems, including replacing broken or leaking components when detected. However, despite diligent efforts, gaskets inevitably deteriorate over time. More frequent maintenance plays a crucial role in achieving energy and water savings. Our

on-site inspections and measurements revealed a significant number of leaking gaskets, highlighting the need for ongoing attention to system upkeep.

- Leakage Rates from Faulty Gaskets

Participants in the Energy Trust gasket replacement measure exhibited fewer and smaller leaks compared to non-participants. However, both groups still experienced leaking gaskets, indicating opportunities for program engagement across the entire population of irrigators. Additionally, many irrigators were unaware of critical system setpoints, such as pressure. Enhanced education on system parameters could help irrigators detect leaks more promptly and improve overall system efficiency.

- System Upgrade Decision-Making and Appetite for Moisture Monitoring Controls

Most survey respondents indicated they do not use automated sprinkler systems, with many citing high costs and a lack of familiarity as key barriers to adoption. Expanding educational efforts and offering targeted incentives for these systems could enhance market penetration and lead to significant long-term water and energy savings.

- Other Findings and Recommendations

There is a significant population of gasket measure non-participants in Eastern Oregon, which had notably lower response rates compared to other regions. Enhancing outreach efforts targeting this group could boost participation and lead to greater energy and water savings for Energy Trust.

# MEMO

**Date:** 9/18/2024
**To:** Energy Trust Board of Directors
**From:** Leila Shokat, Evaluation Project Manager
Kirstin Pinit, Sr. Program Manager – Industry and Agriculture
Andi Nix, Engineer – Planning and Evaluation
**Subject:** Staff Response to the Irrigation Measure Market Research Report

The Cadmus Group conducted market research during the spring and early summer of 2024 to investigate leakage rates from gaskets and equipment maintenance practices among irrigators. This study had the primary goal of updating assumptions about typical leakage rates from faulty gaskets to inform the Production Efficiency program's gasket replacement measure update. This measure is offered through the Standard Industrial track and helps irrigators in Oregon save water and electricity by encouraging replacement of leaking gaskets along irrigation lines. The results of this study show a higher rate of leaking gaskets and a higher average leak flow rate among gasket measure non-participants compared to gasket measure participants, indicating the measure is effective in reducing overall water loss due to leaking gaskets.

The study found a gasket failure rate of 28% among gasket measure participants compared to 49% among non-participants, and the average gasket leakage rate of participants was 55% lower than that of non-participants. Energy Trust will use these findings to inform the measure development process while updating deemed savings for the gasket replacement measure. Cadmus conducted interviews with irrigation equipment vendors to collect gasket price information, which will be an additional input into updating the gasket replacement measure.

Cadmus also investigated irrigation equipment maintenance practices more broadly, beyond gaskets. It found most surveyed irrigators primarily rely on reactive maintenance, replacing only broken or damaged irrigation equipment rather than replacing prior to equipment failure. Most of the irrigators also reported conducting maintenance checks themselves and using visual inspection of irrigation lines to identify equipment failures. The variation in observed leakage rates, despite general alignment in self-reported equipment maintenance practices, suggests opportunities exist to improve water and electricity savings through standardization of irrigator maintenance practices. In addition to investigating maintenance practices and leakage rates, the study also explored irrigators' appetite for upgrading to automated systems or adopting advanced irrigation controls. Cadmus found cost, lack of perceived need or benefit and unfamiliarity with advanced irrigation systems were key reasons irrigators decided not to upgrade. Energy Trust's Production Efficiency program will draw on these insights as a part of ongoing efforts to understand irrigators' operations comprehensively and offer incentives and resources that make sense for these customers.

Cadmus encountered some challenges in scheduling site visits with irrigators due to time constraints as well as later than usual rains that caused irrigators to delay the start of their irrigating season. Though Energy Trust does not have near-term plans to conduct further site visits with irrigators, these challenges underscore the importance of tailoring research approaches to different types of Production Efficiency customers whenever possible.

# Introduction

Energy Trust of Oregon (Energy Trust) contracted Cadmus to complete market research on irrigation measures for its Production Efficiency (PE) program, which seeks to update its measures and offerings to more accurately reflect savings and make offerings more accessible and attractive to its agricultural customers.

## 2020–2023 Gasket Measure Participation

Cadmus reviewed the program data to develop a sampling plan that accurately represented both participant and non-participant gasket replacement practices and leakage rates and met Energy Trust's objectives. Table 1 and Table 2 below display the distribution of projects for participants from 2020 to 2023 and the regions where each of these projects were implemented.

**Table 1. Gasket Replacement Sites, Projects, and Savings by Year, 2020 to 2023**

| Program Year | Sites | Projects | Kilowatt-hour Savings |
|---|---|---|---|
| 2020 | 114 | 137 | 8,408,080 |
| 2021 | 59 | 63 | 1,541,330 |
| 2022 | 58 | 66 | 1,293,366 |
| 2023 | 26 | 28 | 662,585 |
| **Total** | **203** | **296** | **11,921,263** |

**Table 2. Gasket Replacement Sites, Projects, and Savings by Region, 2020 to 2023**

| Region | Sites | Projects | Kilowatt-hour Savings |
|---|---|---|---|
| Central Oregon | 28 | 31 | 1,196,295 |
| Eastern Oregon | 14 | 14 | 123,928 |
| Portland Metro & Hood River | 31 | 41 | 2,216,838 |
| Southern Oregon | 38 | 65 | 4,949,011 |
| Willamette Valley | 92 | 145 | 3,435,191 |
| **Total** | **203** | **296** | **11,921,263** |

# Report Organization

The remainder of this report is organized into the following sections:

- **Overview of Methodology:** This section provides the market research objectives, methodology, and analysis.
- **Measure Research Results and Findings:** This section provides the results and findings from each leg of the research.
- **Conclusions and Recommendations:** This section provides conclusions that summarize the findings from each leg of the research and associated recommendations.
- **Appendices:** The appendices provide supporting information for this market research.

# Overview of Methodology

The corresponding sections outline the methodology Cadmus followed to conduct the research activities that are presented in this report.

## Evaluation Goals and Key Research Objectives

Cadmus' irrigation measures market research included the following goals:

- Understand irrigation system and gasket market including pricing and availability, and where these items are typically purchased.
- Investigate gasket replacement and leakage prevention practices of participant and non-participant irrigators.
- Assess leakage rates from faulty gaskets among participant and non-participant irrigators.
- Understand irrigators' system upgrade decision-making and appetite for moisture monitoring controls offerings in the future.

## Research Methodology

To thoroughly research the irrigation products market, Cadmus sought out insight from both vendors and irrigators. For irrigators we sought feedback from both previous gasket measure participants and non-participants to get deeper understanding and perspectives. Our entire sample (participants and non-participants) of irrigators are sites that have previously participated in Energy Trust programs, but for the purposes of this report, participants and non-participants are defined with respect to participation in the gasket measure from the years 2020 through 2023. Additionally, for gasket leakage research, Cadmus visited participant and non-participant sites across the state to test and count gasket leaks.

Before starting work on this market research, Cadmus, along with Energy Trust's guidance, developed a workplan specifying the activities, methods, and deliverables for this study. Cadmus followed the evaluation guidelines in the *Irrigation Measures Market Research Work Plan*, approved by Energy Trust of Oregon. Below is a brief summary of the activities and methods used to address research questions. These activities and methods are described in further detail in the rest of this section.

| VENDOR INTERVIEWS |
| --- |
| Cadmus conducted interviews to understand irrigation system and gasket market pricing and availability as well as how components are typically purchased. These interviews covered topics such as current pricing, sales volume, purchasing practices, and potential for midstream offerings. We gathered the information through one-on-one phone interviews. |
| **IRRIGATOR SURVEYS** |
| Cadmus investigated gasket measure participant and non-participant irrigators' gasket replacement and leak repair practices, sprinkler system upgrade decision-making, interest in control offerings, and general maintenance practices through online surveys and in person during site visits. We analyzed the feedback to assess if the program offerings match the market needs and to identify further opportunities to support customers with irrigation upgrades. |
| **SITE VISITS** |
| Cadmus field inspectors sampled and measured six leaks per irrigation system, then tallied any remaining leaks into bins based on their relative flow (high, medium, or low). Additionally, field inspectors noted the system's pump information including horsepower and efficiency, system pressure, and the existence of a VFD. We analyzed leakage rates based on geographical location and system specifications. |

## Vendor Interviews

The Cadmus team conducted interviews with participating vendors to understand irrigation system and gasket market pricing and availability and how components are typically purchased. Cadmus drafted an interview guide with questions covering topics such as current pricing, sales volume, purchasing practices, and potential for midstream offerings. Energy Trust supplied a list of about 50 participating vendors from the Production Efficiency program's irrigation measure offerings. Our team reached out to each vendor via email and phone calls to schedule and conduct interviews. We completed phone interviews with 16 of the 50 vendors and analyzed the data, summarized in the *Results and Findings* section. Cadmus provided $50 incentives via Tango for each completed interview, delivered immediately over email upon completion of the interview.

## Irrigator Surveys

To understand whether program offerings match the market need and to identify further opportunities to support customers with irrigation upgrades, the Cadmus team administered an online survey with gasket measure participant and gasket measure non-participant irrigators and compared the results between the two groups. Field inspectors also carried out these surveys in person during site visits. We administered the same survey for both gasket measure participants and non-participants, attempting to assess gasket replacement and leak repair practices, sprinkler system upgrade decision-making, interest in control offerings, and general maintenance practices. Additionally, we tracked crop types, regions, and irrigation methods. For both gasket measure participants and non-participants, Cadmus provided

$50 incentives via Tango for each completed survey. Respondents received the incentive immediately from Tango upon completing the online survey. In cases where the survey was administered on site, our team followed up with an email shortly after providing the Tango gift card.

## Irrigator Site Visits

Upon the award of this work, Cadmus began working with Energy Trust and program administrators to identify what types of data would be reasonable to measure on site and helpful for the purpose of investigating gasket leaks. We concluded that bucket testing a random sample of leaks would be sufficient to estimate the leakage of all leaking gaskets on a line. Using graduated buckets, site inspectors would collect water leaking from gaskets for 10 seconds and note the approximate quantity of water. In some cases, the bucket can be placed underneath the line and capture all the leaking water. In others where the line is directly on the ground or spraying erratically, plastic bags or other flexible materials could be used to capture the leaking water or direct it into the bucket for measurement. To make things easier for site inspectors, a data sheet was made with helpful information, necessary equipment, and tables to fill in data from each visit. Cadmus also held a training for all staff who went on site, going over what the lines and gaskets looked like, what to measure and how to maintain consistency, and general safety and professionality guidelines.

While conducting surveys, the Cadmus team began scheduling site visits across the population of approximately 200 gasket measure participants and 143 gasket measure non-participants with a target sample of 20 participant and 20 non-participant site visits. We achieved 21 participant site visits and 11 non-participant site visits. The main goal of the site visits was to walk the lines to identify and measure gasket leaks within the system for hand and wheel lines on site. We aimed to sample six random leaks to verify leakage rates at each site. The Cadmus field inspector also tallied all other leaks through a visual inspection and grouped them into high, medium, and low bins using the verified leaks on site as a guideline for grouping. Depending on the size of the site, conditions in the fields, and the operating status of the lines, the field inspector may have only inspected a portion of the lines on any given property. For sites where only a portion of the gaskets were inspected, the Cadmus team only applied the leakage findings to the visually inspected leaks and did not extrapolate to the full site. The Cadmus field inspector also noted system pump information such as horsepower, efficiency, pressure, and existence of a VFD to provide additional operational characteristics of the irrigation system at each site. Our field inspectors conducted the irrigator survey on site if the site contact had not already completed it. Upon completion of all site visits, the Cadmus team aggregated the collected data and drew findings, conclusions, and recommendations as they related to research objectives.

### Weighting Considerations for Leaks

On site, six randomly sampled leaks per system are used to categorize all leaking gaskets. The six randomly sampled leaks were measured via ten second bucket tests, then grouped into high, medium, and low bins comparatively. Each system has its own set of bins, high leakage rates at one site may be equivalent to low leakage rates at other sites. The main objective of the grouping was to understand the leakage rate relevant to the site and corresponding visual inspection. After determining the high, medium, and low bins at a site, we take the average of the measured leaks within each bin and apply

this to the rest of the failing gaskets on site through a visual inspection. Each visually inspected gasket is first confirmed to be leaking and then assigned a high, medium, and low leakage rate which is included as part of the count for the relevant bin. The measured and visually inspected leakage rates within a site are used to calculate the overall site-specific leakage average (this includes all leaks in the low, medium, and high bins). Once we determine the average leakage rates of inspected gaskets at each of the sampled sites, we calculate the total weighted average leakage rate across the full sample of participants and non-participants. The overall weighted average leakage rate was calculated for gasket measure participant sites, gasket measure non-participant sites, and across the full sample. This was calculated by taking the average leak rate per site multiplied the number of inspected gaskets for that particular site. We then sum up the resulting leakage rates of all sites and divide this by the total quantity of inspected gaskets across all sites.

### Assumptions and Considerations

We did not extrapolate leaks across full sites and only considered leaks that were directly measured or visually inspected in our analysis. This was done for several reasons:

- While on-site the team was only able to measure and inspect the gaskets that were present on operating irrigation equipment. Not all systems were running during the site visit.
- Some sites were too large (in some cases thousands of acres) and it was not feasible to inspect all the gaskets on site.
- Site contacts were not aware and not tracking the number of gaskets present at site which made extrapolation challenging.
- At large sites there may have been multiple pumps with different flow rates and pressure setpoint specifications that could lead to different failure rates. Each sampled line has its own results with the pump specifications serving the line used.
- Different crop types can also lead to different line specifications and irrigation requirements which will lead to differences in leakage rates. Crop type was not accounted for in the average leakage rates.

Other assumptions we made involved bins being determined on site. Bin ranges and values varied between sites and were based off six randomly measured leaks per system. We used the bucket test for these leaks, however there may be other approaches that provide more accuracy depending on the leak. These low, medium, and high leakage rate bins were then applied to visually inspected gaskets on site. This opens the potential for human error in assigning leaks in this manner that should be considered when reviewing results of the study. Some precautions were taken to mitigate this such as providing training for our field staff. Each inspector assigned bins to leaks on a site-by-site basis, meaning that our staff could capture more accurate data for each site than binning leaks similarly across all sites.

## Evaluation Sample

Energy Trust staff provided a list of vendors, gasket measure participant irrigators, and all irrigation participants across all measures (not just gaskets). The full participant list excluding those who

participated in the gasket measures were defined as gasket measure non-participants for this study. The following subsections outline the sampling plans for each of these efforts.

## Vendor Interviews

At the start of the project and based on discussions with Energy Trust, Cadmus anticipated a list of 20 participating vendors and developed the workplan to reach out to all of them with a target response rate of 50% to achieve 10 interviews. Energy Trust was able to provide a list of 50 participating vendors. Cadmus began contacting vendors on April 1, 2024, and concluded the outreach at the end of April. The Cadmus team reached out to a census of these participating vendors and were able to complete 16 interviews for a response rate of 32%.

## Irrigator Surveys

Energy Trust provided a list of 203 participant and 143 non-participant irrigators to contact regarding surveys. The Cadmus team targeted a completion of 51 completed surveys for each category of customers participating and non-participating in gasket measures to achieve a 90/10 confidence and precision result. Cadmus launched the survey and emailed a link to every contact. Additionally, field inspectors on site visits worked directly with the site contacts to take the survey and administer it themselves if the site contact was willing. The survey was launched on May 22, 2024, and was kept online for four weeks with scheduled weekly reminders. Due to lower response rates than planned after multiple reminder emails, the Cadmus team conducted direct outreach to both participants and non-participants and conducted the survey directly over the phone to bolster completions. We completed 37 participant surveys and 32 non-participant surveys with response rates of 18% and 23% respectively. For both gasket participants and gasket non-participants, Cadmus provided $50 incentives via Tango for each completed survey. Respondents received the Tango incentives immediately via email upon completing the online survey.

## Irrigator Site Visits

Cadmus planned to achieve 20 site visits each for participant and non-participant irrigators. Our scheduling strategy involved the following activities:

- Using the overlap with the 2022 PE program impact evaluation, including a question asking about interest in the site visits.
- Conducting direct outreach to both participant and non-participant lists to recruit participation in site visits.
- Using the online survey to gauge interest in a site visit by providing a checkbox and following up by phone to schedule with survey respondents who indicated an interest in a site visit.

For each scheduled site visit, the team verified that the equipment was installed, and the irrigators were irrigating before conducting the site visit. We provided a $100 incentive to each participating site.

Table 3 shows the evaluation activities and data collected for the Irrigation Measures Market Research Evaluation.

### Table 3. Irrigation Measures Market Research Evaluation Methodology

| Activities | Evaluation Protocol or Approach | Population Size | Completions Achieved [c] | Response Rate |
|---|---|---|---|---|
| Vendor interviews | Interview participating vendors from the Production Efficiency program who sell irrigation measures to understand market pricing and availability and potential for midstream offerings. | 50[a] | 16[b] | 32% |
| Participant irrigators survey | Interview participating irrigators in Production Efficiency program's gasket measure offerings to understand irrigation equipment needs and identify further opportunities to support customers with irrigation upgrades. | 203 | Complete: 37<br>Partial: 1 | 19% |
| Non-participant irrigators survey | Interview non-participating irrigators to understand irrigation equipment needs and identify further opportunities to support customers with irrigation upgrades. | 143 | Complete: 32<br>Partial: 2 | 24% |
| Participant irrigators site visits | Directly measure gasket leaks and system specifications in the field for participating customers. | 203 | 21 | 10% |
| Non-participant irrigators site visits | Directly measure gasket leaks and system specifications in the field for non-participating customers. | 143 | 11 | 8% |

[a] Cadmus identified 50 participating vendors to contact from the provided irrigation vendors list, including those with viable phone numbers and those whose numbers we researched online.
[b] Cadmus interviewed 16 vendors in total. One vendor lacked a physical storefront and could not answer all questions.
[c] Partial responses are for those who started but did not complete the survey and answered at least one question included in this report.

# Measure Research Results and Findings

This section presents the findings of each research effort including analysis of interview, survey, and site visit data and general observations.

## Vendor Interviews

Cadmus identified 50 participating vendors to contact from the provided irrigation vendors list, including those with viable phone numbers and those whose numbers we researched online. Cadmus began contacting vendors on April 1, 2024, and concluded the outreach at the end of April. In total, Cadmus interviewed 16 vendors. However, one vendor did not have a physical storefront and could not answer all interview questions.

Nine vendors sell irrigation equipment both within and outside of Oregon, while seven sell equipment only in Oregon. Cadmus asked vendors what part of Oregon generates most of their irrigation equipment sales. Most vendors reported that most of their sales come from the Willamette Valley region (7 respondents), followed by Central Oregon (3 respondents) and Southern Oregon (3 respondents). Table 4 shows the count of vendors who conduct most of their sales in a given region, based on the Oregon Agriculture Regions.

**Table 4. Top Regions in Oregon for Vendor Irrigation Equipment Sales**

| Agricultural Region | Count |
|---|---|
| Willamette Valley | 7 |
| Central Oregon | 3 |
| Southern Oregon | 3 |
| Columbia Plateau | 2 |
| Northeast Oregon | 1 |
| Southeast Oregon | 1 |
| **Total** | **16** |

Source: Energy Trust of Oregon Irrigation Measures Market Research, Vendor Interview Question: B6. "What part of Oregon do most of your irrigation equipment sales come from?" (n=16)

All vendors stock nozzles, sprinklers, and low-pressure regulators, though some do not stock drains and tubes. Vendors noted that seasonal demand patterns significantly impact their inventory, with highest demand in spring and summer.

Wheel line, hand line, and center pivot gasket sales varied, with reported sales ranging from 10 to 50,000 units. Vendors found it easy to obtain these gaskets and expressed interest in selling them at discounted prices if incentivized by Energy Trust Oregon. These findings will be discussed in more detail in the following sections.

## Market Pricing and Availability

All 15 interviewed vendors stock nozzles, sprinklers, and low-pressure regulators.[1] One vendor, lacking a physical storefront, was not eligible to answer the question. One vendor does not stock drains, and another does not stock wheel line, hand line, or center pivot boot gaskets. Of the 15 respondents, 3 do not stock tubes such as goose necks, drop tubes, and hose extensions.

Cadmus asked vendors if there are seasonal variations or other factors that impact the irrigation components they stock. Most vendors (10 respondents) cited seasonal demand patterns, indicating that demand varies during specific times of the year such as the growing season or other periods of heightened customer interest. Two vendors reported that seasonal slowdowns impact their stock. One vendor reported that component availability depends on supplier factors, such as stock levels or order delays. Another vendor mentioned making inventory adjustments based on seasonal needs. One vendor did not think that any factors or seasonal variations impact the components they stock. When asked about the seasonality or time of year when sales of gaskets tend to be highest, seven vendors reported that sales peak in spring (with some specifying April and May), while six vendors indicated that sales are highest in summer (mostly in June).

Eight out of 15 respondents said they sell irrigation components as a system. Cadmus then asked these eight respondents which irrigation systems brought in the most sales in 2023. Three vendors reported that LEPA (low energy precision application) brought in the most sales, three vendors said LESA (low elevation spray application), two vendors said MESA (mid-elevation spray application), and one reported PMDI (precision mobile drip irrigation). Four vendors did not know which systems brought in the most sales in 2023.

When asked about the number of wheel line gasket units sold in 2023, vendors reported a range from 10 to 50,000 units. Two vendors reported selling around 100 units, and two reported selling 1,000 units. For hand line gasket units sold in 2023, vendors reported a broad range from ten to 30,000 units. For center pivot gasket units sold in 2023, vendors reported a range from ten to 1,100 units. Table 5 provides the exact breakdown of gasket units sold in 2023 and the frequency of those sales numbers.

**Table 5. Gasket Sales in 2023**

| Vendor | Wheel Line Units Sold | Hand Line Units Sold | Center Pivot Units Sold |
|---|---|---|---|
| Vendor #1 | 1,000 | 8,000 | 100 |
| Vendor #2 | 1,100 | 1,100 | 1,100 |
| Vendor #3 | 250 | 700 | 35 |
| Vendor #4 | 900 | 3,000 | 0 |
| Vendor #5 | 10 | 10 | 10 |

[1] ETO Irrigator Vendor Interview. Question D1. “Please tell me, yes or no, if you ever stock these components at your store.” Answer options were: A, “Nozzles,” B, “Drains,” C, “Wheel line, hand line, or center pivot boot gaskets,” D, “Sprinklers such as rotating type, multi-trajectory, and impact,” E, “Low pressure regulators,” F, “Tubes such as goose necks, drop tubes, and hose extensions.”

| Vendor | Wheel Line Units Sold | Hand Line Units Sold | Center Pivot Units Sold |
|---|---|---|---|
| Vendor #6 | 100 | 100 | 100 |
| Vendor #7 | 1,000 | 1,800 | 200 |
| Vendor #8 | 50,000 | 30,000 | 400 |
| Vendor #9 | 200 | 500 | 0 |
| Vendor #10 | 100 | 100 | 300 |
| **Total** | **54,660** | **45,310** | **2,245** |

Source: Energy Trust of Oregon Irrigation Measures Market Research, Vendor Interview Question: D4. "How many wheel line, hand line, and center pivot boot gasket units did you sell in 2023? A rough estimate is fine." (n=10)

As seen in Table 6, Cadmus also asked respondents to provide the average retail price per unit for each gasket type sold in 2023. The average retail price reported for wheel line gaskets is $4.91, for hand line gaskets is $4.33, and for center pivot boot gaskets is $26.86.

**Table 6. Counts of Average Retail Prices per Unit for Gaskets in 2023**

| Vendor | Wheel Line Gaskets Price | Hand Line Gaskets Price | Center Pivot Boot Gaskets Price |
|---|---|---|---|
| Vendor #1 | $2.89 | $2.9 | - |
| Vendor #2 | $3.00 | $3.00 | $3.00 |
| Vendor #3 | $1.50 | $2.00 | $45.00 |
| Vendor #4 | $3.00 | $4.00 | - |
| Vendor #5 | $2.50 | $2.50 | $40.00 |
| Vendor #6 | $5.00 | $1.50 | $1.00 |
| Vendor #7 | $3.25 | $3.25 | $20.00 |
| Vendor #8 | $6.00 | $2.00 | $59.00 |
| Vendor #9 | $2.00 | $2.19 | - |
| Vendor #10 | $20.00 | $20.00 | $20.00 |

Source: Energy Trust of Oregon Irrigation Measures Market Research, Vendor Interview Question: D6. "What was the average retail price per unit for the wheel line, hand line, and center pivot boot gaskets you sold in 2023? A best guess is fine." (n=7-10)

## Potential for Midstream Offerings

Cadmus asked vendors about the ease of obtaining wheel line, hand line, and center pivot boot gaskets for their stores. Nine vendors found it *very easy* to obtain these gaskets, while six found it *somewhat easy*. No vendors reported any difficulty in obtaining these gaskets.

Cadmus also asked vendors to imagine that Energy Trust of Oregon would pay incentives so they could sell irrigation components to customers at a discounted price. As seen in Table 7, most vendors expressed interest in selling *sprinklers* (14 respondents), followed by *gaskets* (12 respondents) and *nozzles* (12 respondents). Eleven respondents said they were interested in *regulators* and *drains*. Five respondents who reporting selling common irrigation components also chose *other*, specifying PVC pipes, levelers, wheel-line hoses, and complete systems like K-line. One vendor expressed no interest, citing concerns about offering discounted prices due to differences in incentives between California and Oregon, which could lead to dissatisfaction among California customers.

**Table 7. Interest in Selling Irrigation Components at a Discounted Price**

| Component | Number of Interested Vendors |
|---|---|
| Sprinklers | 14 |
| Nozzles | 12 |
| Gaskets | 12 |
| Regulators | 11 |
| Drains | 11 |
| Tubes | 10 |
| Other | 5 |
| None | 1 |

Source: Energy Trust of Oregon Irrigation Measures Market Research, Vendor Interview Question: F3. "Imagine that Energy Trust of Oregon would pay you incentives so that you can sell irrigation components to your customers at a discounted price. Which irrigation component, if any, would you be interested in selling to customers at a discounted price?" (n=8)

Cadmus asked respondents for advice on increasing the sales of irrigation components that help irrigators save energy and water.[2] Five vendors suggested increasing incentives, four recommended conducting more education and outreach, and three suggested product-specific incentives for items like below ground PVC pipes, tubing, and control valves. Two respondents suggested supporting farmers with the installation or maintenance of systems, possibly through labor incentives or support for system upgrades. Four vendors had no suggestions.

## Irrigator Surveys

To understand whether program offerings match the market need, and to identify further opportunities to support customers with irrigation upgrades, the Cadmus team collected feedback from irrigators, including both gasket measure participants and gasket measure non-participants within the Production Efficiency program.

We obtained 37 completed surveys from gasket measure participants and 32 from gasket measure non-participants. It is important to note that this report includes analysis of three partial responses: two from gasket measure non-participants and one from a gasket measure participant. The following sections detail the results and findings from surveys.

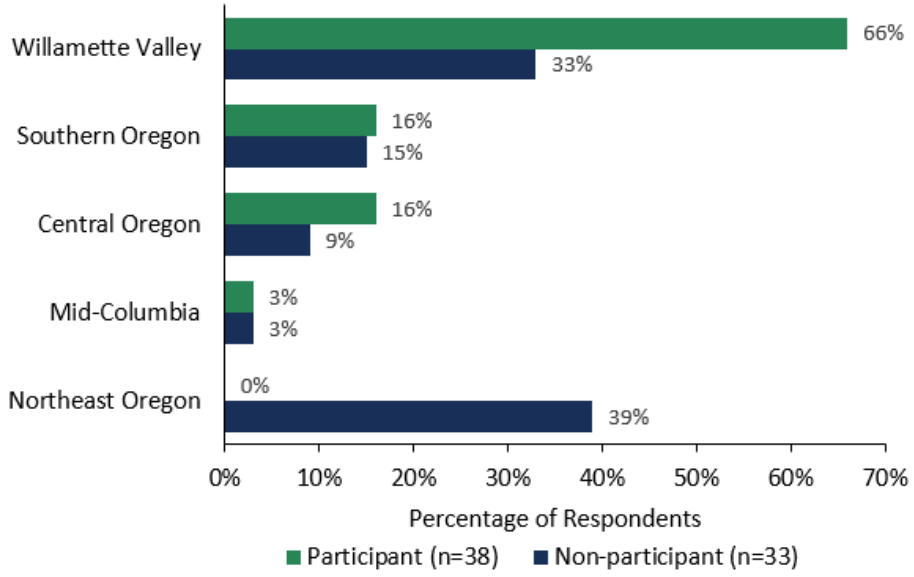
### Irrigation Characteristics

To understand irrigation characteristics, Cadmus asked both gasket measure participants and gasket measure non-participants questions about their geographical location, types of crops grown, and irrigation methods used. The survey asked all respondents about the location of their farmland in

[2] ETO Irrigator Vendor Interview. Question F4. "Do you have any advice on how we could increase the sales of irrigation components that specifically help an irrigator save energy and water?"

Oregon. As shown in Figure 1, most respondents are based in *Willamette Valley* (66%), while most non-participants are located in *Northeast Oregon* (39%).

**Figure 1. Farmland Locations in Oregon Reported by Respondents**




Source: Energy Trust of Oregon Irrigation Measures Market Research, Participant and Non-participant Irrigator Survey Question: B2. "What part of Oregon is your farmland located?" (n=33-38)

Table 8 shows that most gasket measure participants own farms ranging in size from 51 to 100 acres (10 respondents) and 101 to 500 acres (11 respondents). These farms are primarily located in Willamette Valley. Notably, no gasket measure participant reported owning a farm in Northeast Oregon. In contrast, gasket measure non-participants own farms ranging from 11 to 50 acres (7 respondents) and 101 to 500 acres (9 respondents), with most of these farms located in Northeast Oregon and Willamette Valley (Table 9).

**Table 8. Counts of Farm Size by Geographic Location (Gasket Measure Participants)**

| | Central Oregon | Mid-Columbia | Southern Oregon | Willamette Valley | Total |
|---|---|---|---|---|---|
| **Acres of Farmland** | | | | | |
| 0 - 10 acres | 1 | - | - | 1 | **2** |
| 11 - 50 acres | - | - | 2 | 4 | **6** |
| 51 - 100 acres | 2 | - | - | 8 | **10** |
| 101 - 500 acres | 2 | 1 | 3 | 5 | **11** |
| 501 - 1000 acres | 1 | - | 1 | 4 | **6** |
| 1001 - 5000 acres | - | - | - | 1 | **1** |
| 5001+ acres | 1 | - | - | 1 | **2** |
| **Total** | **7** | **1** | **6** | **24** | **38** |

Source: Energy Trust of Oregon Irrigation Measures Market Research, Vendor Interview Questions: B2. "What part of Oregon is your farmland located?" B4. "How many acres of farmland do you irrigate? A rough estimate is fine. Please enter a number only."

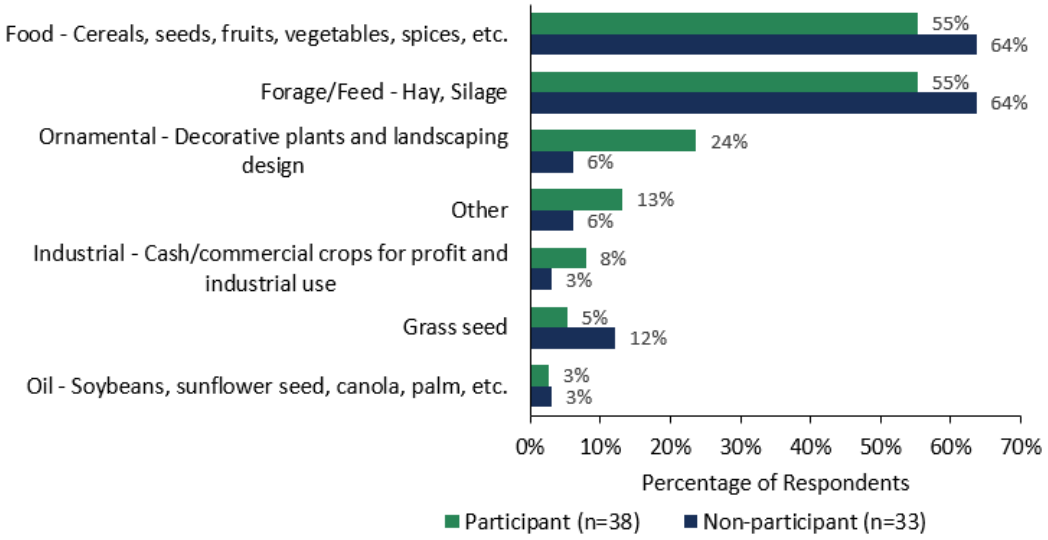
### Table 9. Counts of Farm Size by Geographic Location (Gasket Measure Non-Participants)

| | Central Oregon | Mid-Columbia | Northeast Oregon | Southern Oregon | Willamette Valley | Total |
|---|---|---|---|---|---|---|
| **Acres of Farmland** | | | | | | |
| 0 - 10 acres | 1 | - | - | - | - | **1** |
| 11 - 50 acres | - | - | 1 | 2 | 4 | **7** |
| 51 - 100 acres | - | - | 1 | - | 3 | **4** |
| 101 - 500 acres | - | - | 5 | 1 | 3 | **9** |
| 501 - 1000 acres | 1 | - | 2 | 1 | 1 | **5** |
| 1001 - 5000 acres | 1 | 1 | 2 | 1 | - | **5** |
| 5001+ acres | - | - | 1 | - | - | **1** |
| **Total** | **3** | **1** | **12** | **5** | **11** | **32** |

Source: Energy Trust of Oregon Irrigation Measures Market Research, Vendor Interview Questions: B2. "What part of Oregon is your farmland located?" B4. "How many acres of farmland do you irrigate? A rough estimate is fine. Please enter a number only."

When asked about the types of crops produced on their farms, 55% of gasket measure participants reported growing food crops such as cereals, seeds, and fruits, while another 55% reported growing forage and feed crops such as hay and silage. Similarly, 64% of gasket measure non-participants grow food crops, and 64% produce forage and feed. Figure 2 provides a breakdown of other crops grown.

### Figure 2. Types of Crops Produced




Source: Energy Trust of Oregon Irrigation Measures Market Research, Participant and Non-participant Irrigator Survey Question: B3. "What types of crops do you produce at your farm? Select all that apply." (n=33-38)

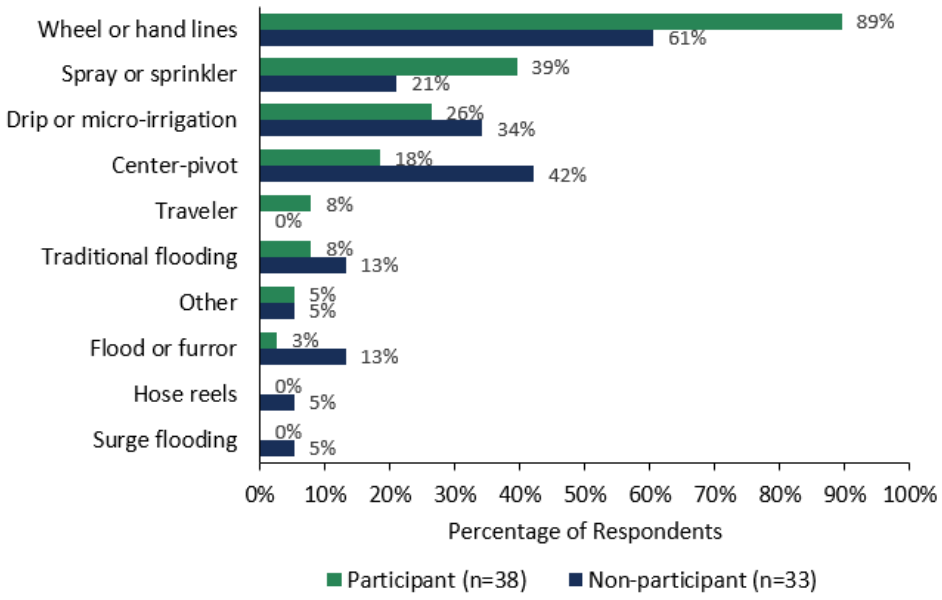
**Table 10. Overall Counts of Crops Produced by Farm Size**

| | Food | Forage/ Feed | Fiber | Industrial | Oil | Ornamental | Other |
|---|---|---|---|---|---|---|---|
| **Acres of Farmland** | | | | | | | |
| 0 - 10 | 2 | 2 | - | - | - | - | - |
| 11 - 50 | 5 | 6 | - | - | - | 2 | 3 |
| 51 - 100 | 8 | 5 | - | 2 | - | 1 | 7 |
| 101 - 500 | 9 | 13 | - | 2 | 1 | 1 | 6 |
| 501 - 1000 | 4 | 7 | - | - | - | 2 | 2 |
| 1001 - 5000 | 7 | 5 | - | - | 1 | - | 1 |
| 5001+ acres | 2 | 2 | - | - | - | 1 | 1 |

Source: Energy Trust of Oregon Irrigation Measures Market Research, Vendor Interview Questions: B4. "How many acres of farmland do you irrigate? A rough estimate is fine. Please enter a number only." B3. "What types of crops do you produce at your farm? Select all that apply."

The survey asked respondents what irrigation methods they use. As shown in Figure 3, the majority of gasket measure participants (89%) and gasket measure non-participants (61%) reported *wheel or hand lines*. Other common methods cited by gasket measure participants were *spray or sprinkler* (39%), *drip or micro-irrigation* (26%), and *center-pivot* (18%). Non-participants cited *wheel or hand lines* (61%), center-*pivot* (42%), *drip or micro-irrigation* (34%), and *spray or sprinkler* (21%). Non-participants were primarily concentrated in Northeast Oregon, with 10 respondents using wheel or hand lines and 9 respondents using center-pivots. Most respondents who reported using drip or micro-irrigation (6 respondents) or spray or sprinkler (five respondents) were located in Willamette Valley.

**Figure 3. Irrigation Methods Used**




Source: Energy Trust of Oregon Irrigation Measures Market Research, Participant and Non-participant Irrigator Survey Question: B6. "What irrigation method do you use? Select all that apply." (n=33-38)

Table 11 shows that wheel or hand lines are the most common irrigation methods reported by participants in all regions, except in Mid-Columbia, where wheel or hand lines and center pivot are equally common.

**Table 11. Counts of Common Irrigation Methods per Region**

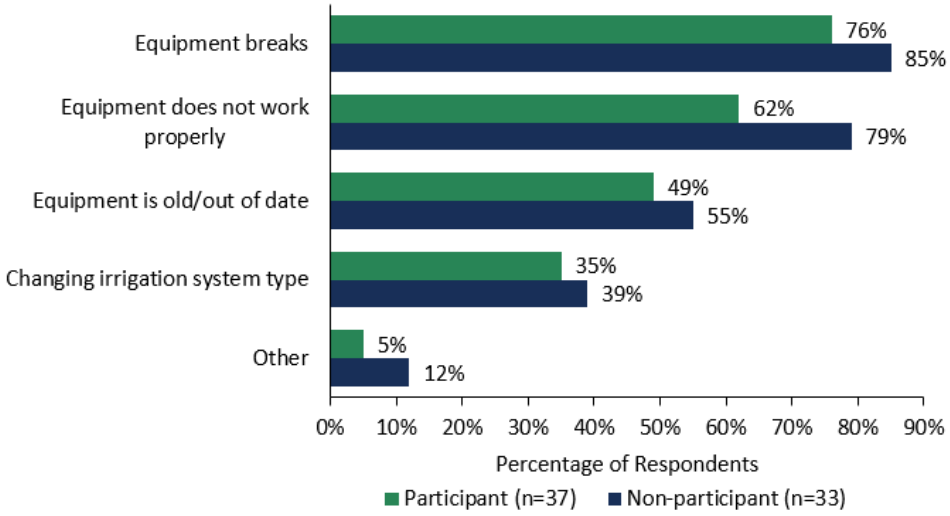
| | Central Oregon | Mid-Columbia | Northeast Oregon | Southern Oregon | Willamette Valley |
|---|---|---|---|---|---|
| **Irrigation Method** | | | | | |
| Center-pivot | 3 | 2 | 9 | 4 | 5 |
| Wheel or hand lines | 9 | 2 | 10 | 11 | 25 |
| Drip or micro-irrigation | 2 | 1 | 2 | 2 | 14 |
| Flood or furrow | 1 | 1 | 2 | 2 | - |
| Spray or sprinkler | 3 | 1 | 2 | 2 | 15 |
| Surge flooding | - | - | 1 | 1 | - |
| Traditional flooding | 1 | 1 | 2 | 4 | - |
| Other (please describe) | - | - | 2 | 2 | 7 |
| Don't know | - | - | - | - | - |

Source: Energy Trust of Oregon Irrigation Measures Market Research, Participant and Non-participant Irrigator Survey
Question: B6. "What irrigation method do you use? Select all that apply." B2. "What part of Oregon is your farmland located?"

## General Maintenance Practices

To gain insight into general maintenance practices, the survey asked respondents to identify the reasons they replace their irrigation equipment. As shown in Figure 4, 76% of gasket measure participants and 85% of gasket measure non-participants cited equipment failure as the primary reason. Over half (62%) of gasket measure participants and 79% of gasket measure non-participants cited equipment not working properly as another major reason for replacement.

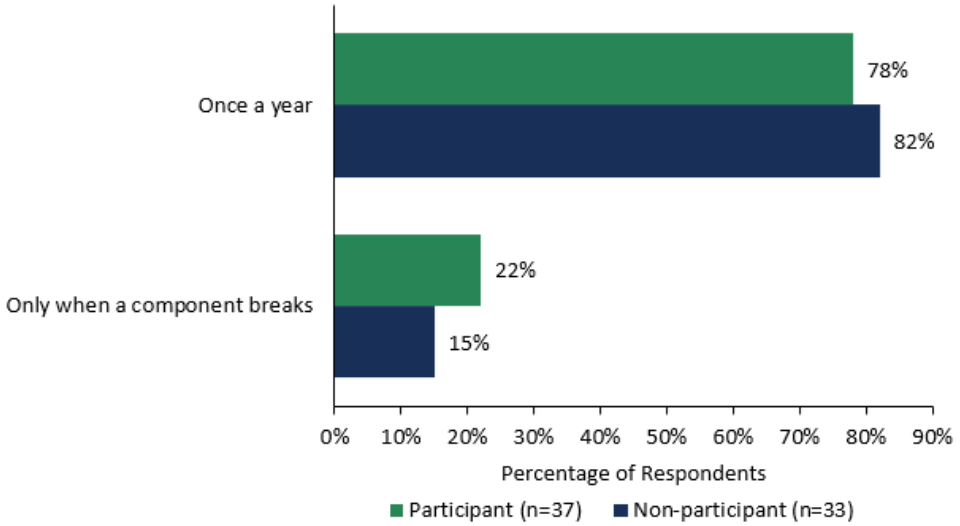
**Figure 4. Reasons for Replacing Irrigation Equipment**




Source: Energy Trust of Oregon Irrigation Measures Market Research, Participant and Non-participant Irrigator Survey Question: C1. "In general, what causes you to replace your irrigation equipment? Select all that apply." (n=33-37)

Figure 5 displays how often gasket measure participants and gasket measure non-participants perform a maintenance check or test on their irrigation equipment. Most gasket measure participants and gasket measure non-participants reported conducting these checks annually (78% of participants, 82% of non-participants). The other respondents reported performing maintenance checks when a component breaks (22% of participants, 15% of non-participants). 3% of non-participants cited uncertainty about how often they perform a check (not shown in the figure).

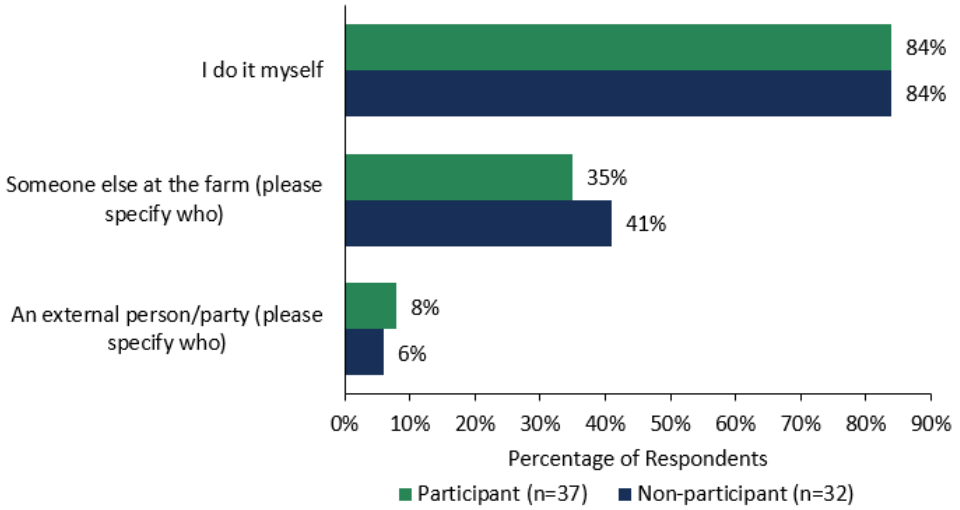
**Figure 5. Frequency of Maintenance Checks on Irrigation Equipment**




Source: Energy Trust of Oregon Irrigation Measures Market Research, Participant and Non-participant Irrigator Survey Question: C2. "How often do you perform a maintenance check or test on your irrigation equipment?" (n=33-37)

As shown in Figure 6, when asked who performs the maintenance check or test on their irrigation equipment, 84% of both participants and non-participants said they do it themselves. Of those, 28% own farms between 101 and 500 acres, and 23% own farms between 51 and 100 acres (Table 12). 35% of gasket measure participants and 41% of gasket measure non-participants indicated that someone else at the farm performs the maintenance check, while 8% of gasket measure participants and 6% of gasket measure non-participants said that an external person/party is responsible.

**Figure 6. Responsibility for Maintenance Check on Irrigation Equipment**




Source: Energy Trust of Oregon Irrigation Measures Market Research, Participant and Non-participant Irrigator Survey Question: C3. "Who performs the maintenance check or test on your irrigation equipment? Select all that apply." (n=32-37)

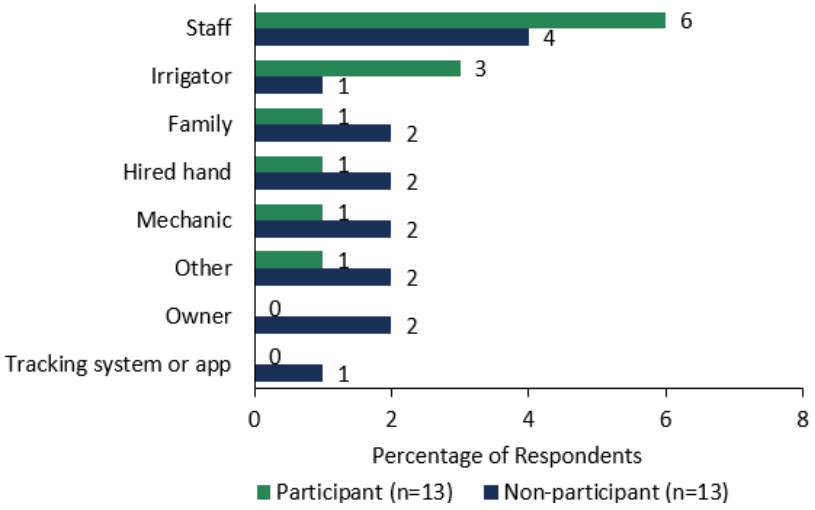
**Table 12. Responsibility for Maintenance Check by Farm Size**

| | I do it myself | Someone else at the farm | An external person/party |
|---|---|---|---|
| 0 - 10 acres | 3 | 1 | - |
| 11 - 50 acres | 8 | 5 | 1 |
| 51 - 100 acres | 13 | 2 | 2 |
| 101 - 500 acres | 16 | 5 | 1 |
| 501 - 1000 acres | 8 | 3 | 1 |
| 1001 - 5000 acres | 6 | 7 | - |
| 5001+ acres | 3 | 2 | - |

Source: Energy Trust of Oregon Irrigation Measures Market Research, Vendor Interview Questions: B4. "How many acres of farmland do you irrigate? A rough estimate is fine. Please enter a number only." C3. "Who performs the maintenance check or test on your irrigation equipment? Select all that apply."

The survey asked respondents who identified someone else at the farm or an external party to specify who performs the maintenance check. Among those who reported that someone else at the farm performs the task, six participants named staff, one named "irrigation manager", and another one simply said "irrigator" as the primary. The most frequent response from non-participants identified staff as responsible (four of thirteen respondents). Figure **7** provides a breakdown of farm personnel responsible for maintenance checks.

**Figure 7. Responsibility for Maintenance Check on Irrigation Equipment: On-Farm Staff**




Source: Energy Trust of Oregon Irrigation Measures Market Research, Participant and Non-participant Irrigator Survey Question: C3, option 2. "Who performs the maintenance check or test on your irrigation equipment? Someone else at the farm (please specify who)." (n=13)

Among those who reported that an external party performs the maintenance check, one participant and two non-participants identified contractors as the external party responsible for checking their irrigation equipment.

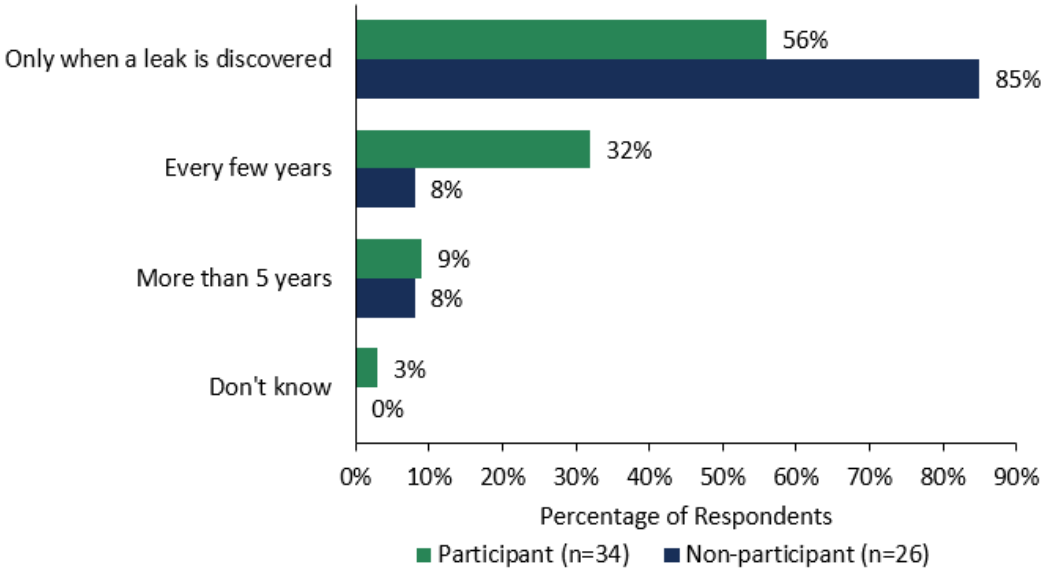
The survey asked respondents to rank maintenance checks or tests performed on their irrigation equipment from most important to least important, where a score of 1 meant *most important* and 9 meant *least important*. The averages indicate that gasket measure participants primarily check for irrigation tires (average 5.6) but place less emphasis on checking system pressures (2.3) or for leaks and damages (2.3). Gasket measure non-participants prioritize leak tests (5.1) and place the least emphasis on checking for leaks and damages (2.5). It is important to note that not all respondents ranked every type of maintenance check. The full results are listed in Table 19 in *Appendix D*.

## Gasket Replacement and Leak Repair Practices

To assess gasket replacement and leak repair practices, Cadmus asked respondents who reported using the center-pivot, wheel, or hand line irrigation method about the number of gasket units on their farm. *Appendix D* details the breakdown of the number of gasket units.

When asked how often they replace their gaskets, 56% of participants reported *only when a leak is discovered*, followed by *every few years* (32%), and *more than 5 years* (9%). While the majority of non-participants replaced their gaskets *only when a leak is discovered* (85%), only 8% replaced their gaskets *every few years* and 8% replaced it *more than 5 years* (Figure 8).

**Figure 8. Frequency of Replacing Gaskets**

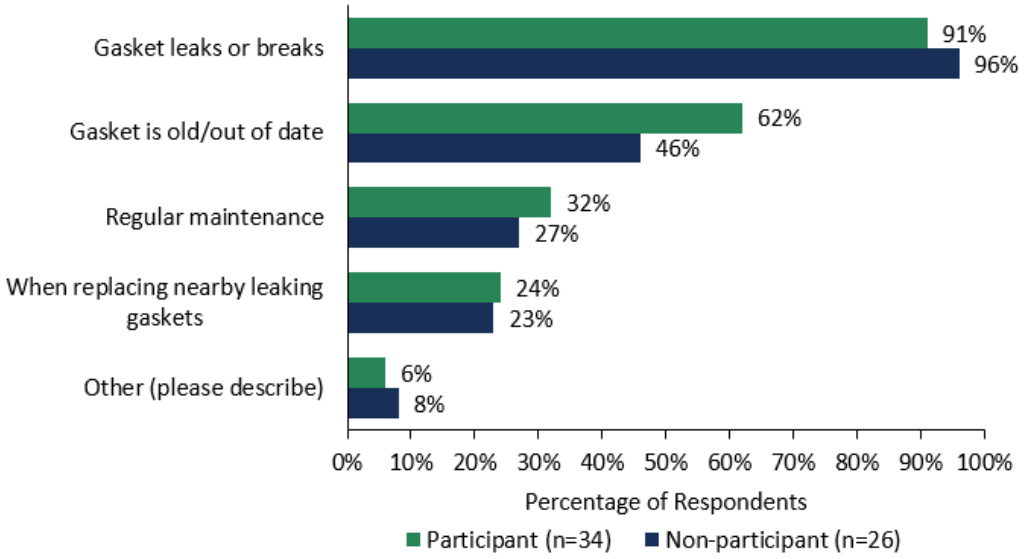



Source: Energy Trust of Oregon Irrigation Measures Market Research, Participant and Non-participant Irrigator Survey Question: D2. "How often do you replace your gaskets?" (n=26-34)

Cadmus asked respondents to identify what causes them to replace their gaskets. Figure 9 shows that 91% of participants and 96% of non-participants primarily replace gaskets when they leak or break.

Seven participants (21%) of participants and nine non-participants (35%) reported that they only replace gaskets when it leaks or breaks. Other reasons include gaskets being old or outdated (62% of participants, 46% of non-participants), as part of regular maintenance (32% of participants, 27% of non-participants), and when replacing nearby leaking gaskets (24% of participants, 23% of non-participants). Six percent (two respondents) of participants reported *other*, specifying that they replaced their gaskets due to incentives from Energy Trust of Oregon. Among non-participants, one said, "sometimes winter things get replaced if lots were identified as brittle," and the second respondent mentioned replacing gaskets "when pipes won't go together."

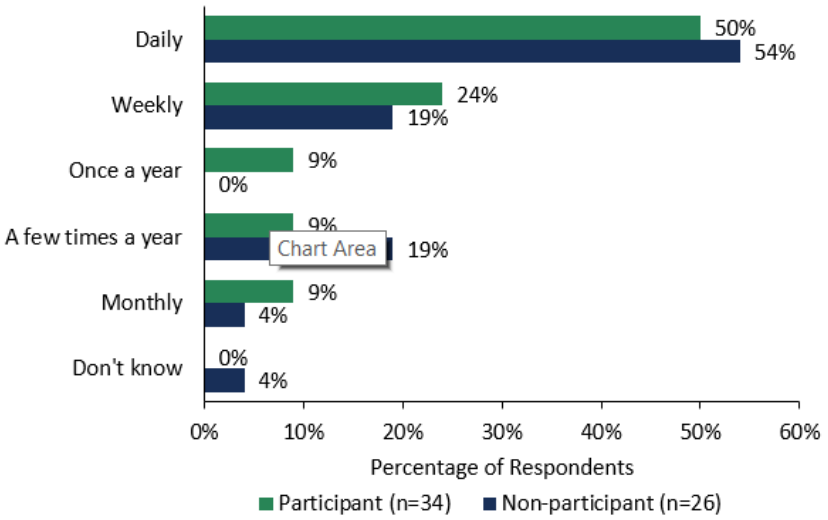
**Figure 9. Reasons for Replacing Gaskets**




Source: Energy Trust of Oregon Irrigation Measures Market Research, Participant and Non-participant Irrigator Survey Question: D3. "What causes you to replace your gaskets? Select all that apply." (n=26-34)

As shown in Figure **10**, when asked how often they check for leaks in their gaskets, most participants and non-participants reported *daily* (50% of participants, 54% of non-participants). Among participants, 24% check *weekly*, 9% do so *monthly*, and 9% check *a few times a year*. In contrast, 19% of non-participants check *weekly*, 19% check *a few times a year*, 4% check *monthly*, and 4% were unsure.

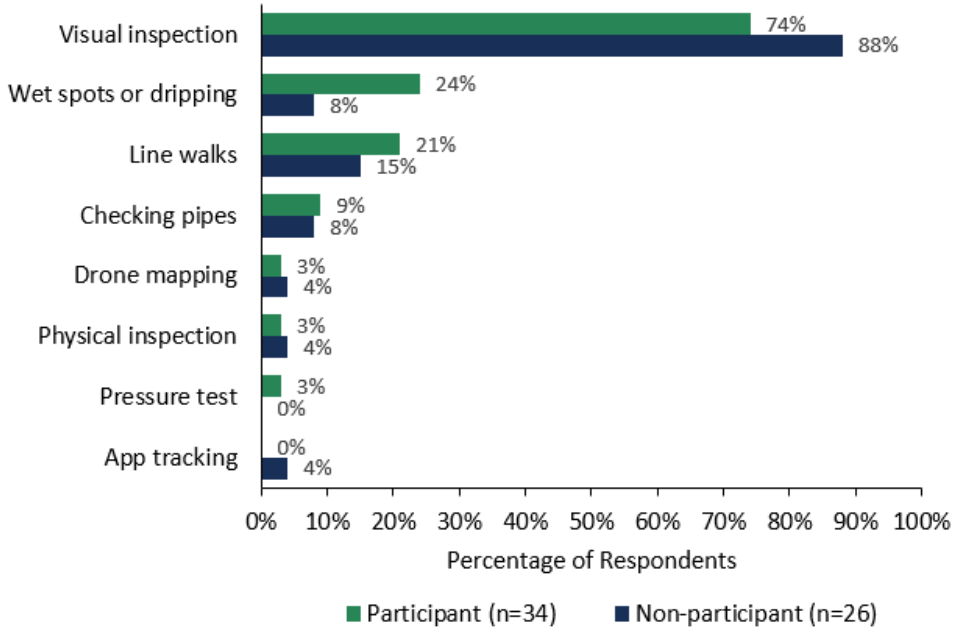
**Figure 10. Frequency of Gasket Leak Inspections**




Source: Energy Trust of Oregon Irrigation Measures Market Research, Participant and Non-participant Irrigator Survey Question: D5. "How often do you check for leaks in your gaskets?" (n=26-34)

The survey asked respondents how they check for leaks. As shown in Figure 11, both participants and non-participants primarily used visual inspections (74% of participants, 88% of non-participants). Twenty-four percent of participants reported looking for wet spots or dripping, and 21% conducted line walks as other methods of leak detection. Non-participants also reported conducting line walks (15%), checking for wet spots or dripping (8%), and inspecting pipes (8%) as other methods for detecting leaks.

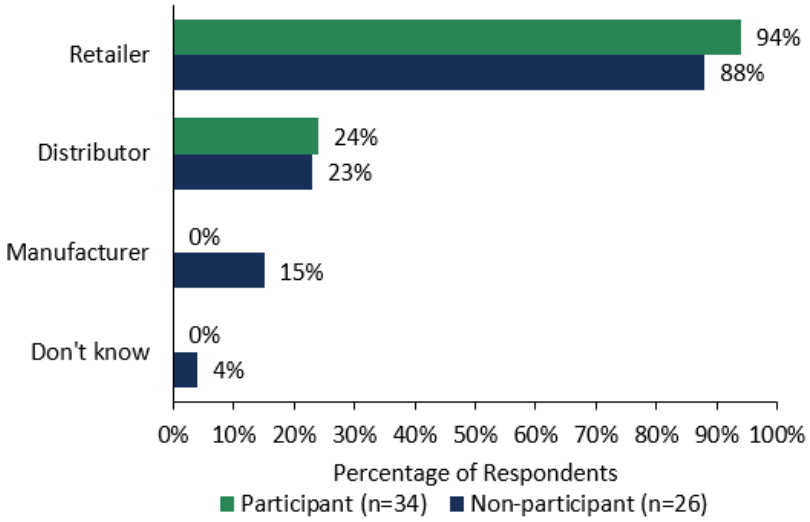
**Figure 11. Methods for Leak Detection**




Source: Energy Trust of Oregon Irrigation Measures Market Research, Participant and Non-participant Irrigator Survey Question: D6. "How do you check for leaks?" (n=26-34)

The survey asked respondents to identify if they work with a manufacturer, distributor, or retailer directly on obtaining gaskets for their farms. Most respondents indicated they mostly work directly with retailers, with 94% of participants and 88% of non-participants reporting this. Figure 12 displays the responses.

**Figure 12. Sources of Gasket Supply**




Source: Energy Trust of Oregon Irrigation Measures Market Research, Participant and Non-participant Irrigator Survey Question: D7. "Do you work with a manufacturer, distributor, or retailer directly on obtaining gaskets for your farm? Select all that apply." (n=26-34)

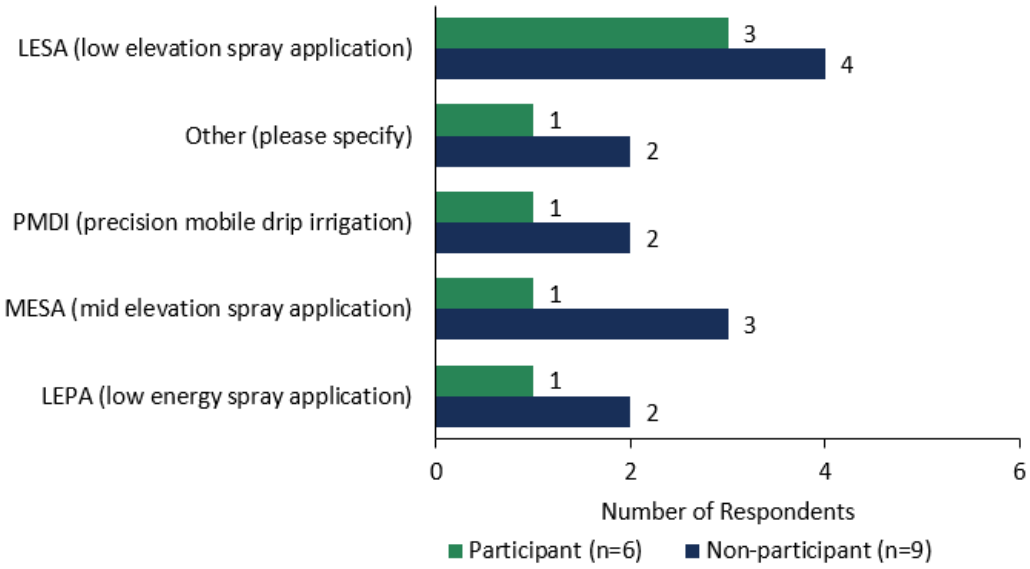
Cadmus asked respondents who reported checking for leaks in their gaskets daily to identify which manufacturer, distributor, or retailer they work with to obtain gaskets for their farm. 34 gasket measure participants and 25 gasket measure non-participants provided an answer. The most popular vendor among participants was indicated by 53% of participant respondents, while the most popular vendor among non-participants was indicated by 20% of respondents. These responses were different, and both are participating vendors. Among the vendors mentioned, both participants and non-participants mentioned the same 4 vendors, participants mentioned an additional 4, and non-participants mentioned an additional 2.

## Sprinkler System Upgrade Decision-Making

Cadmus asked respondents about their irrigation systems and equipment components to assess decisions regarding sprinkler system upgrades. The survey asked whether respondents purchased irrigation equipment components as an automated system, such as LESA, MESA, LEPA, or PMDI. Seventy-eight percent of gasket measure participants and 56% of gasket measure non-participants reported that they did not. Sixteen percent of gasket measure participants and 31% of gasket measure non-participants confirmed that they did. In addition, 5% of gasket measure participants and 13% of gasket measure non-participants answered, "I don't know."

Respondents who answered yes to the previous question were asked to identify which irrigation systems they had purchased in the past two years (Figure 13). Of the six participants and nine non-participants who answered the question, the majority of respondents reported LESA (three participants, four non-participants).

**Figure 13. Types of Irrigation Systems Purchased in the Past Two Years**




Source: Energy Trust of Oregon Irrigation Measures Market Research, Participant and Non-participant Irrigator Survey Question: E2. "Which irrigation system have you purchased in the past two years? Select all that apply." (n=6-9)

When asked to specify their *other* answer, three respondents provided the following answers:

- Nelson Twig System and Valley Icon X[3]
- Low pressure[4]
- Valley 365[5]

The survey also asked respondents about their reasons for buying an automated irrigation system (Figure 14). Of the 6 gasket measure participants and 10 gasket measure non-participants who answered this question, the top reason cited by the majority of respondents was to save on water, with 83% of gasket measure participants and 80% of gasket measure non-participants indicating this. In

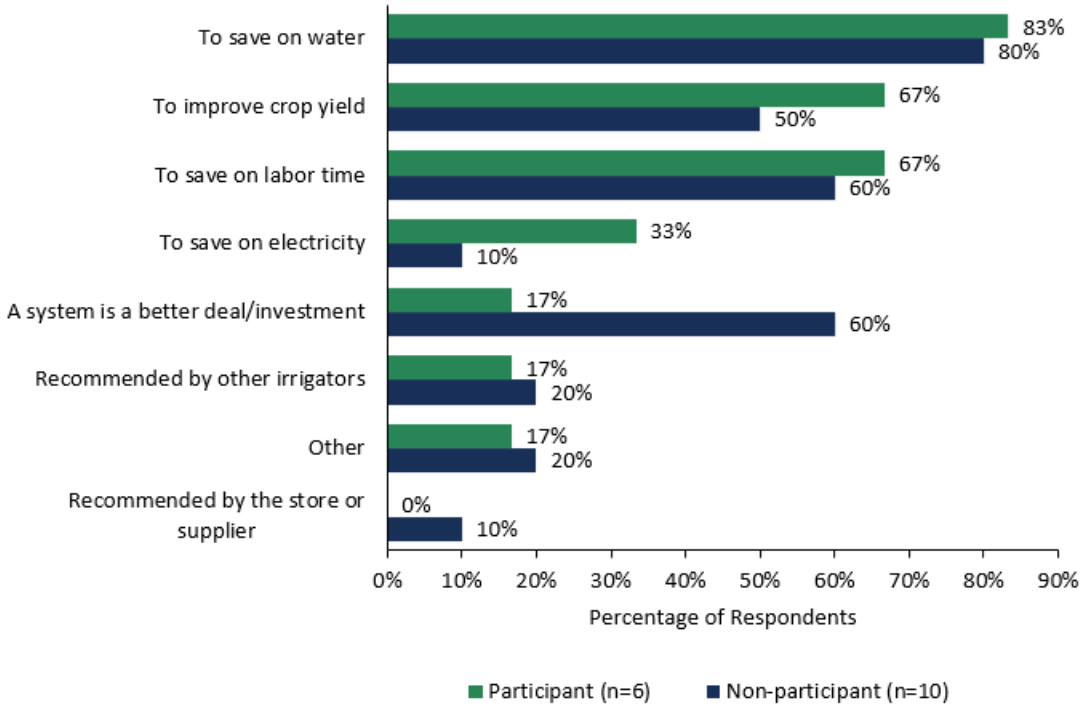
[3] Indicated by one participant. Both systems are controllers.

[4] Indicated by one non-participant. LESA systems are inherently low pressure. This could be a LESA system but it is likely a different low pressure system.

[5] Indicated by one non-participant. Valley 365 is a controller command center.

addition, gasket measure participants also cited improving crop yield (67%) and saving on labor time (67%) as top reasons. Gasket measure non-participants cited saving on labor time (60%) and the belief that a system is a better deal or investment than their current system as their main motivators (60%).

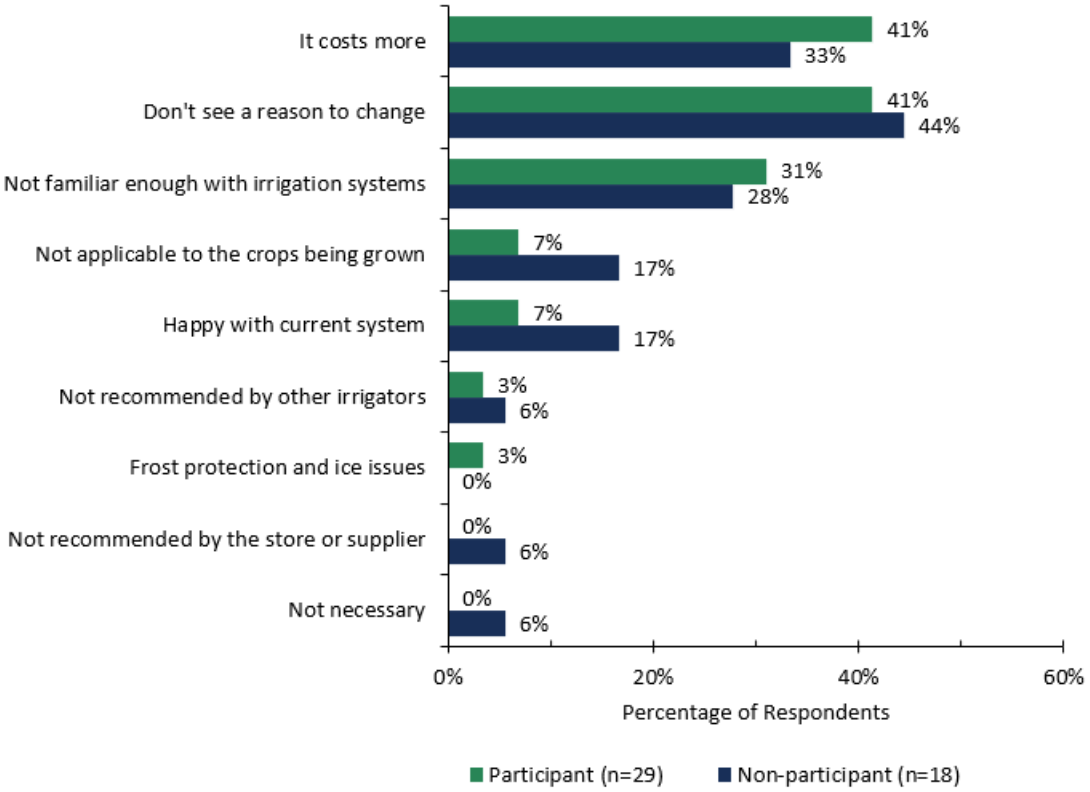
**Figure 14. Motivations for Purchasing Irrigation Systems**




Source: Energy Trust of Oregon Irrigation Measures Market Research, Participant and Non-participant Irrigator Survey Question: E3. "Why did you choose to buy an irrigation system? Select all that apply." (n=6–10)

Cadmus asked respondents who do not buy irrigation equipment components as an automated system to explain why they have not purchased an irrigation system. The top three reasons gasket measure participants cited were higher costs (41%), no perceived need for change (41%), and lack of familiarity with irrigation systems (31%). These findings closely resemble the top three reasons given by gasket measure non-participants, whose primary reasons were that they did not see a reason to change (44%), higher costs (33%), and lack of familiarity with irrigation systems (28%). These results suggest that cost and raising awareness or providing education about the benefits of these systems are key factors in promoting wider adoption. Figure 15 provides a breakdown of other reasons reported by respondents.

**Figure 15. Reasons for Not Purchasing an Irrigation System**



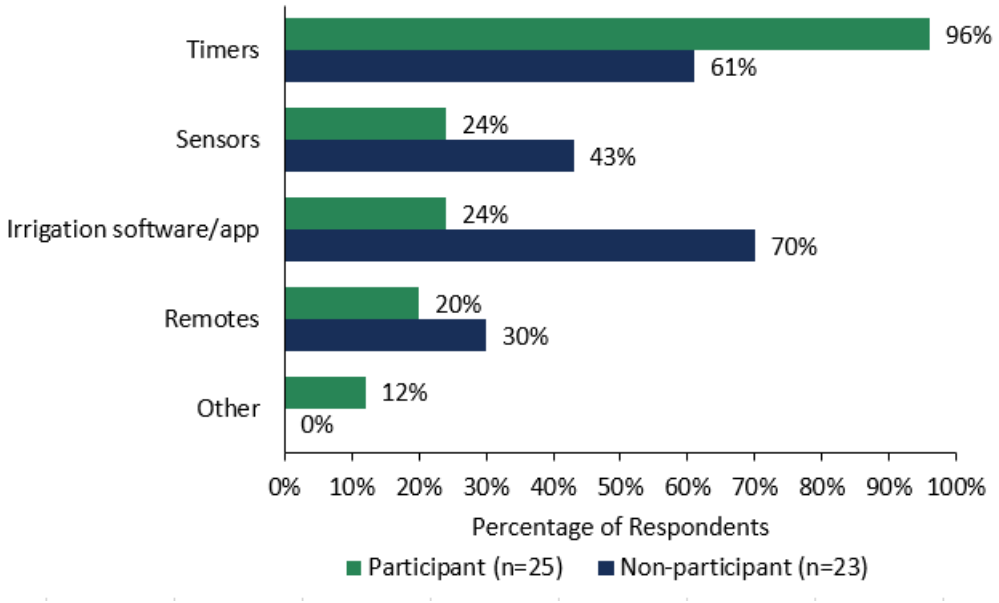

Source: Energy Trust of Oregon Irrigation Measures Market Research, Participant and Non-participant Irrigator Survey Question: E4. "Why haven't you purchased an irrigation system? Select all that apply." (n=18-29)

## Interest in Automated Controls Offerings

To identify interest in control offerings, Cadmus asked respondents if they currently use irrigation controller components such as timers, sensors, or remotes. Sixty-nine percent of gasket measure participants and 72% of gasket measure non-participants reported that they do, while 31% of gasket measure participants and 28% of gasket measure non-participants reported that they do not.

The survey also asked respondents who said they use irrigation controller components to specify which irrigation controller components they use, as shown in Figure 16. Most gasket measure participants reported using *timers* (96%), followed by *sensors* and *irrigation software/application* (both 24%), and *remotes* (20%). In contrast, gasket measure non-participants primarily reported using *irrigation software/application* (70%), *timers* (61%), *sensors* (43%), and *remotes* (30%).

**Figure 16. Irrigation Controller Components Used**

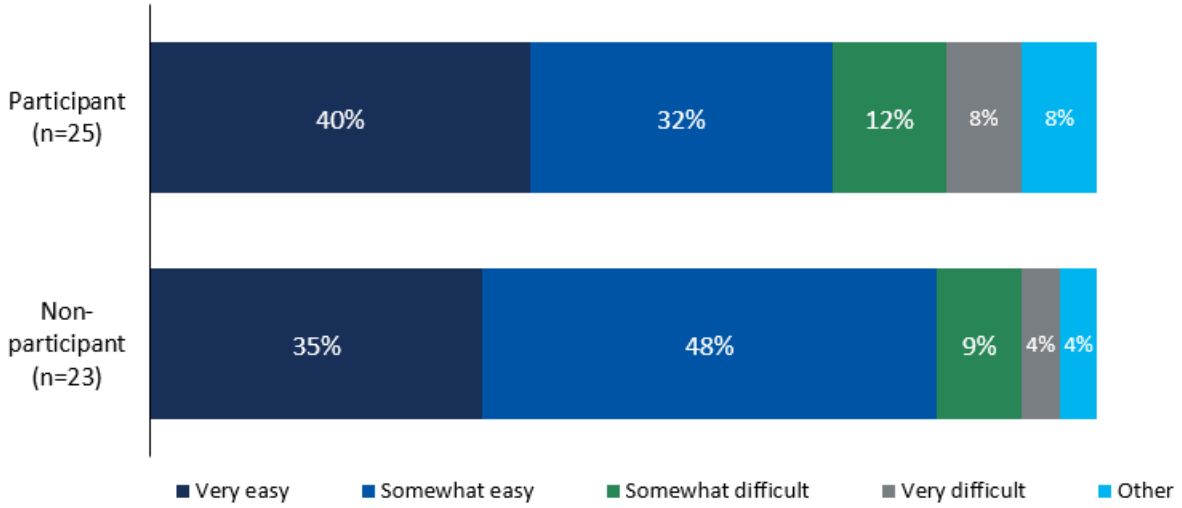



Source: Energy Trust of Oregon Irrigation Measures Market Research, Participant and Non-participant Irrigator Survey Question: F2. "Which irrigation controller components do you use?" (n=23-25)

Of the three gasket measure participants who selected *other*, one mentioned using a pressure regulator, another specified "VFD, solenoid values with controller/timer," and the third did not provide a response.

As indicated in Figure 17, when asked about the ease of finding irrigation controller components at a store or supplier, the majority of gasket measure participants felt it was *very easy* (40%), followed by *somewhat easy* (32%). Gasket measure participants who felt it was *somewhat difficult* (12%) or *very difficult* (8%) were all located in Willamette Valley (five respondents). Among gasket measure non-participants, 48% felt it was *somewhat easy*, and 35% considered it *very easy*. One participant noted that it depends on the component; for example, they ordered a 12-channel online.

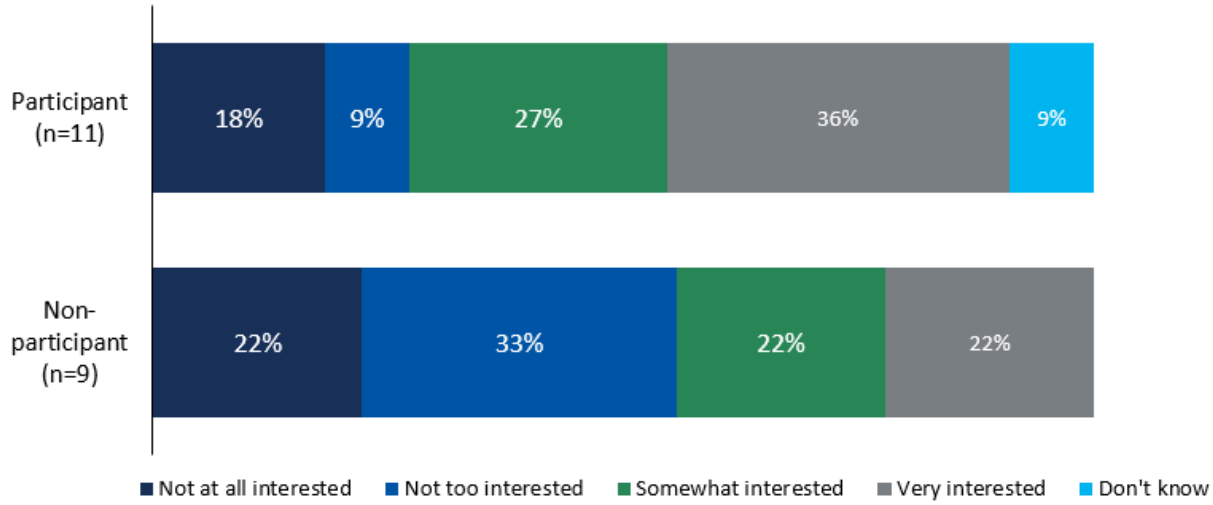
**Figure 17. Ease of Finding Irrigation Controller Components**




Source: Energy Trust of Oregon Irrigation Measures Market Research, Participant and Non-participant Irrigator Survey Question: F3. "How easy or difficult is it to find irrigation controller components at a store or supplier?" (n=23-25)

Cadmus asked respondents who do not currently use irrigation controller components about their interest in getting irrigation controllers for their farm (Figure 18). Overall, gasket measure participants expressed interest in controllers with 36% of participants saying they were *very interested* and 27% *somewhat interested*. In contrast, 33% of gasket measure non-participants were *not too interested*, while the rest were evenly divided among *very interested*, *somewhat interested*, or *not at all interested*, each category capturing 22%.

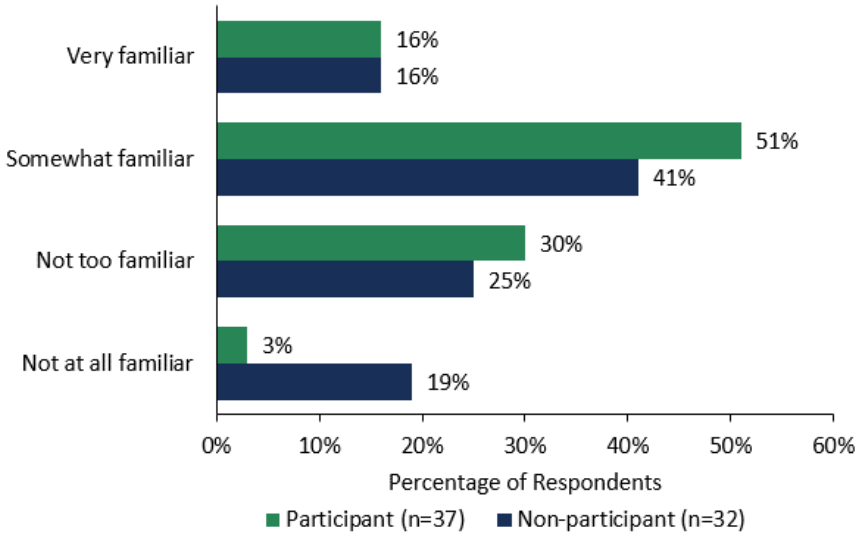
**Figure 18. Interest in Irrigation Controllers for Farms**




Source: Energy Trust of Oregon Irrigation Measures Market Research, Participant and Non-participant Irrigator Survey Question: F4. "How interested are you in getting irrigation controllers for your farm?" (n=9–11)

The survey asked respondents how familiar they are with irrigation equipment offerings from Energy Trust of Oregon (Figure 19). Overall, half of gasket measure participants and gasket measure non-participants felt familiar with the offerings. Fifty-one percent of gasket measure participants and 41% percent of gasket measure non-participants felt *somewhat familiar* with the offerings, followed by 30% of gasket measure participants and 25% of gasket measure non-participants who felt *not too familiar*. Only 16% of gasket measure participants and 16% of gasket measure non-participants felt *very familiar* with the offerings.

**Figure 19. Awareness of Energy Trust's Irrigation Equipment Offerings**




Source: Energy Trust of Oregon Irrigation Measures Market Research, Participant and Non-participant Irrigator Survey Question: F5. "How familiar are you with irrigation equipment offerings from Energy Trust of Oregon?" (n=32–37)

To identify further opportunities to support customers with irrigation upgrades, the survey asked respondents what Energy Trust of Oregon could do to improve the program. Of the thirty-one gasket measure participants who provided a response, most suggested incentives for new equipment, upgrades, and repairs, incentives for pumps, incentives for VSDs/VFDs and to increase current incentives/rebates. Six gasket measure participants had no suggestions and four were satisfied with the current program offerings.

Of the seventeen gasket measure non-participants who provided a response, most respondents recommended incentives for pivots, incentives for automated systems, and more communication and support from Energy Trust of Oregon. Four gasket measure non-participants had no suggestions and three said they are satisfied with the current program offerings.

Table 13 provides their suggested incentives or services:

**Table 13. Suggested Irrigation Equipment Incentives or Services from Energy Trust**

| Theme | Participant Count | Non-participant Count |
|---|---|---|
| Incentives for new equipment, upgrades, and repairs | 4 | - |
| Incentives for pumps | 4 | - |
| Incentives for VSDs/VFDs | 4 | - |
| Increase current incentives/rebates | 4 | 1 |
| Incentives for no-leak pipes | 3 | - |
| Incentives for pivots | 3 | 3 |
| Incentives for technical support and installation | 3 | 1 |
| Incentives for drip irrigation | 2 | 1 |
| More communication and application support from ETO | 2 | 2 |
| Incentives for controllers | 1 | 1 |
| Incentives for hoses | 1 | - |
| Incentives for remotes | 1 | - |
| Incentives for sprinklers | 1 | 1 |
| Other | 1 | 1 |
| Incentives for automated systems | - | 2 |
| Incentives for pipelines | - | 1 |
| Incentives for regulators | - | 1 |
| Incentives for solar panels | - | 1 |
| **Respondent Total** | 31 | 17 |

Source: Energy Trust of Oregon Irrigation Measures Market Research, Participant and Non-participant Irrigator Survey Question: F6. "Are there irrigation equipment incentives or services that you'd like to see from Energy Trust of Oregon? Please share your ideas with us." (n=17–31)

## Irrigator Site Visits

Cadmus sent field inspectors to a total of 21 gasket measure participant irrigators and 11 gasket measure non-participant irrigators out of a goal of 20 for each track. Difficulties with scheduling site visits with gasket measure non-participants stemmed from a smaller population than participants, alignment between the irrigation season and evaluation timeline, irrigators not having or running wheel or hand line systems, and a couple of instances where the site contact did not make the scheduled site visit date and time.

The site visits were conducted to cover the five geographic regions serviced by Energy Trust of Oregon, which included Portland Metro and Hood River, Willamette Valley, Eastern Oregon, Central Oregon, and Southern Oregon. Cadmus attempted to recruit sites from across all geographic regions for both participants and non-participants in Energy Trust's Gasket Replacement measure to provide a

representative sample of both geographic regions and participant types. Table 14 provides the coverage of the sampled sites for both gasket measure participant and gasket measure non-participant site visits.

**Table 14. Site Visits Across Geographic Regions**

| Geographic Region | Participant Count | Non-participant Count |
|---|---|---|
| Portland Metro & Hood River | 5 | 0 |
| Willamette Valley | 7 | 1 |
| Eastern Oregon | 2 | 6 |
| Central Oregon | 4 | 2 |
| Southern Oregon | 3 | 2 |
| **Totals** | **21** | **11** |

To develop a quantitative estimate of leakage rates within each selected system, the inspector randomly sampled six gasket leaks to measure using the bucket test. Each leak was measured for ten seconds and the resulting volume of water was recorded, then the six randomly sampled measured leaks were grouped into high, medium, and low leakage bins. The field inspector then walked the entire property where feasible to visually inspect gaskets. Each of the visually inspected gaskets that was found to be leaking was assigned a site specific high, medium, or low leak rating based on the grouping done for the initial six sampled gaskets in each system. This allowed the field inspector to extrapolate leaks across all the leaking gaskets at the site and determine average leakage rates per site.

An average gasket failure rate describes the percentage of gaskets that had leaks out of the total number of gaskets that were inspected for the system on site. Table 15 provides two average failure rates broken out by gasket measure participant and gasket measure non-participant. The per site average represents the average leakage rate of the individual sites rolled up together across all sites using a straight-line average method. The weighted average represents the sites within the gasket measure participation and gasket measure non-participation category weighted based on the quantity of inspected gaskets on each site and then averaged.

**Table 15. Average Site Visit Leaks Observed**

| Gasket Measure Participation | Average Per Site | | Weighted Average Per Site | |
|---|---|---|---|---|
| | Average leakage rate (L/min) | Average Gasket Failure Rate (# Identified/# Inspected) | Average leakage rate (L/min) | Average Gasket Failure Rate (# Identified/# Inspected) |
| Participant | 1.17 | 32% | 1.15 | 28% |
| Non-Participant | 1.54 | 38% | 2.57 | 49% |

Table 15 presents two clear observations. The first is that sampled participants within the Energy Trust Gasket Replacement measure had both lower average leakage rates and a lower percentage of gaskets leaking versus non-participants. The second key observation is that for both the average leak rate and the average failure rate, the weighted average showed a significant increase in the collected gasket measure non-participant data. This was because there were a couple of large gasket measure non-

participant sites that were discovered to have significantly higher leakage rates and failure rates, which increased the weighted averages.

The Cadmus field inspectors evaluated two types of irrigation systems during the site visits: hand lines and wheel lines. Table 16 shows the variation between types of equipment across the gasket measure participants and gasket measure non-participants.

**Table 16. Average Leakage Rate Between Equipment**

| Gasket Measure Participation | Equipment Type | Averaged Per Site | | Weighted Average | |
|---|---|---|---|---|---|
| | | Average leakage rate (L/min) | Average Gasket Failure Rate (# Identified/# Inspected) | Average leakage rate (L/min) | Average Gasket Failure Rate (# Identified/# Inspected) |
| Participant | Wheel Lines | 2.41 | 56% | 3.19 | 56% |
| | Hand Lines | 3.68 | 23% | 0.39 | 18% |
| Non-Participant | Wheel Lines | 1.78 | 47% | 2.92 | 54% |
| | Hand Lines | 6.96 | 27% | 1.19 | 26% |

The per site averages suggest that the hand lines have a higher average leakage rate than wheel lines. This was mainly due to the large number of smaller leaks relative to the observed leaks within each site skewing the average rate across all sites when using a straight-line average. The weighted average, weighted by the quantity of inspected gaskets on each site, corrects for the distribution of leak sizes across the larger sample, better representing the actual leakage rate.

Table 17 shows the distribution of sites that provided pressure set point information. As can be seen in the data below, there were several sites in the Central and Southern Oregon regions that did not know their pressure setpoints and did not have pressure gauges available to visually check pressure. Overall, 29% of gasket measure participants and 27% of gasket measure non-participants did not know their pressure setpoints.

**Table 17. Knowledge of Pressure Set Points Between Regions**

| Geographic Region | Participant Count | | Non-participant Count | |
|---|---|---|---|---|
| | Yes | No | Yes | No |
| Portland Metro & Hood River | 5 | 0 | 0 | 0 |
| Willamette Valley | 6 | 1 | 1 | 0 |
| Eastern Oregon | 2 | 0 | 6 | 0 |
| Central Oregon | 1 | 3 | 0 | 2 |
| Southern Oregon | 1 | 2 | 1 | 1 |
| **Totals** | **15** | **6** | **8** | **3** |

Figure 20 shows the distribution of pressure set points provided by both participants and non-participants. Pressure setpoints ranged from 30 psi all the way up to 110 psi. It should be noted that

there were several factors that resulted in varying pressures. Mainly there were different systems being pressurized which had different pressure requirements. One observation of note is that there were some site contacts that indicated running higher setpoints to account for pressure drops from leaks and run distance of the piping systems. In some cases, water had to be pumped several miles to get to the location of the crops since they were not allowed to pump water from anywhere but the river. In some cases, the pumps providing water were not within the irrigator's property. Please see Appendix E for additional details on pressure set points, pump horsepower and other site characteristics.

**Figure 20. Histogram of Hand Line Pressure Setpoints**

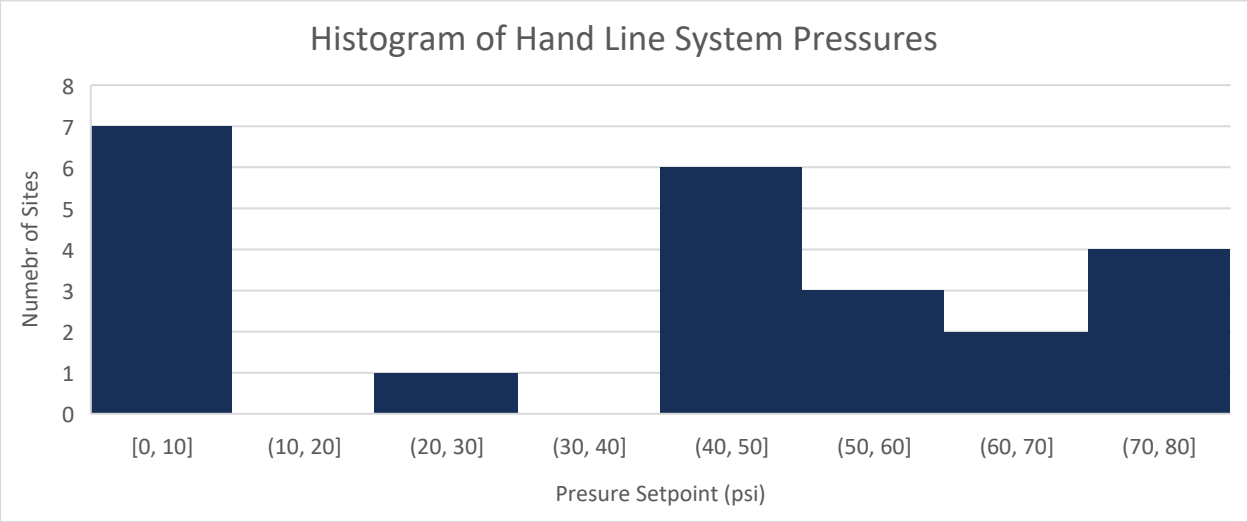
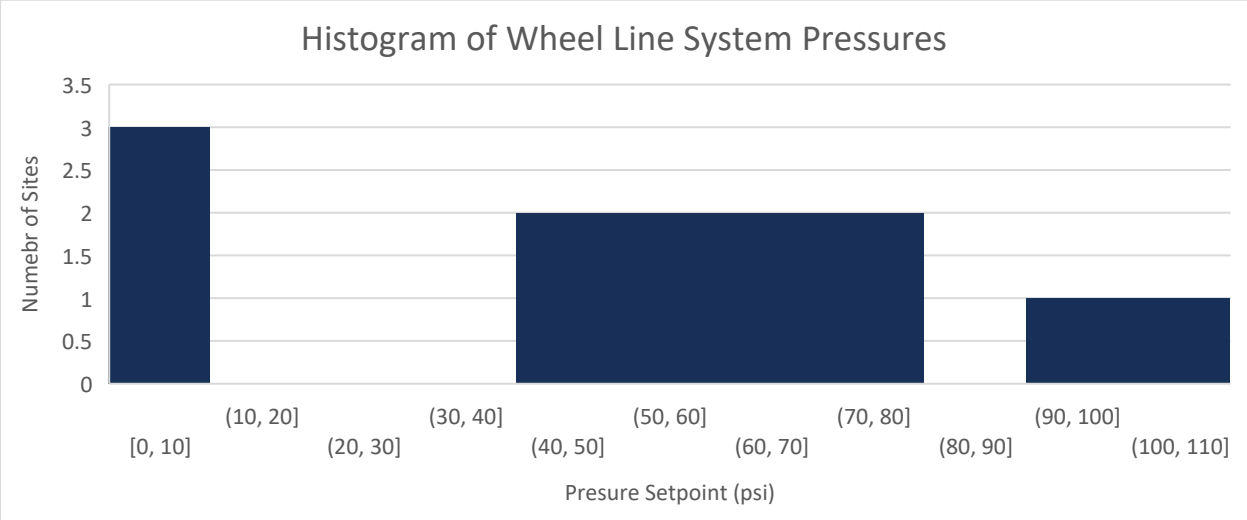



**Figure 23. Histogram of Wheel Line Pressure Setpoints**



# Conclusions and Recommendations

Cadmus conducted research into irrigation measures and purchases to inform the Production Efficiency program's updates in future program years. Research was carried out through interviews with participating vendors, surveys with irrigators, and site visits to irrigating facilities.

Based on its research into gasket and irrigation system replacement practices, Cadmus provides a list of conclusions and recommendations to help inform future program development and improvement. Conclusions and recommendations are divided into the four main research objectives of the study. If a recommendation applies to multiple tracks or was an observation outside of the main research objectives, we include it in the Other Findings and Recommendations section.

## Irrigation System and Gasket Market Pricing and Availability

### Vendor Interviews

- **Conclusion 1:** Vendors experience highest seasonal demand in spring and summer, which affects stocking practices and sales patterns. This may affect how much inventory they need and their sales patterns.
- **Recommendation 1:** Consider offering promotions and discounts in the off-season, encouraging irrigators to do maintenance checks earlier to promote early replacement of equipment with more efficient options. This will additionally benefit vendors by helping them to unload off-season stock at better prices for irrigators.
- **Conclusion 2:** Vendors are interested in selling irrigation components at discounted prices if incentivized, not only for sprinklers, gaskets, and nozzles, but also for items like control valves. Some vendors also suggested offering support for farmers with system installation or maintenance.
- **Recommendation 2:** Consider developing programs that provide financial support to vendors, allowing them to offer discounts on key irrigation components like sprinklers, gaskets, nozzles, PVC pipes, tubing, and control valves. Additionally, explore ways to support farmers with system installation and maintenance through labor incentives or technical assistance.
- **Conclusion 3:** Vendors indicated that there was no difficulty obtaining wheel line, hand line, and center pivot boot gaskets for their store and while seasonal demand has impacts on inventory, this did not create any significant challenges as they are able to restock quickly or forecast demand appropriately.
- **Conclusion 4**: In 2023, sales of wheel line gaskets, hand line gaskets, and center pivot gaskets varied significantly across interviewed vendors.

### Irrigator Surveys

- **Conclusion 5**: Both vendors and customers have emphasized that increased incentives could boost sales and adoption of energy and water-saving irrigation components and systems. Both

gasket measure participants and gasket measure non-participants cited high costs as a primary barrier to purchasing irrigation systems.

- **Recommendation 5**: Consider increasing incentives to reduce cost barriers of automated irrigation systems and promote the adoption of more efficient irrigation systems that save energy and water.
- **Conclusion 6**: There is a strong preference among both program participants and non-participants for working directly with retailers to obtain irrigation components. Vendors have shown a high level of interest in selling discounted irrigation components if provided with incentives.
- **Recommendation 6:** Consider partnering with retailers and offer discounts on key irrigation components. This reduces the burden of documentation on the end-user, and could increase participation. This could support irrigator needs for upgrades and support Energy Trust's goal of exploring midstream offerings.

## Maintenance and Leakage Prevention Practices

### Irrigator Surveys

- **Conclusion 1:** The primary reasons for replacing irrigation equipment are breakdowns and improper functioning, with most maintenance performed by the individual themselves. Both gasket measure participants and gasket measure non-participants primarily rely on reactive maintenance, replacing gaskets only when issues occur, but they conduct daily leak checks using high level methods like visual inspections.
- **Recommendation 1a:** Consider developing and implementing training programs and resources aimed at improving maintenance and preventative maintenance practices among irrigators. Consider offering operations and maintenance measures that help proactively address irrigation equipment issues. Energy Trust could also support irrigators by developing a checklist for routine inspections and repairs and some tutorials or educational materials that can be followed by irrigators and their staff.
- **Recommendation 1b:** There could be an opportunity to provide no cost irrigation equipment assessments to gasket measure participants and gasket measure non-participants in order to check equipment before a failure or break occurs and help identify other opportunities for energy efficiency. Consider adding documentation of current system operating parameters (pressure, pump speed, etc..) and how to identify increased leaks from these parameters. Considering that most irrigators conduct maintenance themselves, having an external person or party support may result in additional opportunities for water and energy conservation.
- **Conclusion 2:** There was mixed feedback from gasket measure participants and gasket measure non-participants when asked to rank type of maintenance checks for irrigation equipment. While maintenance in general was identified as an important activity, trends were less clear around the priority areas for maintenance.

- **Recommendation 2:** Considering feedback from both gasket measure participants and gasket measure non-participants around maintenance practices which include doing maintenance themselves and conducting repairs when systems break, it may help for Energy Trust to provide some educational material around opportunities for energy efficiency and maintenance within the irrigation sector, tied with high level potential for savings and program incentives.

## Leakage Rates from Faulty Gaskets

### Irrigator Site Visits

- **Conclusion 1:** There was clear evidence within the site visit sample that the average gasket leak rate and gasket failure rate of gasket measure participant sites in Energy Trust's gasket replacement measure was lower than that of gasket measure non-participant sites indicating that the program was effective.
- **Recommendation 1:** The data suggests that the Energy Trust gasket replacement program is having an impact on reducing leaks at participant sites. We recommend looking for opportunities to expand the program to serve more customers in the region. We also note that both participants and non-participants of the gasket program had high leakage rates and there are opportunities for both participants and non-participants to reduce leak rates.
- **Conclusion 2:** Both gasket measure participant and gasket measure non-participant irrigators experienced high leakage rates with the gaskets inspected by the Cadmus field inspectors.
- **Recommendation 2:** Consider developing a program that provides irrigators with incentives to perform more-frequent inspections and checks of gaskets. An O&M program would offer irrigators incentives to perform regular checks, which would reduce leakage rates across their gaskets by lowering the time that a failing gasket is leaking. This could also include documenting system parameters such as pressure and pump speed to identify that leaks are occurring without needing to walk the lines. It will not be feasible to get leakage down to zero, but there is an opportunity for major reductions with consistent maintenance.
- **Conclusion 3:** We observed higher average leakage rates in some regions than in others with Willamette Valley having the lowest average leakage rate both on a per gasket and weighted average basis and Central Oregon having the highest leakage rates both on a per gasket and weighted average basis.
- **Recommendation 3:** The data collected is not sufficient to make a conclusive recommendation due to small sample sizes in each region, but there is evidence to suggest that increased opportunities exist to support both participant and non-participant irrigators in Eastern, Central, and Southern Oregon.
- **Conclusion 4:** There was a high percentage of gasket measure participants and gasket measure non-participants that were not knowledgeable about pressure setpoints within their system and did not have any gauges or controls to visually determine pressure within their system.
- **Recommendation 4:** The findings point to an opportunity for Energy Trust to provide additional educational material and training on the importance of monitoring and adjusting pressures of

irrigation systems to reduce energy and water usage, catch leaks without having to visually inspect each gasket, improve crop yields, increase the longevity of the irrigation systems and prevent soil erosion and runoff.

## System Upgrade Decision-Making and Appetite for Moisture Monitoring Controls

### Irrigator Surveys

- **Conclusion 1:** The majority of respondents do not have automated sprinkler systems (LESA, MESA, LEPA, or PMDI). While water and labor savings are key motivators for upgrading, varying perceptions of cost-effectiveness and barriers like high costs, lack of perceived need, and unfamiliarity with the systems may prevent wider adoption.
- **Recommendation 1a:** Consider providing cost-benefits analyses and case studies that show long-term water and labor savings and crop yield improvement. Explore ways to reduce the financial burden of purchasing new systems by offering incentives.
- **Recommendation 1b**: Investigate specific solutions to barriers that non-participants face with controller components. This could include providing financial incentives, demonstrating successful case studies, and offering educational materials to emphasize the benefits and cost savings associated with using controller components.

## Other Findings and Recommendations

- **Conclusion 1:** There is a significant gasket measure participant count in Northeast Oregon, however none of this population responded to surveys. This presents an opportunity in Energy Trust's outreach and engagement efforts in that area.
- **Recommendation 1**: Increase outreach to program participants for studies like this. If more program participants are made aware of research or evaluation efforts prior to our outreach, they may be more likely to participate in surveys and site visits.
- **Conclusion 2:** Respondents had high awareness of Energy Trust of Oregon's offerings, with over half of respondents being knowledgeable about offerings. When asked about potential incentives or services, suggestions included more incentives for equipment, repairs, and upgrades, as well as enhanced communication and support.
- **Recommendation 2:** Consider expanding incentives to cover the specific needs identified by both participants and non-participants. This includes new equipment, upgrades, potential repairs, center pivots, and automated systems. For measures that were identified as areas of interest for participants and non-participants but that are already offered by Energy Trust such as pumps, VSDs/VFDs, there may be an opportunity to increase awareness in offerings especially considering that irrigators conduct maintenance and repairs on their own and do not have external parties supporting maintenance and upgrades.

## Lessons Learned

- Recruiting
- Timing of Research (Take place later in the irrigation season)
- Leak Measurement Techniques

Over the course of this research study, we encountered unforeseen issues that made certain aspects of data gathering more difficult, all of which could be easily alleviated. These issues and the lessons learnt from them are listed below.

- Recruiting: We found it to be difficult to recruit irrigators, particularly gasket measure non-participant irrigators, for participation in both surveys and site visits. This difficulty came from old population data with sites that had closed, no notice of the study from the implementation team, and sites who either didn't show up or weren't running lines when a site inspector arrived. These issues could be alleviated by taking a sample and having the implementation team reach out to each site contact, verifying that the contact is correct and letting the contact know of the importance of the study. Having someone the contact is familiar with tell them about the study will make them more likely to participate and be easier to work with.
- Timing of Research: When we put together the schedule for this research effort, we weren't as knowledgeable about irrigators as we are now, and assumed a much faster timeline than was possible. In the original workplan, we intended to start site visits in March and finish them in June. Due to the schedule of irrigators, we couldn't get onto sites until late May because they weren't irrigating the fields. The rain this year did last longer than most years, but being aware that irrigators won't start until the rain stops is important when planning out deliverables for projects that require on-site action with running irrigation lines. Additionally, it is important to get out on fields as early as possible because irrigators may be more hesitant to allow field staff into the fields when crops are close to harvest because of the likelihood of damage.
- Leak Measurement: Measuring leaks from gaskets is tricky for a couple of key reasons. Spray can go in multiple directions, or the hand lines may be directly on top of the ground. Our original plan that we developed alongside Energy Trust and the implementation team was to simply place or hold a bucket underneath the leaking gasket and capture all of the water that way. While this did work very well on wheel line systems, it was much harder to get the bucket under hand line systems to capture all of the water that leaked out of the gasket. The best solutions we found were to bring plastic bags which can capture water right along the ground and wrap around the leak to capture water much more reliably.

# Appendix A. Site Visit Data Sheet

Site Name: _____ Site Address: _____
Date: _____ Tech Name: _____

On-Site Guidelines

- Make sure to wear closed toe shoes, **bring a hard hat and eye protection** and ask the site if they have any PPE requirements prior to the visit.
- You will need to bring the measurement buckets, a stopwatch or phone, and this guide. You may also need a tarp, flexible sheet of plastic, or plastic bags for ground systems.
    - You may need a small shovel for digging around leaks. **Do not dig without authorization from the site contact.**
- Call the site contact ahead of arrival to the site to inform them of your arrival.
- On site we should emphasize the importance of the study and their participation. They took time to participate, and we should be very thankful for their time.
- Any questions outside the scope of the site visit should be relayed to the PM and/or Energy Trust.
    - If asked a question about the study that is not relevant to the visit let the site contact know you will share this with the program team.
- The scope of the visit is to assess leakage rates of gaskets for hand line and wheel line irrigation systems. This study will not focus on center pivot systems.
- Print out multiple pages of this guide, sites may have numerous irrigation lines.

Use the tables below to collect a sample of leaks and then a tally of leaks estimated based on those samples:

| | |
|---|---|
| Line Name | |
| Line Type | |
| Pump Make and Model | |
| Pump Horsepower | |
| Pump Efficiency | |
| System Pressure | |
| VFD? | |
| Sample Leak 1 | |
| Sample Leak 2 | |
| Sample Leak 3 | |
| Sample Leak 4 | |
| Sample Leak 5 | |
| Sample Leak 6 | |
| High Bin Tally | |
| Medium Bin Tally | |
| Low Bin Tally | |
| Total gaskets inspected (including non-leaking) | |

| | |
|---|---|
| Line Name | |
| Line Type | |
| Pump Make and Model | |
| Pump Horsepower | |
| Pump Efficiency | |
| System Pressure | |
| VFD? | |
| Sample Leak 1 | |
| Sample Leak 2 | |
| Sample Leak 3 | |
| Sample Leak 4 | |
| Sample Leak 5 | |
| Sample Leak 6 | |
| High Bin Tally | |
| Medium Bin Tally | |
| Low Bin Tally | |
| Total gaskets inspected (including non-leaking) | |

| | |
|---|---|
| Line Name | |
| Line Type | |
| Pump Make and Model | |
| Pump Horsepower | |
| Pump Efficiency | |
| System Pressure | |
| VFD? | |
| Sample Leak 1 | |
| Sample Leak 2 | |
| Sample Leak 3 | |
| Sample Leak 4 | |
| Sample Leak 5 | |
| Sample Leak 6 | |
| High Bin Tally | |
| Medium Bin Tally | |
| Low Bin Tally | |
| Total gaskets inspected (including non-leaking) | |

# Appendix B. Customer Interview Guides

## A. Introduction

Hi, my name is [Interviewer's Name] from Cadmus, calling on behalf of Energy Trust of Oregon. May I please speak with someone who is familiar with the inventory irrigation equipment at your business?

A1. My company is conducting research for Energy Trust, and we'd like your expert advice about the irrigation equipment market. Are you familiar with the inventory of irrigation equipment at your business?

1. *Yes*
2. *No [Ask to speak with person who is familiar and repeat A1]*
3. *Don't know [Ask to speak with person who is familiar and repeat A1]*

A2. [Ask if A1=1] I have specific inventory and sales related questions to ask you. For answering my questions, you will receive a $50 gift card. Your answers will remain anonymous, your business will not be mentioned in any reports, and we will not share your answers with other parties. Do you have 15 minutes right now to participate?

1. *Yes*
2. *No [Ask for a better time to call back]*
3. *Don't know [Ask for a better time to call back]*

A3. [Ask if A2=2 or 3] Is there a better time to call you back?

1. *Yes [Record time to call back]*
2. *No, do not call me back/not interested in participating [Thank and terminate]*

## B. Firmographics

Thank you for agreeing to answer my questions. Let's get started. My first questions are about [CompanyName].

B1. Are you a vendor with a physical store that sells irrigation equipment?

1. *Yes*
2. *No*

B2. [If B1=2] Are you a distributor, supplier, manufacturer, or a mix of these?

1. *Distributor*
2. *Manufacturer*
3. *Supplier*
4. *Something else [Text entry]*

B3. How many people work at your business? This includes full-time and part-time employees. [Interviewer, enter a number 0-999. A range is ok.]

1. *[Text entry]*

B4. Does your business sell irrigation equipment outside of Oregon?
1. *Yes*
2. *No*
3. *Don't know*

B5. [Ask if B4=1] About what percent of your irrigation equipment sales are within Oregon? [Interviewer, enter a number 0-100. Do not enter percentage symbol.]
1. *[Numeric entry]*

B6. What part of Oregon do most of your irrigation equipment sales come from?
1. *[Text entry]*

## C. Inventory Practices

[Ask section C if B1=1]

C1. How do you keep track of your store's inventory and sales of irrigation equipment?
1. *[Text entry]*

C2. With the tracking system you currently use, do you have the ability to generate sales reports broken out by equipment type?
1. *Yes*
2. *No*
3. *Don't know*

C3. [Ask if C2=1] About how long would it take to do that?
1. *[Text entry]*

## D. Availability, Sales, and Pricing

[Ask section D if B1=1]

D1. I'm going to name different types of irrigation components. Please tell me, yes or no, if you ever stock these components at your store. [Read list] [Answer choices: Yes=1, No=2, Don't know=3]
A. *Nozzles*
B. *Drains*
C. *Wheel line, hand line, or center pivot boot gaskets*
D. *Sprinklers such as rotating type, multi-trajectory, and impact*
E. *Low pressure regulators*
F. *Tubes such as goose necks, drop tubes, and hose extensions*

D2. Are there seasonal variations or other factors that impact irrigation components you have in stock?
1. *[Text entry]*

D3. I'm going to read off the irrigation components again. This time, please tell me what your total sales in dollars in 2023 was for that component. Your best guess is fine. If you need some time to gather this information, I can call you back. [Read list] [Interviewer, enter a number 0-999999]

*A. Wheel line, hand line, or center pivot boot gaskets [Numeric entry]*
*B. Sprinklers [Numeric entry]*
*C. Nozzles [Numeric entry]*
*D. Drains [Numeric entry]*
*E. Low pressure regulators [Numeric entry]*
*F. Tubes [Numeric entry]*

D4. [Ask if D3A>0] Let's just focus on gaskets. How many wheel line, hand line, and center pivot boot gasket units did you sell in 2023? A rough estimate is fine. [Read list] [Interviewer, enter a number 0-999999]

*1. Wheel line gaskets [Numeric entry]*
*2. Hand line gaskets [Numeric entry]*
*3. Center pivot boot gaskets [Numeric entry]*

D5. [Ask if D3A>0] Is there a seasonality or time of year when sales of gaskets tend to be highest?

*1. Yes (please ask why that is) [Text entry]*
*2. No (please ask why that is) [Text entry]*
*3. Don't know*

D6. [Ask if D3A>0] What was the average retail price per unit for the wheel line, hand line, and center pivot boot gaskets you sold in 2023? A best guess is fine. [Read list] [Interviewer, enter a number 0-999. Decimals ok.]

*1. Wheel line gaskets [Numeric entry]*
*2. Hand line gaskets [Numeric entry]*
*3. Center pivot boot gaskets [Numeric entry]*

D7. Do you sell any of the irrigation components as a system? For example LESA, MESA, LEPA, or PMDI.

*1. Yes*
*2. No*
*3. Don't know*

D8. [Ask if D7=1] Which irrigation systems brought in the most sales in 2023? [Read list if needed] [Select all that apply] [Multiple answers allowed]

*1. LESA (low elevation spray application)*
*2. LEPA (low energy precision application)*
*3. MESA (mid elevation spray application)*
*4. PMDI (precision mobile drip irrigation)*
*5. Don't know*

D9. [Ask if D3A>0] What percent of your gasket sales in 2023 were part of an irrigation system sale? [Interviewer, enter a number 0-100. Do not enter percentage symbol.]
1. *[Numeric entry]*

## E. Procurement Practices

[Ask section E if B1=1]

E1. How do you decide which types of gaskets to carry?
1. *[Text entry]*

E2. How do you decide when to stock up on gaskets?
1. *[Text entry]*

E3. How do your irrigator customers make a decision on which gasket to buy and how many? What factors do they consider in their purchase decision-making?
1. *[Text entry]*

E4. From your experience, are your irrigator customers replacing a lot of gaskets at once on a line or are they only replacing the leaking ones?
1. *Once on a line*
2. *Leaking ones*
3. *Something else [Text entry]*
4. *Don't know*

E5. How easy or difficult is it to obtain wheel line, hand line, and center pivot boot gaskets for your store? Would you say… [Read list]
1. *Very easy*
2. *Somewhat easy*
3. *Somewhat difficult*
4. *Very difficult*
5. *Don't know*

E6. Why do you say that?
1. *[Text entry]*

## F. Midstream Opportunity

Thanks for staying on with me. We will be done in 3 minutes.

F1. [Ask if B1=1] Do you work with any manufacturers or distributors directly on obtaining irrigation components for your store?
1. *Yes*
2. *No*
3. *Don't know*

F2. [Ask if F1=1] Which manufacturers or distributors do you work with?
   1. *[Text entry]*

F3. [Ask if B1=1] Imagine that Energy Trust of Oregon would pay you incentives so that you can sell irrigation components to your customers at a discounted price. Which irrigation component, if any, would you be interested in selling to customers at a discounted price? [Select all that apply] [Multiple answers allowed]
   1. *Gaskets*
   2. *Sprinklers*
   3. *Nozzles*
   4. *Drains*
   5. *Regulators*
   6. *Tubes*
   7. *Other [Text entry]*

F4. Do you have any advice on how we could increase the sales of irrigation components that specifically help an irrigator save energy and water?
   1. *[Text entry]*

## G. Closing and Gift Cards

G1. Those were all the questions I had. As promised, you can receive a $50 gift card. Would you like to receive the gift card?
   1. *Yes*
   2. *No*

G2. [Ask if G1=1] This will be an electronic gift card through a service called Tango Card. Tango offers a wide selection of retailers to choose from. Can you provide an email address that we can send the gift card to?
   1. *[Enter email address]*

G3. [If yes to gift card] I'll send you an email as a record of our conversation. It will have my contact info in case you have any questions about the gift card. You should receive your Tango gift card in about 2 weeks. Please check your email. Sometimes it appears in the junk/spam mail.

Thank you so much for your time today. Have a good rest of your day. Bye!

# Appendix C. Irrigator Surveys

## Variables To Pull into Survey

- CONTACTNAME
- FARMCOMPANY
- GROUP = Participant or Nonparticipant
- EMAIL
- PHONE

## Survey Invite Email

To: [EMAIL]
From: ETO Irrigation Research
Subject: Provide your insight on irrigation and get $50

Hi [CONTACTNAME],

You've been invited by Energy Trust of Oregon to participate in a study about irrigation equipment. This study aims to understand your irrigation equipment needs and find new ways to help your farming business. We'd appreciate you completing this approximately ten-minute survey. For your time, you will receive a $50 e-gift card.

**Click the link below to take the survey:**

[auto-generated link]

Or you may copy and paste the URL below into your internet browser: [auto-generated URL]

If you have difficulties taking the survey, please contact Carolina Ramos at Cadmus, the research firm conducting this survey on our behalf. You can reach her at carolina.ramos@cadmusgroup.com. If you have any questions about the legitimacy of the study, contact Leila Shokat at Leila.Shokat@energytrust.org

Thank you in advance for your time.

Leila Shokat
Project Manager - Evaluation
Energy Trust of Oregon

## H. Start Screen

Welcome! This survey will take 12 minutes or less to complete. Your responses will remain confidential and will only be used for research purposes. Names of individuals and companies will not be disclosed in any reports. When you complete the survey, you will be eligible to receive a $50 e-gift card.
[Start button]

# I. Irrigation Characteristics

I1. Would you be interested in further aiding this study through a site visit for an additional $100 incentive? The site visit would take roughly 2 hours and be focused on leaks in irrigation systems. Involvement in the site visit will not affect the incentive from this survey.
1. *Yes*
2. *No*

I2. What part of Oregon is your farmland located?
1. *Coastal*
2. *Central Oregon*
3. *Columbia Plateau*
4. *Mid-Columbia*
5. *Northeast Oregon*
6. *Southern Oregon*
7. *Willamette Valley*

I3. What types of crops do you produce at your farm? Select all that apply. [Multiple answers allowed]
1. *Food - Cereals, seeds, fruits, vegetables, spices, etc.*
2. *Forage/Feed - Hay, Silage*
3. *Fiber - Cotton, hemp, flax, etc.*
4. *Industrial - cash/commercial crops for profit and industrial use (specify) [Text entry]*
5. *Oil - Soybeans, sunflower seed, canola, palm, etc.*
6. *Ornamental - Decorative plants and landscaping design*
7. *Other (please describe) [Text entry]*

I4. How many acres of farmland do you irrigate? A rough estimate is fine.
1. *[Numeric Entry]*

I5. About what percent of your irrigation work takes place during each season?
Your total should add up to 100%.
[Constant sum]
1. *Spring [Numeric entry]*
2. *Summer [Numeric entry]*
3. *Fall [Numeric entry]*
4. *Winter [Numeric entry]*

I6. What irrigation method do you use? Select all that apply. [Multiple answers allowed]
1. *Center-pivot*
2. *Wheel or hand lines*
3. *Drip or micro-irrigation*
4. *Flood or furrow*
5. *Spray or sprinkler*
6. *Surge flooding*
7. *Traditional flooding*
8. *Other (please describe) [Text entry]*
9. *Don't know*

I7. Here is a list of irrigation equipment. For each item, please tell us if you have this component at your farm. [Answer choices: Yes=1, No=2, Don't know=3]
A. *Nozzles*
B. *Drains*
C. *Sprinklers such as rotating type, multi-trajectory, and impact*
D. *Low pressure regulators*
E. *Tubes such as goose necks, drop tubes, and hose extensions*

## J. General Maintenance Practices

J1. In general, what causes you to replace your irrigation equipment? Select all that apply. [Multiple answers allowed]
1. *Equipment breaks*
2. *Equipment does not work properly*
3. *Equipment is old/out of date*
4. *Changing irrigation system type*
5. *Other (please describe) [Text entry]*
6. *Don't know [Exclusive answer]*

J2. How often do you perform a maintenance check or test on your irrigation equipment?
1. *Only when a component breaks*
2. *Once a year*
3. *Every few years*
4. *More than 5 years*

5. *Don't know*

J3. [Ask if C2≠5] Who performs the maintenance check or test on your irrigation equipment? Select all that apply. [Multiple answers allowed]
   1. *I do it myself*
   2. *Someone else at the farm (please specify who) [Text entry]*
   3. *An external person/party (please specify who) [Text entry]*
   4. *Don't know [Exclusive answer]*

J4. [Ask if C2≠5] Please rank the maintenance checks or tests that are performed on your irrigation equipment from most important to least important. Select all that apply. [Ranking]
   1. *Check system pressures*
   2. *Check sprinkler patterns*
   3. *Check irrigation tires*
   4. *Check for leaks and damages*
   5. *Visual inspection of components*
   6. *Leak test*
   7. *Usage and flow rate calculations*
   8. *Other (please describe) [Text entry]*
   9. *Don't know [Exclusive answer]*

## K. Gasket Replacement Practices

[Ask section D if B6 = 1 or 2 = Yes]

K1. You mentioned having wheel line, hand line, or center-pivot systems. How many wheel line, hand line, and center-pivot boot gasket units does your farm have? A rough estimate is fine.
   1. *Wheel line gaskets [Numeric entry]*
   2. *Hand line gaskets [Numeric entry]*
   3. *Center-pivot boot gaskets [Numeric entry]*

K2. How often do you replace your gaskets?
   1. *Only when a leak is discovered*
   2. *Once a year*
   3. *Every few years*
   4. *More than 5 years*
   5. *Don't know*

K3. What causes you to replace your gaskets? Select all that apply. [Multiple answers allowed]
   1. *Gasket leaks or breaks*
   2. *Gasket is old/out of date*
   3. *Regular maintenance*
   4. *When replacing nearby leaking gaskets*
   5. *Other (please describe) [Text entry]*

6. *Don't know [Exclusive answer]*

K4. How easy or difficult is it to find gaskets at a store or supplier?
1. *Very easy*
2. *Somewhat easy*
3. *Somewhat difficult*
4. *Very difficult*
5. *Don't know*

K5. How often do you check for leaks in your gaskets?
1. *Daily*
2. *Weekly*
3. *Monthly*
4. *A few times a year*
5. *Once a year*
6. *Never*
7. *Don't know*

K6. How do you check for leaks?
1. *[Text entry]*

K7. Do you work with a manufacturer, distributor, or retailer directly on obtaining gaskets for your farm? [Multiple answers allowed]
1. *Manufacturer*
2. *Distributor*
3. *Retailer*
4. *Don't know*

K8. [Ask if D5=1] Which manufacturer, distributor, or retailer do you work with?
1. *[Text entry]*

# L. Sprinkler System Upgrade Decision-Making

L1. Do you ever buy irrigation equipment components as an automated system? For example: LESA (low elevation spray application), MESA (mid elevation spray application), LEPA (low energy precision application), or PMDI (precision mobile drip irrigation).
1. *Yes*
2. *No*
3. *Don't know*

L2. [Ask if E1=1] Which irrigation system have you purchased in the past two years? Select all that apply. [Multiple answers allowed]

1. *LESA (low elevation spray application)*
2. *LEPA (low energy precision application)*
3. *MESA (mid elevation spray application)*
4. *PMDI (precision mobile drip irrigation)*
5. *Other (please specify) [Text entry]*
6. *Don't know [Exclusive answer]*

L3. [Ask if E1=1] Why did you choose to buy an irrigation system? Select all that apply. [Multiple answers allowed] [Randomize list 1-5]

1. *To improve crop yield*
2. *To save on water*
3. *To save on labor time*
4. *A system is a better deal/investment*
5. *Recommended by other irrigators*
6. *Recommended by the store or supplier*
7. *Other (please describe) [Text entry]*
8. *Don't know [Exclusive answer]*

L4. [Ask if E1=2] Why haven't you purchased an irrigation system? Select all that apply. [Multiple answers allowed] [Randomize list 1-5]

1. *It costs more*
2. *Not in stock at the store or with the supplier*
3. *Not familiar enough with irrigation systems*
4. *Not recommended by other irrigators*
5. *Not recommended by the store or supplier*
6. *Don't see a reason to change*
7. *Other (please describe) [Text entry]*
8. *Don't know [Exclusive answer]*

# M. Interest in Control Offerings

M1. Do you currently use irrigation controller components such as timers, sensors or remotes?

1. *Yes*
2. *No*
3. *Don't know*

M2. [Ask if F1=1] Which irrigation controller components do you use? Select all that apply. [Multiple answers allowed]

1. *Timers*
2. *Sensors*
3. *Remotes*
4. *Irrigation software/app*

5. *Other (please describe)* [Text entry]

M3. How easy or difficult is it to find irrigation controller components at a store or supplier?

1. *Very easy*
2. *Somewhat easy*
3. *Somewhat difficult*
4. *Very difficult*
5. *Don't know*
6. *Depends on the component (please describe)* [Text entry]

M4. [Ask if F1≠1] How interested are you in getting irrigation controllers for your farm?

1. *Very interested*
2. *Somewhat interested*
3. *Not too interested*
4. *Not at all interested*
5. *Don't know*

M5. How familiar are you with irrigation equipment offerings from Energy Trust of Oregon?

1. *Very familiar*
2. *Somewhat familiar*
3. *Not too familiar*
4. *Not at all familiar*

M6. Are there irrigation equipment incentives or services that you'd like to see from Energy Trust of Oregon? Please share your ideas with us.

1. [Text entry]

## N. Closing and Gift Cards

N1. You've made it through the survey! If you would like to receive the $50 e-gift card, please select "Yes."

1. *Yes*
2. *No*

N2. [Ask if G1=1] This will be an electronic gift card through a service called Tango Card. Tango offers a wide selection of retailers to choose from. Please provide an email address that we can send the gift card to.

1. [Enter email address]

End of Survey Message: Your responses have been submitted. You should receive your Tango gift card in about 3-4 weeks. Please check your email. Sometimes it appears in the junk/spam mail. Should you need assistance with your gift card, please contact the person listed in the email with the survey link. Thank

you for your time today. For more information on the study, contact Leila Shokat at Leila.Shokat@energytrust.org.

# Appendix D. Detailed Results for Selected Survey Questions

The following section presents the full results for questions B4 and D2, D1, and D8 of the Irrigator Surveys.

The irrigator survey (question B4) asked respondents: "How many acres of farmland do you irrigate? A rough estimate is fine." Table 18 presents these results, cross-tabulated with question D2, which asks respondents how often they replace their gaskets. The table combines counts of responses from both participants and non-participants.

**Table 18. Frequency of Replacing Gaskets by Farm Size**

| | Only when a leak is discovered | Once a year | Every few years | More than 5 years | Total |
|---|---|---|---|---|---|
| **Acres of Farmland** | | | | | |
| 0 - 10 acres | 2 | - | 1 | - | 3 |
| 11 - 50 acres | 4 | - | 3 | 1 | 8 |
| 51 - 100 acres | 8 | - | 3 | 1 | 13 |
| 101 - 500 acres | 11 | - | 3 | 2 | 16 |
| 501 - 1000 acres | 7 | - | 1 | 0 | 8 |
| 1001 - 5000 acres | 5 | - | 1 | 1 | 7 |
| 5001+ acres | 2 | - | 1 | - | 3 |

The irrigator survey (question C4) asked respondents: "Please rank the maintenance checks or tests that are performed on your irrigation equipment from most important to least important, with 1 being most important. Select all that apply." Table 19 presents those results for participant and non-participant groups and overall respondents.

**Table 19. Priority Ranking of Maintenance Checks for Irrigation Equipment**

| | Participant Average | Non-Participant Average | Overall Average |
|---|---|---|---|
| Check system pressures | 2.3 | 2.8 | 2.5 |
| Check sprinkler patterns | 2.6 | 3.6 | 3.0 |
| Check irrigation tires | 5.6 | 4.2 | 4.7 |
| Check for leaks and damages | 2.3 | 2.5 | 2.4 |
| Visual inspection of components | 3.6 | 2.6 | 3.1 |
| Leak test | 4.4 | 5.1 | 4.7 |
| Usage and flow rate calculations | 5.2 | 4.9 | 5.1 |
| Other (please describe) | 2.7 | 6.0 | 4.0 |
| Don't know | 5.0 | 4.0 | 4.5 |

The irrigator survey (question D1) asked respondents with wheel line, hand line, or center-pivot systems: "How many wheel line, hand line, and center-pivot boot gasket units does your farm have? A

rough estimate is fine." Table 20through Table 25 present those results for participant and non-participant groups.

### Table 20. Number of Wheel Line Gasket Units: Participant Responses

| Number of Gasket Units | Percentage of Respondents | Count of Respondents |
|---|---|---|
| No Wheel Lines on site | 23% | 5 |
| 15 | 5% | 1 |
| 20 | 5% | 1 |
| 50 | 5% | 1 |
| 80 | 5% | 1 |
| 100 | 14% | 3 |
| 102 | 5% | 1 |
| 120 | 9% | 2 |
| 150 | 5% | 1 |
| 160 | 9% | 2 |
| 200 | 5% | 1 |
| 300 | 5% | 1 |
| 500 | 5% | 1 |
| 512 | 5% | 1 |
| **Total** | | **22** |

### Table 21. Number of Hand Line Gasket Units: Participant Responses

| Number of Gasket Units | Percentage of Respondents | Count of Respondents |
|---|---|---|
| 20 | 6% | 2 |
| 25 | 3% | 1 |
| 40 | 3% | 1 |
| 50 | 16% | 5 |
| 52 | 3% | 1 |
| 90 | 3% | 1 |
| 100 | 6% | 2 |
| 120 | 3% | 1 |
| 150 | 3% | 1 |
| 160 | 3% | 1 |
| 179 | 3% | 1 |
| 200 | 6% | 2 |
| 220 | 3% | 1 |
| 400 | 6% | 2 |
| 500 | 13% | 4 |
| 750 | 3% | 1 |
| 1000 | 6% | 2 |
| 1200 | 3% | 1 |
| 1500 | 6% | 2 |
| **Total** | | **32** |

### Table 22. Number of Center-pivot Gasket Units: Participant Responses

| Number of Gasket Units | Percentage of Respondents | Count of Respondents |
|---|---|---|
| No Center Pivot Lines on Site | 63% | 12 |
| 5 | 5% | 1 |
| 7 | 5% | 1 |
| 10 | 5% | 1 |
| 13 | 5% | 1 |
| 15 | 5% | 1 |
| 20 | 5% | 1 |
| 25 | 5% | 1 |
| **Total** | | **19** |

### Table 23. Number of Wheel Line Gasket Units: Non-participant Responses

| Number of Gasket Units | Percentage of Respondents | Count of Respondents |
|---|---|---|
| No Wheel Lines on Site | 21% | 3 |
| 40 | 14% | 2 |
| 70 | 7% | 1 |
| 120 | 7% | 1 |
| 125 | 7% | 1 |
| 200 | 7% | 1 |
| 264 | 7% | 1 |
| 432 | 7% | 1 |
| 500 | 7% | 1 |
| 840 | 7% | 1 |
| 1150 | 7% | 1 |
| **Total** | | **14** |

### Table 24. Number of Hand Line Gasket Units: Non-participant Responses

| Number of Gasket Units | Percentage of Respondents | Count of Respondents |
|---|---|---|
| No Hand Lines on Site | 5% | 1 |
| 10 | 5% | 1 |
| 32 | 5% | 1 |
| 35 | 5% | 1 |
| 40 | 14% | 3 |
| 50 | 14% | 3 |
| 100 | 19% | 4 |
| 150 | 5% | 1 |
| 200 | 10% | 2 |
| 264 | 5% | 1 |
| 400 | 10% | 2 |
| 500 | 5% | 1 |
| **Total** | | **21** |

### Table 25. Number of Center-pivot Gasket Units: Non-participant Responses

| Number of Gasket Units | Percentage of Respondents | Count of Respondents |
|---|---|---|
| No Center Pivot Lines on Site | 12% | 2 |
| 1 | 6% | 1 |
| 5 | 6% | 1 |
| 12 | 6% | 1 |
| 16 | 6% | 1 |
| 25 | 6% | 1 |
| 30 | 6% | 1 |
| 40 | 12% | 2 |
| 45 | 6% | 1 |
| 57 | 6% | 1 |
| 70 | 6% | 1 |
| 84 | 12% | 2 |
| 100 | 6% | 1 |
| 3000 | 6% | 1 |
| **Total** | | **17** |

# Appendix E. Detailed Participant Data from Site Visits

The table below provides additional detail on data collected through the site visits.

**Table 26. Additional Data Collected During Site Visits**

| Participant Number | Program Participation | Geographic Region | VFD? | Leakage Rate (L/min) | Pressure | Motor hp | Gasket Failure Rate |
|---|---|---|---|---|---|---|---|
| Participant 1 | Non-participant | Central Oregon | No | 1.42 | Unknown | 3 | 19% |
| Participant 2 | Non-participant | Eastern Oregon | Yes | 0.18 | 60 | 50 | 14% |
| Participant 3 | Non-participant | Eastern Oregon | Yes | 21.65 | 45 | 15 | 32% |
| Participant 4 | Non-participant | Eastern Oregon | Yes | 0.27 | 78 | 75 | 14% |
| Participant 5 | Participant | Central Oregon | No | 1.12 | Unknown | 5 | 21% |
| Participant 6 | Non-participant | Central Oregon | Yes | 237.23 | Unknown | 50 | 72% |
| Participant 7 | Non-participant | Eastern Oregon | Yes | 144.57 | 45 | 25 | 67% |
| Participant 8 | Non-participant | Eastern Oregon | No | 27.68 | 45 | 25 | 60% |
| Participant 9 | Non-participant | Eastern Oregon | Yes | 3.55 | 55 | 40 | 41% |
| Participant 10 | Participant | Willamette Valley | No | 39.75 | Unknown | 25 | 32% |
| Participant 11 | Participant | Willamette Valley | No | 66.02 | 50 | 60 | 10% |
| Participant 12 | Participant | Willamette Valley | Yes | 11.54 | 80 | 30 | 6% |
| Participant 13 | Participant | Willamette Valley | No | 12.60 | 80 | 15 | 25% |
| Participant 14 | Participant | Central Oregon | Yes | 95.83 | Unknown | 100 | 70% |
| Participant 15 | Participant | Portland Metro | No | 83.76 | 30 | 75 | 27% |
| Participant 16 | Participant | Portland Metro | No | 34.07 | 62 | 200 | 39% |
| Participant 17 | Participant | Central Oregon | No | 122.25 | Unknown | 40 | 70% |
| Participant 18 | Participant | Eastern Oregon | No | 69.54 | 60 | 50 | 44% |
| Participant 19 | Participant | Southern Oregon | No | 154.48 | Unknown | 50 | 69% |
| Participant 20 | Participant | Willamette Valley | No | 0.18 | 75 | 60 | 3% |
| Participant 21 | Participant | Eastern Oregon | Yes | 4.99 | 50 | 40 | 29% |
| Participant 22 | Non-participant | Southern Oregon | Yes | 1030.23 | 50 | 60 | 71% |
| Participant 23 | Participant | Portland Metro | Yes | 23.07 | 61 | 10 | 88% |
| Participant 24 | Participant | Portland Metro | No | 0.00 | 50 | Unknown | 0% |
| Participant 25 | Participant | Portland Metro | Yes | 5.06 | 110 | 60 | 12% |
| Participant 26 | Participant | Southern Oregon | Yes | 2.45 | 70 | 20 | 9% |
| Participant 27 | Non-participant | Willamette Valley | Yes | 0.00 | 95 | 50 | 0% |
| Participant 28 | Non-participant | Southern Oregon | No | 113.84 | Unknown | 75 | 26% |
| Participant 29 | Participant | Central Oregon | No | 0.53 | 65 | 3 | 21% |
| Participant 30 | Participant | Willamette Valley | Yes | 1.47 | 60 | 40 | 11% |
| Participant 31 | Participant | Willamette Valley | No | 19.86 | 75 | 50 | 28% |
| Participant 32 | Participant | Southern Oregon | No | 710.80 | Unknown | 40 | 59% |