NW Natural®

Washington 2024-2025 Biennial Energy Efficiency Report and 2025 Annual Energy Efficiency Report

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Executive Summary

This report serves as both the 2024-2025 biennial conservation report and annual conservation report in compliance with Condition 5(c)(iv) of Attachment 1 to Order 01 in docket UG-230944.

During the 2024-2025 biennium, NW Natural worked with stakeholders and implementation partners to deliver energy efficiency programs to customers in SW Washington. The Company exceeded the established biennial goal and CPA savings target, saving 1,005,374 therms over the last two years at 79% of the established fiscal budget. The conservation achievement represents 0.56% of the 2023 forecasted load, and 0.51% of the actual delivered energy load in Washington for 2024 and 2025[1]. The introduction of NW Natural's Behavioral Energy Efficiency (BEE) pilot was a primary component of the savings achievement. The BEE pilot is a home energy report style program that provides customers with insights into their gas usage and tips for reducing usage and is a cost-effective way to achieve short-term savings.

Table 1 - Biennial Achievement

Metric	Biennial Goal/Budget	Actual Savings/Expenditures	Percent of Goal/Budget
Biennial Savings Goal	790,042	1,005,374	127%
CPA Biennial Target	720,000		140%
Expenditures	$9,008,576	$7,082,096	79%

The residential and commercial incentive programs also had strong performances in 2025 despite the phasing out of the Washington new homes program. Strong trade ally engagement helped in the residential sector and ozone laundry measures led to substantial savings in the commercial sector.

While the BEE pilot surpassed expectations, and incentive programs met their savings goals, there were shortfalls in the low-income weatherization and market transformation programs. Washington Low-Income Energy Efficiency (WA-LIEE) has historically faced challenges in achieving consistent program uptake and meeting participation goals. A key factor has been the limited scale of projects completed, which has resulted in lower overall energy savings. Additionally, market transformation savings have a high level of volatility given the uncertainty

[1] Program saving calculations represent average annual first-year savings that are often based on typical meteorological data. The achievement as a percentage of load may vary depending on weather.

of the market and faced further challenges with the shift away from gas in residential new construction and restrictions from other regional funders.

Background

NW Natural has been offering energy efficiency programs to its SW Washington customers since 2009. The programs were developed under the direction of the Washington Utilities and Transportation Commission (WUTC) and have evolved over the years to include more offerings under the review and guidance of NW Natural's Energy Efficiency Advisory Group (EEAG). At the launch, Energy Trust of Oregon was selected to be the implementer of NW Natural's Washington programs as the service territory is contiguous with the Oregon territory and provides continuity across NW Natural's customer base. The conclusion of the 2025 program year marks the 16th year that Energy Trust of Oregon has provided energy efficiency services and incentives to residential and commercial customers in Washington on behalf of NW Natural.

In addition to the Energy Trust incentive programs, NW Natural also partners with local community action agencies to provide weatherization services to income qualified homes. The Washington Low-Income Energy Efficiency program has been operating since 2011.

Oversight

The EEAG was created at the direction of WUTC to provide advice and oversight for NW Natural's energy efficiency offerings in Washington. The advisory group is comprised of representatives from NW Natural, Energy Trust, WUTC, Washington Public Counsel, The Energy Project (TEP), Association of Western Energy Consumers (AWEC), and Northwest Energy Coalition (NWEC).

Quarterly calls are held with the EEAG to review program activity and seek input on potential program or tariff changes. Additional meetings may be scheduled on an ad hoc basis to seek guidance on time sensitive matters. Typical agenda items may include savings forecast report outs, offering changes, evaluations, planned marketing, code updates, or items brought forward by advisory members.

All regulatory filings are shared with the EEAG thirty days in advance. Interested parties outside of the advisory group may also provide feedback through written comments filed within the related regulatory docket or verbally during an open meeting.

Program Funding

NW Natural's energy efficiency programs are funded through a conservation tariff adjustment filing that the Company makes every year. Variation between the forecasted and actuals are captured in the annual adjustment.

All approved tariffs are published and available on the Company's website.

Biennial Report

Savings Achievement

Table 2 - Biennial Savings Results

Program	2024 Savings (therms)	2025 Savings (therms)	Biennial Savings*	Goal (therms)	Percent Difference
Commercial Incentive Program	121,183	194,863	316,046	286,592	110%
Residential Incentive Program	95,578	104,161	199,739	229,062	87%
Low-Income Weatherization	712	1,179	1,891	8,680	22%
Market Transformation**	25,666	8,022	33,688	60,000	56%
Behavioral Energy Efficiency	197,373	256,637	454,010	205,708	221%
Program Total	440,512	564,862	1,005,374	790,042	127%
2-Year CPA Target	720,000				140%

*Biennial Savings Goals are from NW Natural's 2024-2025 Biennial Energy Efficiency Plan and do not reflect updated 2025 goals.

**2024 NEEA Market Transformation Savings have been revised since the 2024 Annual Report.

Expenditure Summary

Table 3 - Biennial Expenditures

Program	2024 Expenditures	2025 Expenditures	Biennial Expenditures	Budget	Percent of Budget
Commercial Incentive Program	$1,231,449	$1,371,587	$2,603,036	$2,862,137	91%
Residential Incentive Program	$1,547,330	$1,615,646	$3,162,976	$4,293,345	74%
Low-Income Weatherization*	$43,411	$77,884	$121,295	$283,885	43%
Market Transformation	$88,148	$241,203	$329,351	$329,353	100%
RTF Regional Collaboration	$11,100	$14,400	$25,500	$26,100	98%
Industrial	$20,959	$64,516	$85,475	$150,000	57%
Behavioral Energy Efficiency	$324,898	$274,516	$599,415	$753,756	80%
Conservation Potential Assessment	$0	$113,625	$113,625	$150,000	76%
Evaluation	$8,300	$33,123	$41,423	$160,000	26%
Total	$3,275,596	$3,806,500	$7,082,096	$9,008,576	79%
*2024 Low-Income Expenditure has been revised from the 2024 Annual Report after a 2025 mid-year reconciliation					

Portfolio Cost-Effectiveness

NW Natural's programs largely remained cost-effective through the biennium, achieving a weighted average portfolio cost-effectiveness of 1.96 using the Total Resource Cost (TRC) test. A TRC test above one indicates that the benefits are greater than the costs for both participants and non-participants and is the primary metric used in Washington for determining cost-effectiveness. The Utility Cost Test (UCT) only evaluates the costs and benefits from the utility perspective and is reported as a secondary metric.

Between 2024 and 2025 there was a jump in cost-effectiveness for both the Energy Trust incentive programs and the BEE pilot. Several factors contributed to this including: the measure mix achieved, slight updates to avoided costs, and program maturity for the BEE pilot.

Table 4 - Combined Benefit-Cost Ratios

Program	Utility Cost Test	Total Resource Cost Test
Commercial Programs	2.24	2.04
Residential Programs	2.63	1.78
Total NW Natural Washington Energy Trust Programs*	2.44	1.88
NW Natural Low-Income Program (only)	0.67	0.57
NW Natural BEE Home Energy Reports	1.95	1.95
Total NW Natural Washington Programs	2.35	1.86
Total Washington Portfolio**	2.48	1.96

*Does not include NEEA, WA-LIEE, or pilot expenses

**Includes costs associated with NEEA's gas market transformation efforts

Table 5 - 2024 Benefit Cost Ratios

Program	Utility Cost Test Benefit/Cost Ratio	Total Resource Cost Test Benefit/Cost Ratio
Commercial Programs	2.31	1.75
Residential Programs	2.54	1.68
Total NW Natural Washington Energy Trust Programs*	2.44	1.71
NW Natural Low Income Program (only)	0.77	0.67
NW Natural Behavioral Program Pilot	1.66	1.66
Total NW Natural Washington Programs	*2.34*	*1.69*
*Total Washington Portfolio***	*2.73*	*1.99*

** does not include NEEA or WA_LIEE expenses or Pilots*

*** includes costs associated with NEEA's gas market transformation efforts.*

Table 6 - 2025 Benefit Cost Ratios

Program	Utility Cost Test Benefit/Cost Ratio	Total Resource Cost Test Benefit/Cost Ratio
Commercial Programs	2.12	2.51
Residential Programs	2.74	1.89
Total NW Natural Washington Energy Trust Programs*	2.45	2.12
NW Natural Low Income Program (only)	0.50	0.40
NW Natural BEE Home Energy Reports	2.34	2.34
Total NW Natural Washington Programs	*2.38*	*2.08*
*Total Washington Portfolio***	*2.16*	*1.92*

** does not include NEEA or WA_LIEE expenses or Home Energy Reports*

*** includes costs associated with NEEA's gas market transformation efforts.*

Adaptive Management

NW Natural and its partners monitor market and program activity to ensure that savings targets can be met or take corrective action to mitigate savings shortfalls. Over the 2024-25 program years the market continued to recover from the lingering impacts of COVID-19. Disruptions in the supply chain during the peak of the pandemic led to higher equipment costs that continue to persist. In addition to rising costs, there are workforce constraints that have limited the capacity of partner organizations.

To combat some of these challenges, Energy Trust has re-evaluated the level of incentive available for their Savings Within Reach program to motivate more participation. In 2025, increases in insulation and gas furnaces incentives were instituted, which drove more ceiling insulation, floor insulation, and gas furnaces projects compared to 2024.

At the end of 2024, the commercial custom pipeline had a limited number of projects which led to a greater focus on prescriptive measures. Commercial program staff connected with an out-of-state ozone laundry distributor, which led to the completion of three projects that made up the bulk of the commercial sector's savings.

During the biennium, NW Natural continued to assess ways to increase participation in low-income weatherization. NW Natural connected with Northwest Community Action Center with the intention of having them expand their weatherization services into Klickitat and Skamania counties. Unfortunately, due to staffing turnover this connection did not yield the desired outcome, and NW Natural is continuing to investigate ways to increase participation given partner capacity constraints.

Market transformation efforts are another area where NW Natural saw a drop in anticipated savings. Given the upstream nature of the market transformation work this is not something that the utility can adaptively manage. Changes in the state building codes have led to a large reduction in the anticipated savings which is outside the control of the programs. In response to new requirements tied to some of the funders, the Northwest Energy Efficiency Alliance has pivoted funding to leverage more dual-fuel or fuel neutral programs.

Advisory Group Engagement

NW Natural met with its advisory group ten times during 2024 and 2025. Quarterly meetings were held to provide updates on savings goal progress, reporting activities, and program development.

Table 7 - EEAG Meeting Schedule

Meeting Type	Primary Topic	Date
Interim Meeting	Tariff Updates	1/29/2024
2024 Q1 Meeting	NEEA + Program Updates	3/25/2024
2024 Q2 Meeting	Biennial Report Review	5/9/2024
2024 Q3 Meeting	Evaluation + Program Updates	8/14/2024
2024 Q4 Meeting	Program + Plan Updates	10/17/2024
Interim Meeting	CPA + Program Updates	1/29/2025
2025 Q1 Meeting	Program Updates	3/25/2025
2025 Q2 Meeting	Evaluation + CPA Presentation	5/13/2025
2025 Q3 Meeting	Program Updates	8/19/2025
2025 Q4 Meeting	Biennial Plan Review	10/16/2025
Interim Meeting	Industrial Program	12/4/2025

During the biennium there was a decline in stakeholder attendance in part due to staffing turnover. NW Natural has reached out to the organizations and is working on refining the structure and format of the meetings to be more accessible.

2024 Summary

In 2024, NW Natural's standard incentive programs and low-income programs faced challenges meeting participation goals. In the commercial sector the shortfall was due to three large school projects that were delayed until 2025. On the residential side, savings from window projects fell significantly from previous year levels due to a prominent contractor deciding to no longer participate in the program. The BEE pilot was fully up and running in 2024 and able to mitigate savings shortfalls from the incentive programs, resulting in 122% achievement of the annual savings goal.

With less uptake in the incentive programs, the expenditures for 2024 were only 75% of the budgeted amount. The total Washington Portfolio achieved a benefit to cost ratio of 1.99 when

using the total resource cost test. For additional details about 2024 activities please see the full 2024 Annual Energy Efficiency Report.

2024 Results

Table 8 - 2024 Result Summary

Program Track	2024 Savings Goal (therms)	2024 Actuals (therms)	Percentage of Goal Achieved	2024 Budget	2024 Expenditure	Budget Variance
Commercial Incentive Program	133,179	121,183	91%	$1,346,925	$1,231,449	-9%
Residential Incentive Program	111,060	95,578	86%	$2,117,068	$1,547,330	-27%
Low-Income Weatherization*	3,255	712	22%	$109,722	$42,725	-61%
NEEA Market Transformation**	20,000	26,010	130%	$88,149	$88,148	0%
RTF Regional Collaboration	N/A	N/A	N/A	$11,100	$11,100	0%
Pilot & Trial Programs	93,024	197,373	212%	$610,669	$345,858	-43%
Conservation Potential Assessment	N/A	N/A	N/A	$-	$-	0%
Evaluation	N/A	N/A	N/A	$60,000	$8,300	-86%
Savings Total	360,518	440,856	122%	$3,672,964	$3,266,610	-11%
Biennial Goal (therms)	790,042	**Percentage to Biennial Goal**		56%		

*Original reported 2024 low-income expenditure value is shown

**Original reported 2024 NEEA savings shown

2024 Program Highlights

Commercial Sector

- While the overall commercial sector fell short of goal, there was a strong performance in the Strategic Energy Management track, which achieved 128% of its annual goal.
- There was a shift in the commercial outreach approach to diversify the team and more effectively serve the commercial market with dedicated market energy advisors.
- The program team advanced language accessibility and tailored efforts to better serve priority populations, including smaller businesses.

Residential Sector

- Energy Trust expanded its Savings Within Reach program to include more offerings for income-qualified customers.
- The WA-LIEE program exceeded its goal for number of homes served.
- The BEE pilot generated a lot of savings and was positively received by customers.

2025 Annual Report

Energy Trust Programs

In 2025, Energy Trust achieved 137% of the 2025 annual savings goal. The savings achievement was comprised of 194,863 therm savings in the commercial sector and 104,160 therm savings in the residential sector.

Table 9 - Energy Trust 2025 Results

Metric	Goal	Total yearly achievement	Q1 results	Q2 results	Q3 results	Q4 results
Therms Saved	219,054	299,023	41,187	100,186	51,336	106,315
Total Program Expenditures	$ 3,644,028	$ 2,987,234	$ 636,486	$ 806,428	$ 598,636	$ 945,684
Average Levelized Cost Per Therm	Less than $0.90	$ 0.94	$ 1.24	$ 0.97	1.04	0.94
Utility Cost at Portfolio Level	Greater than 1.00	2.16	Reported annually	Reported annually	Reported annually	Reported annually

Commercial Sector

The Energy Trust commercial sector is composed of three major program tracks. The standard track is available for both new and existing buildings and provides set incentives for upgrades that have deemed savings. The custom track is for more complex projects and requires site specific energy modeling to inform claimed savings and incentives. Lastly, the Strategic Energy Management (SEM) program is an operations and maintenance focused program that helps customers track their energy usage and identify opportunities to save energy.

Table 10 -2025 Commercial Savings by Track

Program Track	Annual Savings	2025 Plan Goal	Percent Achieved
Existing Building Custom	10,814	59,093	18%
Existing Building Standard	126,006	26,475	476%
New Building Standard	3,591	-	N/A
Strategic Energy Management	54,452	36,555	149%
Total	194,863	122,123	160%

Table 11 - 2025 Commercial Expenditures

	Actual Expenditures	2025 Budget	Budget Variance	Percent of Budget
Commercial Delivery	$825,048	$995,218	$(170,170)	83%
Incentives	$457,971	$489,962	$(31,991)	93%
Administration	$88,568	$90,748	$(2,180)	98%
Total	$1,371,587	$1,575,928	$(204,341)	87%

Commercial Sector Highlights

- Commercial savings were primarily driven by steam traps and ozone laundry projects. Program staff connected with ozone system representatives to promote the program incentives and encourage enrollment in the Trade Ally Network to continue the success of the ozone laundry measure.
- Energy Trust continued to support customers complying with Washington's Clean Buildings Performance Standard through the SEM program. Additional customers were enrolled in SEM as a result of this targeted outreach.
- The program added a bilingual small business energy advisor to serve Southwest Washington. The advisor made strides in connecting with small businesses.

Table 12 - 2025 Commercial Sites Served

	Q1	Q2	Q3	Q4	Total
Commercial					
Appliance	-	-	1	2	**3**
HVAC	6	5	-	-	**11**
HVAC Controls	-	-	-	1	**1**
Operations & Maintenance	-	12	-	2	**14**
Study	-	-	-	1	**1**
Water Heating	5	6	2	-	**13**
Weatherization	-	1	-	2	**3**

Table 13 - 2025 Commercial Measures

Category	Measure	Measures installed	Total therms saved
Aplliance	Clothes washer	3	87,193
	Aplliance total	**3**	**87,193**
HVAC	Boiler	2	2,622
	Building controls	1	10,814
	Gas furnace	1	101
	Steam traps	8	24,938
	HVAC total	**12**	**38,475**
HVAC controls	Thermostat	1	29
	HVAC controls total	**1**	**29**
Operations & maintenance	Custom Operations & Maintenance	15	54,452
	Operations & maintenance total	**15**	**54,452**
Study	Study	1	-
	Study total	**1**	-
Water heating	Tank water heater	7	1,687
	Tankless water heater	3	188
	Pipe Insulation	10	4,451
	Water heating total	**20**	**6,326**
Weatherization	Ceiling insulation	3	8,387
	Weatherization total	**3**	**8,387**
Grand Total		**55**	**194,862**

Residential Sector

Energy Trust serves residential customers with incentives to upgrade HVAC equipment, weatherize homes, and install smart thermostats. Incentives are provided through various delivery streams; most are rebates delivered through trade allies and some measures like smart thermostats are delivered through instant incentives either on the Energy Trust marketplace or through coupons that can be redeemed at retailers. In addition to the market rate incentives, increased incentives are available to income-qualified customers for furnace and insulation measures. The income qualified pathway was introduced in 2024 and has seen increasing uptake in 2025. Of the 599 furnaces installed in 2025, 57 of them were delivered through the Savings Within Reach pathway representing roughly 10% of the delivered furnace projects.

Table 14 - Residential Savings by Track

Program Track	Annual Savings	2025 Plan Goal	Percent Achieved
Home Retrofit	102,959	93,368	110%
Midstream and Retail	-	15	0%
Small Multifamily	1,202	3,548	34%
Residential Total	104,161	96,931	107%

Table 15 - 2025 Residential Expenditures

Category	Actual Expenditures	2025 Budget	Budget Variance	Percent of Budget
Residential Program Delivery	$613,413	$749,458	$(136,045)	82%
Incentives	$895,697	$1,199,553	$(303,856)	75%
Administration	$106,536	$119,089	$(12,553)	89%
Total	$1,615,646	$2,068,100	$(452,454)	78%

Residential Sector Highlights

- Savings for the residential sector were driven by gas furnaces, weatherization measures, and smart thermostats.
- Savings from HVAC controls (smart thermostats) increased over the course of 2025 as a result of targeted marketing campaigns. This shows that there is still market potential for these historically consistent measures.
- A higher incentive for Savings Within Reach insulation projects was launched midyear and helped drive more insulation projects. Similarly, the Savings Within Reach gas furnace incentive also increased to align with the Oregon incentive.

Table 16 - 2025 Residential Sites Served

	Q1	Q2	Q3	Q4	Total
Residential					
HVAC	130	141	142	209	**621**
HVAC Controls	54	84	112	243	**492**
Water Heating	3	14	11	13	**41**
Weatherization	34	42	28	68	**168**

Table 17 - 2025 Residential Measures

Category	Measure	Measures installed	Total therms saved
HVAC	Furnace	599	67,459
	Gas fireplace	25	423
	HVAC total	**621**	**67,883**
HVAC controls	Thermostat	495	15,613
	Thermostat optimization	7	2,502
	HVAC controls total	**495**	**18,116**
Water heating	Tankless water heater	41	2,488
	Water heating total	**41**	**2,488**
Weatherization	Ceiling insulation	77	10,023
	Floor Insulation	32	3,860
	Wall insulation	10	582
	Windows	91	1,572
	Weatherization total	**168**	**16,036**
Grand total		**1,381**	**104,523**

Trade Ally Network

Energy Trust maintains a list of qualified contractors that can be easily connected to customers that are interested in energy efficiency projects. Trade allies receive ongoing training and support to increase program awareness and ensure program standards are met.

At the end of 2025, 525 trade allies served Washington. This number is up from the 463 that served the program in 2023. 205 of these trade allies are based in Washington.

Customer Satisfaction

Energy Trust conducted short web and phone surveys of NW Natural customers in Washington who participated in Energy Trust programs in 2025 to determine their satisfaction with Energy Trust.

Results from 150 residential customers indicate a generally high level of customer satisfaction. Most residential customers were satisfied with their overall program experience, but some were neutral or dissatisfied with the turnaround time to receive their incentive and the incentive application form.

Table 18 - 2025 Residential Customer Satisfaction

Residential (n=150)	Dissatisfied	Neutral	Satisfied
Overall experience	1%	5%	94%
Incentive application form	4%	8%	88%
Turnaround time to receive incentive	8%	4%	86%

Energy Trust looks at year-over-year trends within their full Fast Feedback Reports. Over the last 5 years overall customer satisfaction has remained consistent with a slight decrease in satisfaction with the application form but an increase in satisfaction with the turnaround time for receiving the incentive.

Table 19 - Historical Residential Satisfaction

Year	Incentive Application Form Satisfaction	n	Time It Took To Receive Incentive	n
2021	94%	143	75%	143
2022	93%	127	79%	131
2023	94%	108	83%	107
2024	83%	104	74%	106
2025	88%	85	86%	90

Only five commercial customers in Washington who participated in Energy Trust programs in 2025 were surveyed. (Strategic Energy Management participants are not eligible for this survey.) All five were satisfied with their overall program experience, incentive amount, ease of applying for the incentive, interaction with program representatives, performance of their project or system and turnaround time to receive the incentive.

Table 20 - 2025 Commercial Customer Satisfaction

Commercial (n=5)	Dissatisfied	Neutral	Satisfied
Overall experience	0%	0%	100%
Incentive amount	0%	0%	100%
Ease of applying for incentive	0%	0%	100%
Interaction with program representative	0%	0%	100%
Performance of project or system	0%	0%	100%
Turnaround time to receive incentive	0%	0%	100%

Washington Low-Income Energy Efficiency

The primary goal of the Washington Low-Income Energy Efficiency Program (WA-LIEE) is to serve income-qualified customers who are unable to access traditional energy efficiency incentive programs. Partners deliver free whole home weatherization services through leveraged funding from federal, state, and local agencies. These leveraged funding sources are subject to savings-to-investment ratio requirements or approved measures list.

Over program years 2024 and 2025, NW Natural's goal was to serve 16 homes achieving an estimated 8,680 therms in energy savings. Our main program partner Clark County Weatherization exceeded participation expectations, completing a total of 25 projects over the two-year period. In program year 2024, 12 projects were completed with estimated savings of 712 therms. In program year 2025, 13 projects were completed with an estimated savings of 1,179 therms.

Table 21 - WA-LIEE Biennial Achievement

Program	2024 Actuals	2025 Actuals	Biennial Total	Biennial Goal	Percent Achieved
Projects	12	13	25	16	156%
Expenditures	$43,411.27	$77,883.54	$121,294.81	$283,885	43%
Savings	712	1179	1891	8,680	22%

Table 22 - 2025 WA-LIEE Measure Summary

Incentives	Total Job Costs	Total Measures	Total Jobs	Est. Therms
Furnace Tune-up (WA)	$1,806.47	1625.83	2	44
Duct Insulation (WA)	$3,462.85	3116.57	3	148
Floor Insulation (WA)	$11,438.58	10294.72	2	357
90% High Efficiency Furn (WA)	$10,749.28	9674.35	2	140
Duct Sealing (WA)	$43.72	39.35	1	5
Infiltration (Shell Sealing) WA	$1,662.05	1495.84	2	95
Hot Water Pipe Insulation (WA)	$647.23	582.51	1	10
Ceiling Insulation R-2 (WA)	$3,889.06	3500.15	1	33
Wall Insulation (WA)	$4,734.46	4261.01	1	347
Total	$38,433.70	34590.33	15	1179
Measure Reimb.	$38,433.70			
Total Admin Fees	$9,608.41			
Total Insp Fees	$-			
Total HSR	$29,841.43			

While the number of homes served exceeded program goals, therm savings did not meet projections. This trend was driven by the size and scope of measures funded through NW Natural. The projects supported by NW Natural tended to be smaller in scale and often included measures such as furnace replacements and tune-ups rather than deeper weatherization upgrades that generate higher therm savings. Homes participating in WA-LIEE continued to receive whole-home weatherization and energy efficiency improvements through leveraged funding sources. Partner agencies often prioritize other sources of funding and as a result NW

Natural funding is frequently used to fill remaining gaps or support measures not covered through other programs. Thus, savings associated with measures funded outside of WA-LIEE are not attributed to NW Natural. Because of this, reported therm savings may underrepresent the broader benefits achieved with participating households. NW Natural continues to observe this trend in 2025.

Over this two-year period, NW Natural also continued efforts to expand partnerships and improve service access across Washington. Once anticipated opportunity involved establishing a partnership with Northwest Community Action Center (NCAC), the current provider serving South Yakima Valley, to expand weatherization and energy efficiency services into Skamania and Klickitat Counties. This collaboration was expected to improve program access. However, the partnership did not materialize as anticipated due to staffing changes and organizational transitions within NCAC. NW Natural has experienced ongoing challenges gaining program traction in the region and increasing overall energy savings outcomes.

NW Natural's 2024 Energy Burden Assessment identified 17,990 low-income households within the company's Washington territory. Of those households, approximately 12% (2,163 households) were identified as having both a high energy burden and high energy efficiency potential, representing customers who could benefit from weatherization and energy efficiency upgrades. An additional 42.8% (7,697 households) were identified as having a high energy burden but lower energy efficiency potential. These customers are assisted through programs like the Bill Discount and Arrearage Management programs.

Since 2016, The Washington Low Income Energy Efficiency Program (WA_LIEE) has completed projects in 128 homes. While the program has delivered meaningful benefits to participating households, NW Natural recognizes the need to address barriers that continue to limit broader program participation and delivery capacity in SW Washington service areas.

To help address these challenges and better meet customer needs, NW Natural is exploring alternative delivery models and pilot opportunities. One concept under consideration is a contractor delivered low-income model similar to approaches piloted by Cascade Natural Gas. This type of delivery approach could supplement existing agency partnerships by leveraging contractor networks to directly deliver energy efficiency services. The goal of exploring this model is to reduce barriers to participation, improve access for customers in underserved communities, and create additional pathways for delivery of these resources throughout the NW Natural SW Washington service territory.

As NW Natural continues evaluating this concept, the Company will seek guidance and feedback from its advisory groups, including the Energy Efficiency Advisory Group (EEAG) and the Gas

Residential Energy Assistance Tarriff (GREAT) Advisory Group, to help inform program design and implementation considerations.

In 2025, NW Natural expanded outreach efforts across Clark, Skamania, and Klickitat Counties to raise awareness of income-qualified programs and resources, including weatherization services and the Bill Discount Program.

NW Natural participated in two key outreach events during the year:

- Clark County Race for Warmth, held in partnership with Clark PUD, had an estimated attendance of 1,775 individuals and generated approximately 150 direct customer engagements.
- In June, NW Natural participated in the Clark County Get Ready Event, bringing together Bill Discount, Weatherization, Energy Planning, and Safety resources. The event had an estimated attendance of 1,200 individuals and resulted in approximately 350 direct engagements and 60 do-it yourself weatherization kits distributed.

Although NW Natural did not directly participate in resource fairs in Skamania and Klickitat Counties, outreach efforts were expanded through a partnership with Next Door Inc in The Dalles, Oregon. Through this collaboration, NW Natural connected with organizations serving these communities and distributed 750 do-it-yourself weatherization kits. Kits included door draft stoppers, window insulation kits, weather seals, outlet sealers, and information on how to enroll in the Bill Discount Program in multiple languages.

Northwest Energy Efficiency Alliance

The Northwest Energy Efficiency Alliance (NEEA) is a regional organization that pools utility resources to advance market transformation in the northwest. Their work is focused on promoting knowledge sharing and removing supply chain barriers to advance adoption of efficient technology. 2025 marked the first year of NEEA's 5-year business and strategic plan, which included a large shift away from residential gas efficiency due to the passage of WA House Bill 1589.

While NEEA will continue to monitor their impact of the prior investment in residential gas efficiency, all programs in 2025 were focused on fuel neutral technology and commercial markets.

Savings in 2025 were generated from commercial product standards and new construction codes. Additional indirect savings were also created through envelope measures in

manufactured homes and extended motor pumps in residential and commercial water heating applications.

Table 23 - 2025 NEEA Savings

NEEA Program	2025 Savings (therms)
Commercial Product Standards	783
Commercial Codes	1,179
Manufactured Homes Envelope	189
Pumps Commercial Water Heating	86
Pumps Residential Water Heating	5,785
Total	8,022

Table 24 - 2025 NEEA Expenditures

Program	2025 Budget	2025 Expenditure	Variance
NEEA	$241,204	$241,203	0%

Behavioral Energy Efficiency (Pilot)

NW Natural launched the Behavioral Energy Efficiency (BEE) Pilot in Q4 of 2023. Participants in the program receive home energy reports that provide customers with information about their usage and tips for reducing their energy consumption. 2025 marks the second year of full program participation.

Table 25 - BEE Pilot 2025 Savings & Expenditures

BEE Program	2025 Budget/Goal	2025 Actual	Percent of Budget/Goal
Platform Cost	$100,000	$100,000	100%
Treatment Cost	$112,010	$112,010	100%
Paper Report Cost	$103,531	$62,506	60%
Program Budget	$315,541	$274,516	87%
Program Savings Goal (therms)	266,327	256,637	96%

43,082 participants were enrolled in the BEE pilot at the beginning of 2025 and the program ended the year with 40,617 participants. Most of the attrition is associated with move-outs or

account holder changes, only 6 participants actively opted out of the program throughout the year.

Participants receive four paper reports a year, and those who have provided their email to NW Natural also receive monthly digital reports. From the online platform, NW Natural gets data about engagement and customer feedback. Overall, the reception of the program has been largely positive; 88.7% of responses have been positive. That is up slightly from the 2024 feedback responses.

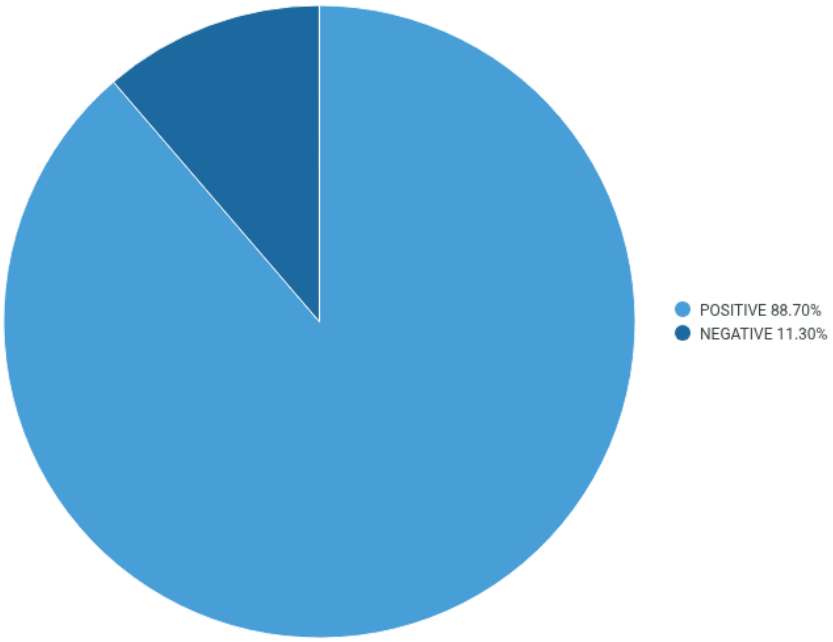

Figure 1 - BEE Pilot 2025 Online Feedback

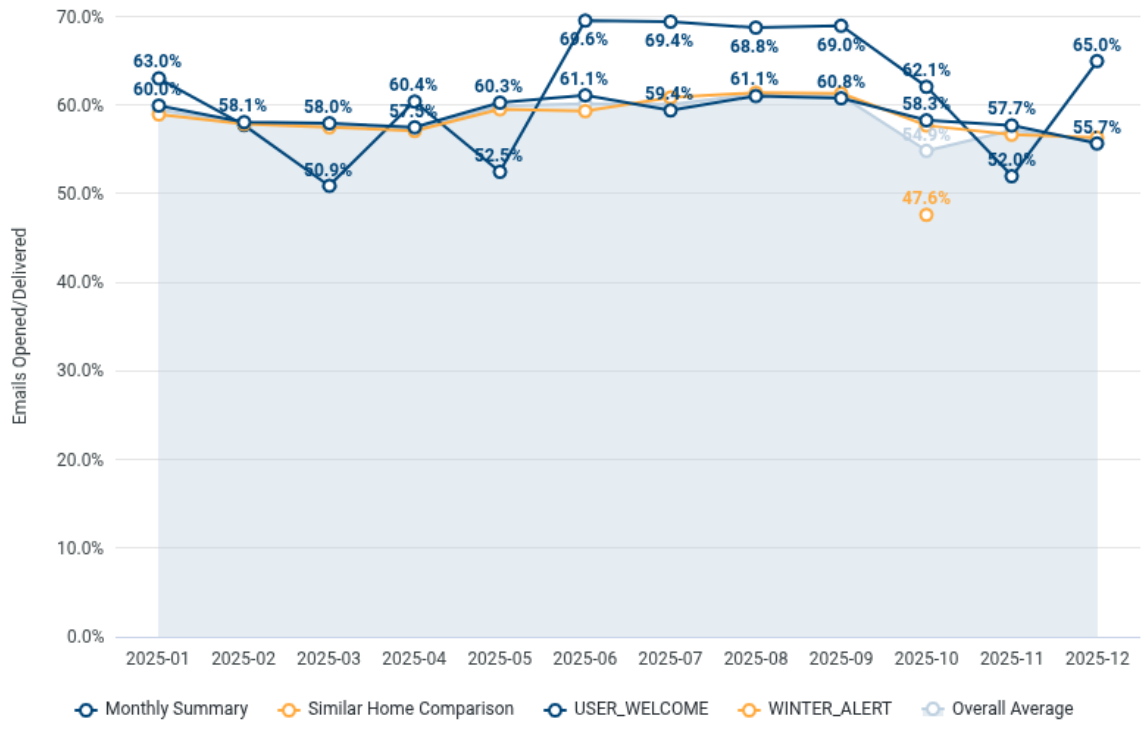

Figure 2 - BEE Pilot Email Open Rate

Regional Technical Forum

The Regional Technical Forum (RTF) was created in 1999 to support the Northwest Power and Conservation Council by developing and maintaining a list of energy efficiency measures. The RTF's work is used within NW Natural's programs as a source for reporting accurate peer-reviewed savings.

Funding provided to the RTF by NW Natural supports the development of gas only and dual-fuel measures. A list of active and past measures with supporting analysis can be found on the RTF website[2].

Industrial Program Development

NW Natural ran an industrial audit pilot from the fall of 2022 through 2024. The primary purpose of the pilot was to gather information on savings opportunities and gauge customer interest in a utility program.

[2] https://rtf.nwcouncil.org/measures/

In 2025, NW Natural began working with a consultant to begin developing a program based on the findings from the audit pilot. The program will offer incentives to customers for projects that reduce natural gas usage. These opportunities include HVAC equipment upgrades, production and operational process improvements, and capital projects.

NW Natural will be administering the program in partnership with pre-approved engineering firms that will provide the savings estimates and perform the measurement and verification work for implemented projects.

The program is anticipated to become available to customers in 2026.

Evaluations

Impact evaluations assess the quantification of energy savings and process evaluations take a qualitative look at the program experience. To ensure programs are running effectively and reported savings are being realized, evaluations are conducted on a regular cadence.

Portfolio Evaluation

In accordance with the 2024-2025 gas conservation plan conditions, NW Natural contracts with an independent third-party to validate the biennial conservation savings achievement. For the assessment, NW Natural provides all project level information and applicable evaluation materials to a hired third-party to verify the portfolio-level savings reported within this report.

For the 2024-2025 biennium there were several discrepancies identified within the memo. The findings were addressed in the report as follows:

1) The draft report contained summation errors in Table 3 (Biennial Expenditures). This has been fixed.
2) Table 2 (Biennial Savings Results) has been corrected to include the updated 2024 NEEA savings value.
3) Table 3 was updated to include the missing 2024 Industrial expenditures.
4) 2024 and 2025 Annual Results Tables were updated to show the breakdown of BEE and Industrial pilots for reporting consistency.
5) Low-income homes served for 2025 was updated from 14 in the draft to 13 based on finding two projects at the same home.
6) Energy Trust data could not be reproduced from underlying project-level tracking data. Energy Trust reported numbers are lower than the project data, indicating that some projects may have been filtered out for various reasons. While there are no updates to the reported values, NW Natural is working to understand what drove the variation and improve the process for future evaluations.

Program Evaluations

Energy Trust Program Evaluations

Energy Trust manages the evaluations for all its administered programs. While not all evaluations carve out Washington for specific findings, many are applicable across both the Oregon and Washington service territories. The following evaluations and research studies were finalized by Energy Trust during the biennium, and full reports are available in the appendices.

2024

- 2023 Fast Feedback Survey Report
- Multifamily Weatherization Program Evaluation
- Trade Ally Interview Report

2025

- Process Evaluation of Energy Trust 2022-2023 Existing Buildings Program
- Honeywell Smart Thermostat Pilot Evaluation
- 2023 Existing Buildings Impact Evaluation Report
- Independent Restaurant Study
- 2021-2024 Greenhouse Measures Market Research
- Billing Analysis of Residential Smart Thermostats

Behavioral Home Energy Report Evaluation

In 2025, NW Natural contracted with ADM Associates to perform an impact evaluation of the Behavioral Energy Efficiency Pilot. The impact evaluation verified the savings reported by the implementation vendor.

WA-LIEE Impact Evaluation

ADM Associates conducted a comprehensive evaluation of both the Oregon Low-Income Energy Efficiency (OLIEE) and Washington Low-Income Energy Efficiency (WA-LIEE) programs. Over the 2010–2022 evaluation period, the WA-LIEE program served 175 households, delivering an average of 3.3 measures per home.

Based on a billing analysis, the evaluation found that WA-LIEE delivers statistically significant energy savings for participating households. Key findings include:

- Average annual savings of 162 therms per participant
- Average reduction in natural gas usage of 25%

Due to limited participation volume, measure-level billing analysis was not feasible for most individual measures. As a result, evaluation findings for Washington are based on whole-home impacts rather than individual measure performance.

The evaluation also found that WA-LIEE passed the Total Resource Cost (TRC) test, with values ranging from 1.37 to 2.08, demonstrating that program benefits exceed costs under standard regulatory cost-effectiveness frameworks.

Key conclusions from the evaluation include:

- **Strong energy savings performance:** Participating households achieved substantial reductions in natural gas consumption, with savings exceeding 25% of annual usage.
- **Cost-effective program delivery:** Program benefits exceeded costs across the evaluation period, indicating effective use of program resources.

Overall, the WA-LIEE program demonstrated strong per-household energy savings and favorable cost-effectiveness outcomes, indicating that the program is delivering meaningful benefits to participating Washington households. However, limitations related to program scale and documentation limited the ability to evaluate measure-specific performance and broader program impacts.

NW Natural Internal Audit

In addition to third-party evaluations, NW Natural conducts an internal audit of the Energy Trust programs to ensure that funds are being appropriately spent and tracked. A statistically based sample of 2025 transactions were reviewed, and no exceptions were noted during the audit.

Appendices

Appendix A: List of Acronyms

Appendix B: Energy Trust Measure Level Forecast V. Actuals

Appendix C: EEAG Meeting Minutes

Appendix D: Portfolio Verification

Appendix E: Energy Trust Evaluations

Appendix F: BEE Evaluation

Appendix G: Low-Income Impact Evaluation

Appendix A: Acronym List

Abbreviation	Definition
AEER	Annual Energy Efficiency Report
AEG	Applied Energy Group
AFUE	Annual Fuel Utilization Efficiency
AMI	Area Median Income
BEE	Behavioral Energy Efficiency
BEEP	Biennial Energy Efficiency Plan
BEER	Biennial Energy Efficiency Report
BOC	Building Operator Certification
CAC	Conservation Advisory Council
CDFI	Community Development Financial Institution
CPA	Conservation Potential Assessment
DAC	Diversity Advisory Council
DHW	Domestic Hot Water
DOE	Department of Energy
DSM	Demand-Side Management
EEAG	Energy Efficiency Advisory Group
EPS	Trademarked name used for residential new homes program
ETO	Energy Trust of Oregon
EUI	Energy Usage Index
FPL	Federal Poverty Level
HER	Home Energy Report
HVAC	Heating Ventilation and Air Conditioning
IOU	Investor-Owned Utility
IRP	Integrated Resource Plan
NEB	Non-Energy Benefit
NEEA	Northwest Energy Efficiency Alliance
NWPCC	Northwest Power and Conservation Council
O&M	Operations and Maintenance
PUD	Public Utility District
RTF	Regional Technical Forum
SEM	Strategic Energy Management
SMI	State Median Income
TRC	Total Resource Cost
UCT	Utility Cost Test
WAC	Washington Administrative Code
WA-LIEE	Washington Low-Income Energy Efficiency
WSEC	Washington State Energy Code
WUTC	Washington Utility and Transportation Commission

Appendix B

Residential Measures - Forecast vs Actuals		Biennium (2024-2025)						2024						2025					
		Measures Installed			Reportable Therms			Measures Installed			Reportable Therms			Measures Installed			Reportable Therms		
Category	Measure	Biennium Budget	Biennium Actuals	Measure Varaince	Biennium Budget	Biennium Actuals	Therm Varaince	2024 Budget	2024 Actuals	Measure Variance	2024 Budget	2024 Actuals	Therm Variance	2025 Budget	2025 Actuals	Measure Variance	2025 Budget	2025 Actuals	Therm Variance
HVAC	Gas Fireplace	96	55	41	1,569	1,143	(426)	58	31	(27)	938	720	(218)	38	24	(14)	631	423	(208)
	Gas Furnace	1,287	1,165	122	144,854	126,891	(17963)	715	565	(150)	80,506	59,432	(21,074)	572	600	28	64,348	67,459	3,112
	HVAC Total	**1,383**	**1,220**	**163**	**146,422**	**128,034**	**(18388)**	**773**	**596**	**(177)**	**81,444**	**60,151**	**(21,293)**	**610**	**624**	**14**	**64,978**	**67,883**	**2,904**
HVAC Controls	Thermostat	608	1,033	(425)	19,305	31,714	12409	268	523	255	8,520	16,461	7,942	340	510	170	10,785	15,253	4,468
	Thermostat Optimization	243	8	235	3,229	5,078	1850	148	4	(144)	2,010	2,576	566	95	4	(91)	1,218	2,502	1,284
	HVAC Controls Total	**851**	**1,041**	**(190)**	**22,534**	**36,793**	**14259**	**416**	**527**	**111**	**10,530**	**19,037**	**8,507**						
New Construction	EPS	-	64	(64)	3,325	1,685	(1640)	-	64	64	3,325	1,685	(1,640)	N/A					
	New Construction Total	**-**	**64**	**(64)**	**3,325**	**1,685**	**(1640)**	**-**	**64**	**64**	**3,325**	**1,685**	**(1,640)**	**435**	**514**	**79**	**12,004**	**17,755**	**5,752**
Water Heating	Tankless Water Heater	47	67	(20)	2,867	4,066	1199	20	26	6	1,220	1,578	358	27	41	14	1,647	2,488	841
	Water Heating Total	**58**	**90**	**(32)**	**3,033**	**4,066**	**1033**	**30**	**49**	**19**	**1,371**	**1,578**	**207**	**28**	**41**	**13**	**1,662**	**2,488**	**826**
Weatherization	Ceiling Insulation	105	129	(24)	12,793	17,294	4501	32	52	20	3,960	7,271	3,311	73	77	4	8,833	10,023	1,190
	Floor Insulation	24	53	(29)	2,127	6,221	4094	8	21	13	713	2,361	1,648	16	32	16	1,414	3,860	2,445
	Wall Insulation	10	22	(12)	627	1,039	412	5	12	7	293	458	165	5	10	5	334	582	248
	Windows	349	177	172	17,129	4,607	(12522)	192	109	(83)	9,423	3,036	(6,387)	157	68	(89)	7,706	1,570	(6,135)
	Weatherization Total	**508**	**401**	**107**	**32,675**	**29,160**	**(3515)**	**247**	**203**	**(44)**	**14,389**	**13,126**	**(1,262)**	**261**	**198**	**(63)**	**18,287**	**16,034**	**(2,253)**
Grand Total		**5,569**	**5,589**	**(20)**	**415,814**	**399,476**	**(16337)**	**2,912**	**2,846**	**(66)**	**221,967**	**191,155**	**(30,810)**	**2,657**	**2,743**	**86**	**193,847**	**208,320**	**14,474**
		Performance to Goal			**96%**			**Performance to Goal**			**86%**			**Performance to Goal**			**107%**		

***Numbers in the table above include Rentals, Savings within Reach & Market Rate. Further breakdown of each category is included below.**

Rentals

Year/Period	Biennium Period	Category	EvaluationCode	Offer Type	Measures Installed	Total Quantity (unit or sqft)	Reportable Therms	Incentive
2024 Actuals	Biennium Actuals	HVAC	GASFURNACE	Rental	42	42	4,647	$67,200
2025 Actuals	Biennium Actuals	HVAC	GASFURNACE	Rental	32	32	3,604	$51,200
2024 Budget	Biennium Budget	HVAC	GASFURNACE	Rental	40	40	4,504	$64,000
2025 Budget	Biennium Budget	HVAC	GASFURNACE	Rental	40	40	4,504	$64,000

Savings Within Reach

Year/Period	Biennium Period	Category	EvaluationCode	Offer Type	Measures Installed	Total Quantity (unit or sqft)	Reportable Therms	Incentive
2024 Actuals	Biennium Actuals	HVAC	GASFURNACE	SWR	19	18	2,027	$21,600
2025 Actuals	Biennium Actuals	Weatherization	CEILINGINSULATE	SWR	22	32,049	2,569	$48,074
2025 Actuals	Biennium Actuals	HVAC	GASFURNACE	SWR	59	59	6,645	$89,200
2025 Budget	Biennium Budget	Weatherization	CEILINGINSULATE	SWR	11	11,800	1,298	$17,700
2025 Budget	Biennium Budget	Weatherization	FLOORINSULATE	SWR	5	5,000	450	$6,250
2025 Budget	Biennium Budget	HVAC	GASFURNACE	SWR	160	160	18,016	$192,000
2025 Budget	Biennium Budget	Weatherization	WALLINSULATE	SWR	2	1,625	130	$3,250

Market Rate

Year/Period	Biennium Period	Category	EvaluationCode	Offer Type	Measures Installed	Total Quantity (unit or sqft)	Reportable Therms	Incentive
2024 Actuals	Biennium Actuals	Weatherization	CEILINGINSULATE	Market Rate	52	80,415	7,271	$100,519
2024 Actuals	Biennium Actuals	Weatherization	FLOORINSULATE	Market Rate	21	26,233	2,361	$32,791
2024 Actuals	Biennium Actuals	HVAC	GASFIRE	Market Rate	31	33	720	$5,550
2024 Actuals	Biennium Actuals	HVAC	GASFURNACE	Market Rate	472	474	52,758	$339,900
2024 Actuals	Biennium Actuals	Water Heating	TANKLESS	Market Rate	26	26	1,578	$10,400
2024 Actuals	Biennium Actuals	Weatherization	WALLINSULATE	Market Rate	12	5,720	458	$7,150
2024 Actuals	Biennium Actuals	Weatherization	WINDOWS	Market Rate	56	7,666	463	$8,999
2024 Actuals	Biennium Actuals	Weatherization	WINDOWS	Market Rate	53	8,741	2,573	$71,558
2025 Actuals	Biennium Actuals	Weatherization	CEILINGINSULATE	Market Rate	55	81,942	7,454	$102,428
2025 Actuals	Biennium Actuals	Weatherization	FLOORINSULATE	Market Rate	32	42,884	3,860	$53,605
2025 Actuals	Biennium Actuals	HVAC	GASFIRE	Market Rate	24	25	423	$4,250
2025 Actuals	Biennium Actuals	HVAC	GASFURNACE	Market Rate	509	508	57,211	$406,250
2025 Actuals	Biennium Actuals	Water Heating	TANKLESS	Market Rate	41	41	2,488	$16,400
2025 Actuals	Biennium Actuals	Weatherization	WALLINSULATE	Market Rate	10	7,270	582	$9,088
2025 Actuals	Biennium Actuals	Weatherization	WINDOWS	Market Rate	37	4,483	250	$4,911
2025 Actuals	Biennium Actuals	Weatherization	WINDOWS	Market Rate	31	4,410	1,321	$32,748
2024 Budget	Biennium Budget	Weatherization	CEILINGINSULATE	Market Rate	27	30,000	3,300	$37,500
2024 Budget	Biennium Budget	Weatherization	FLOORINSULATE	Market Rate	8	7,920	713	$9,900
2024 Budget	Biennium Budget	HVAC	GASFIRE	Market Rate	58	58	938	$9,300
2024 Budget	Biennium Budget	HVAC	GASFURNACE	Market Rate	668	668	75,217	$434,200
2024 Budget	Biennium Budget	Water Heating	TANKLESS	Market Rate	20	20	1,220	$8,000
2024 Budget	Biennium Budget	Weatherization	WALLINSULATE	Market Rate	5	3,660	293	$4,575
2024 Budget	Biennium Budget	Weatherization	WINDOWS	Market Rate	116	15,500	5,810	$257,060
2024 Budget	Biennium Budget	Weatherization	WINDOWS	Market Rate	49	6,500	2,225	$97,695
2024 Budget	Biennium Budget	Weatherization	WINDOWS	Market Rate	27	3,600	1,388	$60,670
2025 Budget	Biennium Budget	Weatherization	CEILINGINSULATE	Market Rate	62	68,500	7,535	$85,625
2025 Budget	Biennium Budget	Weatherization	FLOORINSULATE	Market Rate	11	10,713	964	$13,391
2025 Budget	Biennium Budget	HVAC	GASFIRE	Market Rate	38	38	631	$6,300
2025 Budget	Biennium Budget	HVAC	GASFURNACE	Market Rate	360	360	40,536	$288,000
2025 Budget	Biennium Budget	Water Heating	TANKLESS	Market Rate	27	27	1,647	$10,800
2025 Budget	Biennium Budget	Weatherization	WALLINSULATE	Market Rate	3	2,550	204	$3,188
2025 Budget	Biennium Budget	Weatherization	WINDOWS	Market Rate	93	12,450	4,659	$206,124
2025 Budget	Biennium Budget	Weatherization	WINDOWS	Market Rate	40	5,350	1,798	$78,806
2025 Budget	Biennium Budget	Weatherization	WINDOWS	Market Rate	24	3,240	1,249	$54,603

Appendix B

2024-25 NWN WA Commercial Activity by Track				Biennium (2024-2025)				2024					2025				
Track	Category	Measure	Savings Goal	Biennium Budget	Recognized Savings	Recognized Incentives	Measure Count	Savings Goal	Incentive Budget	Recognized Savings	Recognized Incentives	Measure Count	Savings Goal	Incentive Budget	Recognized Savings	Recognized Incentives	Measure Count
Existing Buildings - Custom			**100,000**	**$337,000**	**37,149**	**$183,575**		**50,000**	**$168,500**	**25,521**	**$112,157**		**50,000**	**$168,500**	**11,628**	**$71,418**	
Existing Buildings - Custom	*HVAC*	*Custom building controls*			*24,158*	*$95,730*	*3*			*12,530*	*$37,590*	*2*			*11,628*	*$58,140*	*1*
Existing Buildings - Custom	*Other*	*Promotion*			-	*$8,277*	*1*			-	*$8,277*	*1*					
Existing Buildings - Custom	*Other*	*Study*			-	*$40,595*	*5*			-	*$27,317*	*4*			-	*$13,278*	*1*
Existing Buildings - Custom	*Process Heating*	*Custom heat recovery*			*12,991*	*$38,973*	*1*			*12,991*	*$38,973*	*1*					
Existing Buildings - Standard			**63,000**	**$211,050**	**166,767**	**$410,130**		**31,500**	**$105,525**	**31,276**	**$202,200**		**31,500**	**$105,525**	**135,491**	**$207,929**	
Existing Buildings - Standard	*Appliance*	*Clothes Dryer*			*3,051*	*$23,200*	*3*			*3,051*	*$23,200*	*3*					
Existing Buildings - Standard	*Appliance*	*Clothes washer*			*93,756*	*$90,000*	*3*								*93,756*	*$90,000*	*3*
Existing Buildings - Standard	*HVAC*	*Boiler*			*9,773*	*$68,309*	*9*			*9,773*	*$68,309*	*9*					
Existing Buildings - Standard	*HVAC*	*Demand Control Ventilation*			*384*	*$519*	*2*			*384*	*$519*	*2*					
Existing Buildings - Standard	*HVAC*	*Gas furnace*			*271*	*$2,129*	*3*			*162*	*$1,634*	*2*			*109*	*$495*	*1*
Existing Buildings - Standard	*HVAC*	*Steam traps*			*26,815*	*$44,450*	*8*								*26,815*	*$44,450*	*8*
Existing Buildings - Standard	*HVAC Controls*	*Thermostat*			*496*	*$8,000*	*2*			*465*	*$7,500*	*1*			*31*	*$500*	*1*
Existing Buildings - Standard	*Other*	*Other measure**			-	*($6,543)*	*4*			-	*($3,256)*	*1*			-	*($3,287)*	*3*
Existing Buildings - Standard	*Refrigeration*	*C&I Refrigeration*			*16,266*	*$100,800*	*1*			*16,266*	*$100,800*	*1*					
Existing Buildings - Standard	*Water Heating*	*Pipe insulation*			*4,786*	*$20,507*	*10*								*4,786*	*$20,507*	*10*
Existing Buildings - Standard	*Water Heating*	*Tanked water heater*			*1,979*	*$6,032*	*9*			*1,174*	*$3,495*	*5*			*805*	*$2,537*	*4*
Existing Buildings - Standard	*Water Heating*	*Tankless water heater*			*171*	*$1,540*	*2*								*171*	*$1,540*	*2*
Existing Buildings - Standard	*Weatherization*	*Ceiling insulation*			*9,019*	*$51,188*	*3*								*9,019*	*$51,188*	*3*
Existing Buildings - Training			**15,930**	**$14,000**	**6,301**	**$4,590**		**7,965**	**$7,000**	**6,301**	**$4,590**		**7,965**	**$7,000**	**-**	**$0**	
Existing Buildings - Training	*O & M*	*Building Operator Certification*			*6,301*	*$5,600*	*4*			*6,301*	*$5,600*	*4*			-	*$0*	*0*
Existing Buildings - Training	*Other*	*Other measure**			-	*($1,010)*	*2*			-	*($1,010)*	*2*					
New Buildings - Standard			**18,000**	**$56,520**	**10,403**	**$36,044**		**6,000**	**$18,840**	**6,583**	**$13,114**		**12,000**	**$37,680**	**3,820**	**$22,930**	
New Buildings - Standard	*Food Service*	*Food equipment*			*655*	*$6,000*	*1*			*655*	*$6,000*	*1*					
New Buildings - Standard	*HVAC*	*Boiler*			*2,790*	*$19,500*	*2*								*2,790*	*$19,500*	*2*
New Buildings - Standard	*HVAC*	*Demand Control Ventilation*			*1,094*	*$1,479*	*2*			*1,094*	*$1,479*	*2*					
New Buildings - Standard	*HVAC*	*Radiant heating*			*3,370*	*$1,438*	*10*			*3,370*	*$1,438*	*10*					
New Buildings - Standard	*Water Heating*	*Tanked water heater*			*2,462*	*$7,348*	*9*			*1,463*	*$4,198*	*6*			*999*	*$3,150*	*3*
New Buildings - Standard	*Water Heating*	*Tankless water heater*			*31*	*$280*	*1*								*31*	*$280*	*1*
Strategic Energy Mgmt			**107,528**	**$280,299**	**116,132**	**$267,293**		**46,083**	**$109,078**	**58,814**	**$111,599**		**61,445**	**$171,221**	**57,318**	**$155,694**	
Strategic Energy Mgmt	*O & M*	*Custom Operations & Maintenance*			*116,132*	*$23,228*	*24*			*58,814*	*$11,764*	*9*			*57,318*	*$11,464*	*15*
Strategic Energy Mgmt	*Other*	*Other fee*			-	*$244,065*	*24*			-	*$99,835*	*12*			-	*$144,230*	*12*
Grand Total			**304,458**	**$898,869**	**673,503**	**$1,803,266**	**148**	**141,548**	**$408,943**	**256,988**	**$ 887,322**	**78**	**162,910**	**$489,926**	**416,515**	**$915,943**	**70**
			Performance to Goal		*111%*	*100%*		*Performance to Goal*		*91%*	*108%*		*Performance to Goal*		*128%*	*93%*	

Appendix C

MEETING SUMMARY	
Topic:	EEAG January Interim Meeting
Date:	January 29, 2024 – 2:00 pm to 3:30 pm
Attendees:	NW Natural: Kellye Dundon, Laney Ralph, Natasha Siores, Rebeca Enriquez, Rebecca Trujillo, Tavia Henley-Storm Clark County WX: Nichole Piesik Energy Project: Shaylee Stokes Energy Trust: Andrew Shepard UTC: Byron Harmon, Emily Gilroy, Joshua Dennis

KEY DISCUSSION ITEMS

1. Welcome/Intros
2. BEE Pilot
3. Upcoming Items
4. Proposed Q1 Agenda
5. Questions/Wrap Up

ACTION ITEMS

Description	Lead	Due Date
Share WA Tariff prior to filing	Laney	2/2/2024

NOTES

Laney presented an update on the Behavioral Energy Efficiency (BEE) Pilot and upcoming changes to the Washington tariff. Andrew gave a brief update on Energy Trust's programs. When asked about Q1 agenda items, Shay expressed wanting to learn more about the low-income program as they're new to the group. Emily expressed wanting to hear more about the BEE evaluation process as it advances. To conclude, Laney let the group know that the tariff filing will happen thirty days after it has been shared with the EEAG and will include the timeline for feedback.

Appendix C

MEETING SUMMARY	
Topic:	EEAG Q1 Meeting
Date:	March 25, 2024 – 1:00 pm to 2:30 pm
Attendees:	NW Natural: Haixiao Huang, Kellye Dundon, Laney Ralph, Matthew Doyle, Natasha Siores, Rebeca Enriquez, Tavia Henley-Storm Clark County WX: Nichole Piesik Energy Project: Shaylee Stokes Energy Trust: Kyle Kent NEEA: Becca Yates, Becky Walker UTC: Joshua Dennis ATG PCU: Corey Dahl Community Action Council of Lewis, Mason, and Thurston: Stephenie Arnold Nathan Krebs

KEY DISCUSSION ITEMS

1. Welcome/Intros
2. NEEA Presentation
3. IRP – Social Cost of Carbon
4. Energy Trust 2023 Results
5. Program Updates
6. Next Steps/Wrap Up

ACTION ITEMS

Description	Lead	Due Date
UTC's question on participation rates and new customer count data on new construction EE program	Andrew	ASAP
Provide breakdown of geographic data for BEE Pilot	Laney	Q2 EEAG Meeting
Provide 2022-2023 EE report for feedback	Laney	May 1, 2024

NOTES

Becca Yates and Becky Walker joined to deliver a NEEA presentation. Becky addressed Matt's query about RBSA data and its usage, mentioning that while there may not be specific trainings, analysts at NEEA can provide one-on-one guidance. Kyle Kent, filling in for Andrew, presented Energy Trust's 2023 annual results. He highlighted the strong performance of the commercial program and the challenges faced in the residential program, such as not being able to provide smart thermostats, though they've become a crucial part of the residential portfolio over last five years. Joshua raised a question about NW Natural's new construction energy efficiency program and what its participation rates are, if the program is still slated to terminate this year (and when), and what the data on new customer counts looks like. Kyle is taking this back to Andrew for follow up. Rebeca reviewed the 2023 numbers and program updates for the WA Low Income Energy Efficiency program, announcing a surpassed goal for weatherization jobs and tune-ups, and that the $4k increase for health and safety measures was approved. Laney provided updates on the BEE Pilot program, mentioning that most people click through for fireplace and furnace rebate offers, driving more people to Energy Trust incentives. Shaylee asked for a breakdown of client characteristics participating in the pilot, to which Laney responded that geographic data could be pulled out, but is not readily available, and that income level data is not being tracked. Laney concluded with the completion of the first biennial period in 2023, and that an energy efficiency report covering 2022 and 2023 will be drafted and out to everyone by May 1 and asking for any feedback by May 31, as the filing date is June 14. A review of this report will be on the agenda for our Q2 meeting.

MEETING SUMMARY	
Topic:	EEAG Q2 Meeting
Date:	May 9, 2024 – 3:00 pm to 4:30 pm
Attendees:	NW Natural: Kellye Dundon, Laney Ralph, Natasha Siores, Rebeca Enriquez, Rebecca Trujillo, Tavia Henley-Storm Energy Project: Shaylee Stokes Energy Trust: Andrew Shepard UTC: Emily Gilroy

KEY DISCUSSION ITEMS

1. Welcome – Check-in
2. Preliminary Draft Overview
3. Portfolio Evaluation
4. Behavioral Pilot Updates
5. Energy Trust Updates
6. Next Steps/Wrap Up

ACTION ITEMS

Description	Lead	Due Date
Biennial EE Report Feedback	EEAG Group	June 1, 2024
Breakdown of geographic data for BEE Pilot	Laney	August 14, 2024 (Q3 Meeting)

NOTES

Laney presented on the 2022-2023 Biennial Energy Efficiency Report, asking if there were any additional items we'd like to see in the biennial report not included in annual reports. We're encouraged to reach out, if so. She gave update on the portfolio evaluation, announcing that Evergreen Economics had been selected as an evaluator. An evaluator for the BEE program is still in process and wrapping up.

Rebeca presented on the low-income evaluation. Shay asked about the deemed measures list and what it would be replacing, and Rebeca explained that the program receives savings through REM reports used by some agencies. Shay then asked if there was a timeline for the contracting process, to which Rebeca answered that the process will begin within the next couple months and be completed late this fall. Emily ask why the low income weatherization program achieved a low percentage compared to the other programs? Because it is such a small program with small projects coming through in a year. In the 2021 CPA, a low-income analysis was done and showed that only 3% of NW Natural customers were low-income. It's been historically hard to reach these customers within a very small section of service territory. Rebeca added that challenges coming out of the pandemic greatly affected the program and that the cross-promotion with the BEE program has been working and they've been receiving a lot more calls about the program. Emily also asked if there had been any plans, developments, or engagements with non-energy impacts with the EEAG, to which Laney answered that though there has not been extensive engagement on non-energy benefits specifically, Energy Trust does include non-energy benefits in their measure analysis, and it is something that will be looked at in the low income evaluation.

Andrew gave Energy Trust updates, expressing that the residential is on track and that Q1 saw good results on the commercial side, largely due to Strategic Energy Management (SEM). SEM is a program offering introduced a couple years ago and is now seeing significant savings come in. On slide 14, Andrew emphasized the table line item 'study', which is representative of energy studies ETO helps to fund for respective clients and NW Natural customers. The study looks to determine what sort of upgrades can be done in the building—what is the cost of doing them, what is the energy savings, and what is the energy bill savings. As more of these will be seen as WA legislature comes into play, this is a line item to pay attention to over the next year or so. When presenting on

the residential income qualified offerings, Emily raised a question about how incentive rates can encourage participation with an eye to how much of an incentive is enough to make customers take action versus being aware of over-incentivizing for a measure. Andrew mentioned that historically, when looking at the Energy Trust program, by and large the market rate incentives cater to households that are making upwards of $100,000/year or more. The programs weren't being utilized by moderate income households. When cost effective screenings are done for measures, ETO defines through that screening what the maximum incentive could be, then figuring out what can be offered below that maximum incentive that can still complete the job. This offering has allowed many Oregon households to make improvements that they otherwise would not have been able to make. Shayl then asked if the state median income in the proposal is to be aligned with Oregon in terms of program design? Has area median income been considered to target the urban versus rural service territory and smaller area in general? Andrew mentioned this being worth exploring and that WA is diverse and that perhaps SW WA isn't reflective of the state as a whole. Shay added that it may make cross referrals from the bill assistance programs for NW Natural's WA customers make a direct connection. Lastly, Andrew touched on the option of increasing ETO's market rate gas furnace incentive to a value of $800 instead of $650, mainly to respond to inflation.

Laney provided updates on the BEE Pilot program and program cross promotion. The geographic display of program participants should be ready to share by the Q3 meeting. Savings projects from Bidgely are still tracking and projecting ahead of what was originally participated. This could be driven by cost increases in WA as well and will be interesting to see how this program performs in the second year of operating.

Laney concluded with an overview of next steps and the proposed Q3 meeting agenda. If there are any requests, please reach out for consideration.

Appendix C

MEETING SUMMARY	
Topic:	EEAG Q3 Meeting
Date:	August 14, 2024 – 1:00 pm to 2:30 pm
Attendees:	NW Natural: Kellye Dundon, Laney Ralph, Natasha Siores, Rebeca Enriquez, Rebecca Trujillo, Tavia Henley-Storm Clark County: Nichole Piesik Energy Project: Shaylee Stokes Energy Trust: Andrew Shepard NWEC: Mike Goetz UTC: Andrew Roberts, Byron Harmon, Emily Gilroy, Joshua Dennis,

KEY DISCUSSION ITEMS

1. Welcome – Check-in
2. Reporting Update
3. Evaluations
4. Program Updates
5. Next Steps/Wrap Up

ACTION ITEMS

Description	Lead	Due Date
Provide link to open recessed meeting	Laney	ASAP
Moderate-income offering: Total project cost averages and how increased incentive has impacted projects.	Andrew	Q4 EEAG Meeting

NOTES

Laney provided a update on the biennial energy efficiency report filed on June 14th. A copy of that filing was sent out, but please reach out if you didn't receive it. Laney highlighted the upcoming Recessed Open meeting on August 22nd at 9am. Mike asked if it's typical for the commission to take a hard look at these filings, to consider what type of feedback might be helpful for them to consider. Laney provided background of both the biennial reports and annual reports—the 2-year cycle is where the most diligence and review happens, whereas the annual reports are updates on progress. With equity, low-income programs, and plans for the pilot programs ongoing, feedback has been collected and heard, and next round there will be an equity specific section to focus on all the different efforts going on and what steps are being taken to address concerns from commissioners. Joshua also added that in addition to offering summaries to commissioners, there is also an opportunity for stakeholders to provide a short presentation to commission during the recess open meeting.

While discussing annual planning, Laney expressed wanting to have draft budgets available for our next EEAG meeting in October. We'll look at where we landed compared to what was filed within our biennial plan and help address any questions or adjust as needed.

Laney then provided updates on all evaluation work. The RFP process for both the evaluator for the BEE Pilot and low-income programs is complete. Once contracting is finalized, the low-income evaluation will begin as soon as possible and the BEE Pilot evaluation will start once a full year of program data has been collected, around mid-November. We hope to wrap up this evaluation around March, so the evaluation findings can be included within our annual report to be filed in June of 2025. Laney also noted that this is different from the evaluation work that Energy Trust conducts on their programs. Joshua if the WALIEE program would be evaluated. Rebeca responded that yes, it would be part of the low-income evaluations, for both Oregon and Washington.

For industrial audit updates, that offering has been winding down over the last year and a half, with six audits performed by Energy350. They conducted onsite assessments, documented all their equipment, and looked for different energy efficiency measure that could be implemented at each of the sites. A final summary report will be shared with the group, aiming for September, which will inform how we plan to move forward with a program. If helpful, Energy350 could be asked to attend the October meeting to answer any questions on the report.

Nichole provided an update on low-income weatherization with Clark County. For the year through November, they'll have 10 full weatherization projects for gas clients and 2 repair-only projects. On average, projects usually range from $14k-$20k. Nichole also shared on a program they're working on for customers with a little higher of an income level. If accepted by council, it will be for 80% AMI households. Referrals will be received as usual through Clark PUD. They will be determining if heating units are accurately heating the client's homes, replacing units older than five years with more energy efficient heating units where appropriate, specifically ductless heat pumps.

Andrew gave Energy Trust updates, noting that their year-to-date savings are higher than typical at mid-year, currently at 108,432 therms, 40% of their total goal. He mentioned it being a slow year for the energy performance score (EPS), and that they're working with builders to get in any remaining homes they've had in their pipeline. Otherwise, they're not offering a new program for new construction. It will be based on the old code and getting homes in through the program that were permitted under that old code. Andrew explained that they run a forecast of their programs every two weeks, and it looks like they're going to meet the annual savings goal for commercial. They'd previously forecasted coming well above their goal, but some larger projects have been shifted to next year. A good driver through their program has been their custom studies, which are performed for bigger commercial projects. The custom studies show customers how much energy and money could be saved through specific energy efficiency measures and the potential incentive available. Through cross-effective metrics, ETO wants to make sure they're maximizing the amount that can be given to the customer, while still making sense for the budgets of both parties. They're finding that they're running up against a space where costs are quite high and they're hearing about these budget concerns from customers. While currently working on their 2025 budgets, there will be an impact related to some of the market tightening up a bit. More will be shared on this at our next meeting. Laney asked, related to the clean buildings program and additional incentives available for early adopters, if that has been a part of the conversations for the custom studies. Andrew stated that there are customers looking to utilize these additional incentives and execute on these projects. He also noted that there are other buildings, because of budgetary reasons, that are not considering these types of projects yet. It's a combination of both these scenarios across the board. He mentioned that on the residential side, they're seeing a bit of retraction in gas furnaces, but nonetheless, gas furnaces are still the largest driver of savings, followed by insulation measures. Because of previous campaigns, smart thermostats are doing well, and they are meeting goals this year as related to the number of thermostats on the market. On a big note, an income-qualified offering launched this month for moderate-income households. These incentives are provided in efforts to drive savings and benefit that housing market demographic. It is a $1200 gas furnace (double the standard) incentive to help lessen the burden of the HVAC replacement. Next year, they'll be expanding the income-qualified offerings to include some of their insulation measures—ceiling, floor, and wall. On a final note, Andrew spoke on their windows incentive. Window measures have been highly dependent on window installers as they were previously the entity informing customers of the incentives available and completing the applications on their behalf. ETO has worked closely with them to make sure they not only know what the incentives are, but that they're available and can show clients how to claim them. Some of their installers have informed them that they do not have the bandwidth or resources to provide that service to customers anymore. They are now developing more materials to bridge

that gap and make the windows measure more friendly, so that customers are still well-served through these programmatic offerings. Laney added that it would be helpful to have an update in 2025 on the learnings from the windows and how ETO has pivoted from that. Shay asked about the moderate-income incentive and if it's a rebate. Andrew explained that it will be provided in a format called instant incentive—the contractor provides the incentive to the customer on the invoice. The invoice is reduced, the contractor floats that incentive, and ETO pays the contractor after the fact. Shay added that it'd be of interest for the group to see figures on total project cost averages and how that incentive has impacted the project. Andrew stated he believes ETO has that information for both Oregon and Washington and will see what he can find. Shay then asked how customers income qualify. Andrew explained it is up to the customer to self-identify through contractors that work within this offering. These contractors need to take additional training and sign a participation agreement in order to provide this incentive. They will provide the customer with the information for the customer to determine if they qualify. Laney added that if we've done any evaluation on the Oregon side for Savings Within Reach, it would be useful for this group to see as it's a new offering in Washington.

Laney concluded with an overview of next steps and the proposed Q4 meeting agenda. If there are any requests, please reach out for consideration.

Appendix C

MEETING SUMMARY	
Topic:	EEAG Q4 Meeting
Date:	October 17, 2024 – 10:30am to 12:00 pm
Attendees:	NW Natural: Kellye Dundon, Laney Ralph, Natasha Siores, Rebeca Enriquez, Rebecca Trujillo, Mary Rudolph-Knobbe Clark County: Nichole Piesik Energy Trust: Andrew Shepard AWEC: Chad Stokes UTC: Andrew Roberts, Byron Harmon, Emily Gilroy, Joshua Dennis,

KEY DISCUSSION ITEMS

1. Welcome – Check-in
2. 2024 Program Update
3. Industrial Audit Report
4. 2025 Budget Review
5. Energy Burden Assessment
6. Upcoming Items

ACTION ITEMS

Description	Lead	Due Date
Send out final Industrial Audit Report	Laney	ASAP
Respond to 2025 availability poll	EEAG	Nov. 15th, 2024

NOTES

2024 Program Updates:

Laney provided an update on the BEE pilot. Savings are still trending above the initial forecast and feedback is still primarily positive. Savings shown are not evaluated; ADM is expected to begin their evaluation in November and there may be a depreciation of the reported savings. Emily asked about the frequency of utility communications as they relate to program opt-outs. Laney explained that enrolled customers receive a monthly email, which is needed to influence behavior for the program. Laney will follow-up with information about frequency of general NW Natural communications and preference options. Joshua asked if the increased savings would impact the program cost. There is not an incentive associated with the program, so increased savings will not increase program costs. Costs are primarily driven by platform fees and mailed paper reports.

Rebeca E. provided an update on the WA-LIEE program. Clark County is on track to meet their goal of 10 homes.

Andrew S. provided an update on the Energy Trust commercial and residential programs. The programs achieved 23% of the annual goal in Q3. Andrew noted the levelized costs/therm in the table are incomplete and do not include all cost data for Q3. Looking at the program forecasts, the commercial program may have a couple of projects that get pushed into 2025. If this happens, the commercial program may fall short of the 2024 goal. Residential program savings may also be a bit short as there has been decreased furnace activity.

Industrial Audit Report:

The industrial audit pilot has concluded. 6 industrial sites participated and a range of measures from O&M to capital intensive projects were identified. The savings versus estimated costs were shown in a graph. This information will be used for formalizing a program in 2025.

2025 Budget and Savings Review

Laney presented the updated 2025 budget as compared to what was filed in the 2024-2025 Biennial Energy Efficiency Plan (BEEP). Not all the budget numbers for each program are final yet. The overall therm goal for 2025 is lower than what was originally filed in the BEEP. NW Natural is still anticipating being able to meet the BEEP goal with extra savings generated by the BEE Pilot to make up for the reduction in savings from the residential and commercial incentive programs.

Energy Burden Assessment

Rebeca E. presented a high-level overview of NW Natural's recently completed Energy Burden Assessment. Information provided included data-sources used, the overview of NW Natural's residential sector, and recommendations from the assessment. Byron asked about the median income, and why it was higher than what is reported by the state. Rebeca E and Natasha helped answer the question by explaining this is specific to NW Natural customers and that third party data used was household specific. Byron asked about the potential for selection bias. It was noted that gas customers are a subset of the populations and that the Oregon numbers also showed a higher level of income for gas customers.

Upcoming Items

Laney gave an overview of upcoming activity. NW Natural is currently conducting a Request for Proposals for the 2025 Conservation Potential Assessment.

NW Natural is looking to schedule the 2025 EEAG meetings. There was interested in continuing to have the interim January meeting to check-in between the quarterly meetings. Laney provided a link to the doodle poll to gauge best days/times to hold the quarterly meetings.

MEETING SUMMARY	
Topic:	EEAG January Interim Meeting
Date:	January 29, 2025 – 2:00 pm to 3:00 pm
Attendees:	NW Natural: Kellye Dundon, Laney Ralph, Rebeca Enriquez, Rebecca Trujillo, Tavia Henley-Storm Clark County WX: Nichole Piesik Energy Project: Shay Stokes UTC: Andrew Roberts, Emily Gilroy, Joshua Dennis

KEY DISCUSSION ITEMS

1. Welcome – Check-in
2. Program Updates
3. 2025 CPA
4. Upcoming Items
5. Wrap Up

ACTION ITEMS

Description	Lead	Due Date
Provide grading criteria percentages breakdown for CPA selection.	Laney	ASAP
Provide any year-over changes and standard incentives breakdown.	Laney	Q1 EEAG Meeting

NOTES

While providing program updates, Rebeca shared that communications will be sent out to check availability for a meeting to go over updates on the low-income program evaluation. This will be separate from the Q1 meeting in March. While providing 2024 program results, Joshua asked about the impact the evaluation would have on the BEE Pilot numbers and if they might come in more aligned. While there may be a slight deration to the numbers, they're not foreseen to decrease drastically. Bidgely has completed an evaluation for a partner in Oregon and aligned well with what was being reported. There's always some interaction with the downstream incentive programs, we want to make sure we're not double counting those savings, Laney added. On the 2025 CPA, Joshua asked if there were any equity considerations during the selection process in choosing the Lighthouse vendor. Laney highlighted that NW Natural's grading criteria has 5 categories, equity being one of those considerations. This percentage breakdown will be provided in the follow up communications. While providing an update on what Clark County WX is expecting this year, Nichole mentioned the uncertainty with federal grants and how to move forward. Nichole will be able to present on how many gas home projects they'll be able to do during the Q1 March meeting. Shay added that this will be a turbulent year in terms of foundational, bedrock programs that may be federally funded. And that it's important now more than ever that we have strong partnerships, engagement, and support from utility partners. Some messaging points will spread confusion and fear into the larger community and it's important to think about how NW Natural's messaging goes out to the customers. There was a suggestion to provide information to customers regarding what information is collected and used. In agreement, Rebeca added that NW Natural is preparing to have information out regarding different resources within, and that we want our customers and partners to know that the levels of funding are not changing and there are resources available to them. Shay asked if there was a breakdown of calendar year incentive adjustments for 2025. Laney will check with ETO to see if they have this breakdown available, believing many items are carrying over from 2024, with the except of the New Homes program. Laney will provide any year-over changes and standard incentives during the Q1 meeting.

Appendix C

MEETING SUMMARY	
Topic:	EEAG Q2 Meeting
Date:	May 13, 2025 – 10:00 am to 11:30 am
Attendees:	NW Natural: Kellye Dundon, Kyle Putnam, Laney Ralph, Natasha Siores, Rebeca Enriquez, Rebecca Trujillo, Tavia Henley-Storm ADM: Chris Johnson Anchor Blue Consulting: Jack Cullen (supporting Lighthouse) Clark County: Nichole Piesik Energy Project: Josh Kirmsse Energy Trust: Andrew Shepard, Kyle Morrill, Kylie Pugh Lighthouse Energy Consulting: Ted Light, Sophia Spencer Nauvoo Solutions: Sophia Spencer (supporting Lighthouse) UTC: Byron Harmon, Jennifer Snyder, Joshua Dennis, Paul Koenig, Wesley Franks

KEY DISCUSSION ITEMS

1. Welcome – Introductions
2. ADM Behavioral Evaluation
3. Lighthouse CPA Presentation
4. Program Updates
5. Upcoming Items

ACTION ITEMS

Description	Lead	Due Date
Share Draft 2024 EE Report	Laney	ASAP

NOTES

Chris Johnson of ADM Associates presented results on the Behavioral Program evaluation. Byron asked if the fuel savings were evenly distributed across all participants, or if they're mostly driven by a small group of high-saving users. Chris explained that while this wasn't analyzed for NW Natural, in similar programs, high-usage customers tend to drive most of the savings. Mid-tier users also contribute, but to a lesser extent, and low-usage customers typically show little statistically significant savings. Byron then asked if there were any lessons on improving outreach or messaging to better engage high-users or boost response from lower-impact participants. Chris added that although ADM did not conduct a process evaluation, past experience shows that accurately personalized messaging is key—the common customer complaint was when the data didn't reflect their actual usage. Laney asked if the attrition rate changes a lot for a second or third year as the program matures. Chris explained attrition should remain steady, as it's mainly due to the natural turnover like move-outs. Barring major economic changes, rates typically stay consistent and rarely exceed 10% annually. Over time, new cohorts can offset shrinkage.

Ted Light of Lighthouse Energy Consulting presented on the 2025 Conservation Potential Assessment. Wesley asked how smart thermostats are reflected in the CPA. Ted explained that to avoid double-counting savings, smart thermostat installations were prioritized where applicable. Behavioral savings were then attributed to homes unlikely to receive a thermostat—like those without gas furnaces but with other gas usage—ensuring distinct savings sources. It was structured this way because thermostat savings are standardized (deemed), whereas behavioral savings are claimed based on billing analysis. Thermostats fall under the HVAC category, which also includes gas furnaces, and weatherization measures.

Andrew gave Energy Trust updates, noting that Q1 started slowly, with many commercial projects wrapping up from the prior year and residential activity dipping during the holidays. Activity picked up in March, reaching 8.5k therms—about 20% of annual goal, above average for Q1.

Rebeca provided low-income updates, sharing that NW Natural will be working with a new community action agency. Northwest Community Action Center will take over low-income weatherization services in Skamania and Klickitat counties. They're currently serving southern Yakima Valley. Discussions have just begun to understand their needs and a plan to co-market resources to eligible customers.

On pilot program updates, Laney shared that Q1 results for the behavioral pilot show NWN is forecasting about 80% of the annual goal. With lower summer gas usage, there may not be any catch up until fall. On industrial development, NW Natural is looking at developing an RFP/RFQ, and details should be ready for review by the next check-in.

For reporting updates, Laney shared the next filing is the CPA, and the annual energy efficiency report would follow in June. A draft will be shared with the group shortly. The 2024 goals have been met and are currently on track to meet the 2024-2025 biennium target.

To conclude, the next EEAG meeting is on August 19. In the meantime, expect draft filings and updates via emails. The Q3 agenda will include program updates, 2026-2027 biennium goal setting using finalized CPA results, and added outreach staff touchpoints in SW Washington, per Andrew. If there are any other topics wanting to be discussed, please reach out to Laney.

MEETING SUMMARY	
Topic:	EEAG Q3 Meeting
Date:	August 19, 2025 – 3:00 pm to 4:30 pm
Attendees:	NW Natural: Kellye Dundon, Laney Ralph, Natasha Siores, Rebeca Enriquez, Rebecca Trujillo, Tavia Henley-Storm Energy Trust: Andrew Shepard, Kylie Pugh Public Counsel: Jean Marie Dreyer The Energy Project: Shaylee Stokes UTC: Andrew Roberts, Byron Harmon, Emily Gilroy, Joshua Dennis

KEY DISCUSSION ITEMS

1. Welcome – Introductions
2. Program Updates
3. Biennial Plan Targets
4. Proposed Plan Updates
5. Upcoming Items

NOTES

Andrew gave Energy Trust updates, noting that they are on track for what they've forecasted for the year thus far. The team had been exploring a measure involving steam traps in laundry facilities. Energy Trust is also focusing on supporting commercial customers comply with the Clean Buildings Performance Standard by helping them better understand their energy use and identify how Energy Trust offers may lower their energy use.

Laney provided BEE Pilot updates, sharing that the savings forecasts are less than the goal in the 2025 Annual EE Plan. It is slightly different from what is in the biennial plan, as the 2025 goal was increased after the first year of program performance. As of now, NWN is forecasting to be a little shy of that 2025 program goal, but overall, still in a good place to meet the biennial target.

Rebeca provided low-income updates, sharing that NW Natural continues outreach efforts in Washington service territory to provide bill discount and weatherization program resources. Also noted is an agreement is being finalized with Northwest Community Action Center, who will be providing services in Klickitat and Skamania counties.

On the industrial program development, Laney shared the focus is custom projects for customers. This is the first incentive offering for these customers as NW Natural's intentionally starting slow to gather insights and understand what works before developing broader.

To conclude, the next EEAG meeting is on October 16. The draft Biennial Energy Efficiency Plan will be shared ahead on the meeting. If there are any other topics wanting to be discussed, please reach out to Laney.

MEETING SUMMARY	
Topic:	EEAG Q4 Meeting
Date:	October 16, 2025 – 1:00 pm to 2:30 pm
Attendees:	NW Natural: Laney Ralph, Rebeca Enriquez, Rebecca Trujillo, Tavia Henley-Storm Energy Project: Shay Stokes Energy Trust: Andrew Shepard AWEC: Elise Koepke UTC: Joshua Dennis

KEY DISCUSSION ITEMS

1. Introductions
2. Program Updates
3. Biennial Plan Overview
4. Upcoming Items

NOTES

Andrew gave Energy Trust updates on both the commercial and residential programs. The commercial program is projecting 197% of its savings goal, nearly double the original forecast, due to strong performance in strategic energy management and steam trap measures in laundry facilities. Standard offerings also contributed significantly. The team continues to build foundational awareness of available programs and incentives for commercial buildings, including outreach to general contractors and new construction projects. Prescriptive measures are offered for new buildings as well. Work is underway to develop the 2026 custom project pipeline, which involves customer meetings, site analysis, planning, budgeting, and implementation.
On the residential side, the program is at 67% of its annual savings goal (62,707 therms out of 93,368) and is expected to meet or exceed the goal by year-end. Efforts include promoting thermostats, weatherization, air purifiers, and online home energy assessments--a tool whereby homeowners can go on the Energy Trust website and assess their home through entering various housing characteristics into the tool and the tool provides some suggestions as to where the homeowner can save energy in their homes. New windows remain a complex but important measure, with support tools in development. Engagement with trade allies (HVAC, window, and insulation contractors) is ongoing to ensure awareness of incentives and proper completion of application paperwork.

Rebeca provided low-income updates, sharing that Clark County completed weatherization and upgrades for 10 homes, including whole-home improvements and furnace/water heating upgrades. Outreach efforts have increased, with collaboration across Bill Discount and IRP teams. The “Get Ready” event attracted approximately 1,200 attendees, distributing weatherization kits and cross-promoting programs. All outreach materials and instructions are translated into English, Spanish, Vietnamese, Russian, and Simplified Chinese. Efforts continue to expand language accessibility, including having coordinators or interpreters available for key languages. The partnership with Northwest Community Action Center for work with Skamania and Klickitat counties is being finalized. Referrals will be informed by energy burden assessments as they have not inherited a waitlist. Sixteen outreach events were attended this year across Washington and Oregon, with positive feedback received. The WALIEE program underwent its first impact and program evaluation in 2024, with another planned for 2027. WALIEE remains flexible to cover funding gaps for NW Natural customers, especially in uncertain times for partners. Continued advocacy for LIHEAP is planned by joining partners for events like LIHEAP Action Day and joining organizations like NEUAC.

Laney provided biennial efficiency pilot updates, sharing that the pilot is on track for 85% of the 2025 goal, with 2024 numbers exceeding targets. Enrollments remain steady. The biennial plan budget is increasing and there

mainly due to the addition of the industrial program. Savings goals are up 24.7% over the previous plan. This is the last reporting cycle for BEE Pilot savings as part of the portfolio total; future savings will be incorporated into baseline usage, as behavioral program savings are not cumulative. A new equity considerations section has been added to the plan, with feedback requested on procedural equity metrics (such as event attendance). Additional materials will be provided as available, and feedback via email is encouraged.

To conclude, the next group meeting will be after the plan filing, unless there is interest in meeting sooner. Historically, feedback has been managed via email. There is a soft deadline of November 5th for plan feedback to allow time for incorporation before filing. Later feedback will be accommodated if possible. On the industrial program, there will be an interim meeting on December 4th to review consultant proposals. This will include a presentation, going over their recommendations for us, and giving the group an opportunity for feedback.

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MEMORANDUM

Date: June 10, 2026

To: Laney Ralph, NW Natural

From: Kevin Price, Evergreen Economics

Re: NW Natural WA Portfolio Evaluation Findings – Final

This memorandum provides an overview of the approach for the NW Natural Washington State Portfolio Evaluation along with the results of the evaluation audit. The evaluation consists of validating savings claims as well as a review of measure-level savings estimates and program evaluations.

The evaluation team identifies areas for future evaluations to build on what was achievable during this evaluation so that future portfolio evaluations can further validate claimed savings.

Savings Validation

Savings Validation Approach Overview

This evaluation included comparing summary and source data files to the 2024-2025 NW Natural Biennial Energy Efficiency Report (*2024-2025 Biennial Report DRAFT*) content.

We started with a comparison of summary data from NW Natural (*2024-2025 Savings Tables.xlsx*) to summary tables in the draft 2024–2025 Biennial Energy Efficiency Report, seeking to identify any internal inconsistencies between the report and the summary data.

We then compared the draft 2024–2025 Biennial Energy Efficiency Report and savings tables against the supporting source data files, including:

- the Energy Trust of Oregon 2024 and 2025 annual reports for Washington and the underlying ETO project-level tracking data (ETO_2024_2025_Project_Data.xlsx);
- the 2025 NEEA Annual Savings Report for NW Natural Gas;
- the Weatherization WA-LIEE participant file (WALIEE_2024_25);
- and the NWN Home Energy Report (BEE) program savings reports for October 2025 and

February 2026.

The next section summarizes our findings. Findings are organized by section of the biennial report: executive summary and portfolio totals (Tables 1–3), 2024 annual results (Table 6), 2025 Energy Trust results (Tables 7–13), WA-LIEE (Table 18), NEEA Market Transformation (Tables 20–21), and the BEE pilot (Table 22).

Savings Validation Findings

As with the prior biennium, most discrepancies are minor arithmetic, rounding, and table-to-table reconciliation issues that do not call into question the overall portfolio impact. However, this round of validation surfaced several issues, most notably:

1. Table 3 (Biennial Expenditures) totals for both 2024 and 2025 do not equal the sum of their column entries;
2. Table 2 (Biennial Savings Results) is internally inconsistent with Table 1 because the 2024 NEEA value has not been refreshed in Table 2;
3. ETO savings figures in the biennial report match the Energy Trust annual reports exactly but cannot be reproduced from the underlying project-level tracking data under any date-filter convention we tested — NW Natural's own reconciliation tab (Sheet4) in the project data workbook documents an 11,181-therm gap between tracking and reports;
4. 2024 BEE expenditures are reported as $324,898 in Table 3 but $345,858 in Table 6.

The remainder of the findings reconcile cleanly to source data.

Executive Summary and Portfolio Totals (Tables 1–3)

Table 1 reports biennial savings of 1,005,374 therms against a 790,042-therm goal (127% achievement) and expenditures of $7,061,756 against a $9,008,576 budget (78%). The biennial expenditure total in Table 1 reconciles to the column sum in Table 3 within $1 (rounding). However, the 2024 and 2025 column totals shown in Table 3 do not match the sums of their underlying line items, as shown in Table 1 of this memo. Table 2 (Biennial Savings Results) is also internally inconsistent: the column sums imply a biennial total of 1,005,717 therms (visible in Table 2 as "1,005,71", apparently truncated), whereas Table 1's biennial figure of 1,005,374 therms reflects the corrected 2024 NEEA value of 25,666 therms (vs. 26,010 still shown in Table 2). The two tables can be reconciled by updating Table 2's 2024 NEEA Market Transformation cell from 26,010 to 25,666 therms (see NEEA section below).

Table 1: Table 3 Column Totals vs. Sum of Line Items

Table 3 Column	Reported Total	Sum of Lines	Difference	Source
2024 Expenditures	$2,922,057	$3,255,255	+$333,198	Biennial Report Table 3
2025 Expenditures	$3,773,377	$3,806,500	+$33,123	Biennial Report Table 3
Biennial Expenditures	$7,061,756	$7,061,755	$1 (rounding)	Biennial Report Table 3
Biennial Budget	$9,008,576	$9,008,576	—	Biennial Report Table 3

The 2024 column total appears to be the largest single arithmetic error in the report and was independently identified in NW Natural's working comments. The variance ($333,198) is equivalent to the BEE ($324,898) and Evaluation ($8,300) Totals lines. The 2025 column total is off by $33,123, which equals the Evaluation line ($33,123). This suggests that lines were omitted from the sum.

2024 Annual Results (Table 6)

Table 6 reports total 2024 savings of 440,856 therms against a 360,518-therm goal (122%) and expenditures of $3,266,610 against a $3,672,964 budget. The savings column ties to its own subtotal but reflects the original (pre-correction) NEEA value of 26,010 therms. With the corrected 25,666 therms (per the 2025 NEEA Annual Savings Report, Summary tab), the 2024 savings subtotal becomes 440,512 therms. Two further issues are worth noting in Table 6:

First, the Pilot & Trial Programs row in Table 6 shows a 2024 budget of $610,669 and 2024 expenditure of $345,858. The 2024 expenditure does not match the 2024 Behavioral Energy Efficiency (BEE) expenditure of $324,898 shown in Table 3 (Biennial Expenditures), a difference of $20,960. The $610,669 budget figure in Table 6 appears to include both the BEE 2024 budget and the $150,000 Industrial Audits budget shown in Table 3, while the expenditure appears to reflect only BEE-related spending. Table 3 does not separately identify a 2024 BEE budget but based on the biennial BEE budget of $753,756 and the 2025 BEE budget of $315,541 shown in Table 22; the implied 2024 BEE budget would be approximately $438,215. NW Natural should reconcile these figures and clarify whether the Pilot & Trial Programs category in Table 6 includes Industrial Audits in budget, expenditure, or both.

Second, Table 6's expenditure column totals reconcile internally to $3,266,610. Based on our review, we believe that the 2024 expenditure total should be $3,276,215, and the 2024 budget total should be $4,343,633; the budget variance is approximately −25%. We confirm that the recalculated variance of −25% is consistent with the narrative statement that 2024 expenditures came in at approximately 75% of budget.

Energy Trust of Oregon Programs (Tables 6–13)

The ETO savings figures in the biennial report (2024: 121,183 commercial / 95,578 residential; 2025: 194,863 commercial / 104,160 residential) match the Energy Trust 2024 and 2025 Annual Reports for Washington. However, neither value can be reproduced from the underlying project-level tracking file (ETO_2024_2025_Project_Data.xlsx) under any reasonable date-filter convention we tested. We tried various combinations of Installation Date, Recognized Date, and Payment Date filters for each program year; none reproduces the reported figures.

The detail is summarized in Table 2 below.

Table 2: ETO Project Data vs. Energy Trust Annual Reports / Biennial Report

Year / Sector	Tracking (IY)	Annual Report	Difference	Notes
2024 Commercial	128,494	121,183	+7,311	Tracking higher
2024 Residential	95,578	95,578	+370	Tracking higher
Total 2024	**224,072**	**216,761**	**+7,681**	
2025 Commercial	209,409	194,863	+14,546	Tracking higher
2025 Residential	105,369	104,160	+1,209	Tracking higher
Total 2025	**314,778**	**299,023**	**+15,755**	
Total biennium	**538,850**	**515,784**	**+23,436**	

Notes: "Tracking (IY)" = sum of Annual.Energy.Savings from ETO_2024_2025_Project_Data.xlsx filtered by Install Year. "Annual Report" = headline figure from the Energy Trust 2024 and 2025 Annual Reports for Washington (matching the biennial report).

2025 incentive amounts tie more cleanly than the savings figures: Table 9 reports $457,971 in commercial incentives vs. $461,488 in the tracking data ($3,517 difference), and Table 13 reports $895,697 in residential incentives vs. $905,343 in the tracking data ($9,646 difference). These small differences are typical of incentive accounting timing.

The NW Natural Biennial Report does not address residential or commercial incentives from Energy Trust, so there is no basis for comparison with the Energy Trust tracking data.

Washington Low-Income Energy Efficiency (Table 18)

WA-LIEE participation, therm savings, and the 2025 expenditure figure tie exactly to the Clark County Weatherization participant file. The 2024 expenditure differs by $619 from the file, and the biennial budget rollup does not reconcile to the sum of the annual budgets.

Table 3: WA-LIEE Validation Against Clark County Weatherization File

Metric	Source File	Biennial Report	Variance	Status
Homes served — 2024	12	12	0	OK
Homes served — 2025	13*	14	0	Investigate
Homes served — biennial	26	26 (goal: 16)	0	OK
Estimated savings 2024 (therms)	712	712	0	OK
Estimated savings 2025 (therms)	1,179	1,179	0	OK
Estimated savings biennial (therms)	1,891	1,891 (goal: 8,680)	0	OK
Total Reimbursement 2024	**$43,411**	**$44,030**	**$619**	**Investigate**
Total Reimbursement 2025	**$77,884**	**$77,884**	**0**	**OK**
Biennial budget	—	$283,885	n/a	See below

*there are 13 unique premise IDs but 14 total records

The $619 difference on the 2024 reimbursement is not explained by the file structure; the workbook's "Total Rebate" row of $43,411.27 matches the sum of the Total Reimb column for individual projects, and HSR ($5,312.78), Admin ($7,318.76), and Inspection ($1,305.03) fees are tracked separately. NW Natural should clarify whether the $44,029.86 in Table 18 includes a partial allocation of one of those categories.

Separately, the biennial budget of $283,885 in Table 18 does not reconcile to the per-year budgets visible elsewhere in the planning documents. Per Table 6, the 2024 WA-LIEE budget was $109,722; per the program-year planning materials, the 2025 budget was $96,200. The sum of the annual budgets ($205,922) is $77,963 below the biennial budget reported in Table 18. This is a material reconciliation gap and either the rollup line or the per-year lines require

correction or a footnote explanation (e.g., if the biennial figure includes administrative or carryover amounts not reflected in the annual budget line items).

We did find that one premise ID was included twice in the 2025 summary file, with one record only containing a minor "HSR" charge of $705.25. While it is possible this was a separate participant at the same premise (i.e., if it was at an apartment building where the building is categorized as a single premise), but more likely it is for the same participant. As a result, the number of homes served in 2025 should be reduced from 14 to 13 unless further evidence is provided (i.e., if they were two separate homes).

NEEA Market Transformation (Tables 20–21)

Table 20 (2025 NEEA Savings) reconciles to the 2025 NEEA Annual Savings Report (Summary tab) line-for-line, as shown in Table 4 below. Table 21 (2025 NEEA Expenditures) reports $241,203 in expenditures against a $241,204 budget; both figures tie to the NEEA report. Importantly, the same NEEA source workbook also contains the updated 2024 figure that supersedes the value still shown in Table 2 of the biennial report: 25,666 therms (vs. the 26,010 therms reported), against the 20,000-therm 2024 goal, for 128% achievement (not the 130% currently shown in Table 6).

Table 4: 2025 NEEA Savings — Biennial Report vs. NEEA Annual Report

NEEA Program	Biennial Report	NEEA Report	Status
Commercial Product Standards	783	782.71	OK
Commercial Codes (New Construction)	1,179	1,179.32	OK
Manufactured Homes Envelope	189	188.94	OK
Pumps — Commercial Water Heating	86	86.35	OK
Pumps — Residential Water Heating	5,785	5,784.93	OK
Total 2025 NEEA Savings (therms)	**8,022**	**8,022.24**	**OK**

One minor editorial item: the WA-LIEE section's final table is Table 18 and the NEEA section's first table is Table 20 – "Table 19" does not exist in the report.

Behavioral Energy Efficiency Pilot (Table 22)

Table 22 reports 2025 BEE savings of 256,637 therms against a 266,327-therm goal (96%) and program expenditures of $274,516 against a $315,541 budget (87%). The arithmetic within

Table 22 is internally consistent. However, we were unable to independently reconcile the 2025 savings figure to the BEE program savings reports provided. The available reports cover program years (PY) running roughly November to October:

Table 5: BEE Pilot Source Data — Program Year vs. Calendar Year

Source	Period Covered	Actual Savings	Status
NWN October 2025 EE Savings Report	PY ending Oct 2025	247,256 therms	Full PY
NWN February 2026 EE Savings Report (YTD)	Nov 2025–Feb 2026	146,387 therms	Partial PY
Biennial Report Table 22	Calendar year 2025	256,637 therms	—

Reconciling Table 22 to the underlying program-year reports requires either a monthly breakdown of BEE savings across calendar 2025 (Jan–Dec) or confirmation from NW Natural that the 256,637-therm figure was prepared on a calendar-year basis from the implementer's monthly tracker. The figures in the program-year reports are directionally consistent with the calendar-year figure but cannot be tied directly. The 2024 BEE savings claim (197,373 therms in Table 2) was previously validated by the ADM Behavioral Energy Efficiency Program Evaluation, which verified the savings reported by the implementation vendor; 2025 BEE savings will require corresponding M&V in the next evaluation cycle.

As noted in the 2024 Annual Results section above, the 2024 BEE expenditure figure also differs between Table 3 ($324,898) and Table 6 ($345,858) — a $20,960 discrepancy that NW Natural should reconcile.

Detailed participant-level data and the underlying figures behind several BEE pilot summary tables — including the BEE Pilot 2025 Online Feedback chart (Figure 1) — were not available in the file set provided to the evaluation team.

Validating Measure-Level Savings

The evaluation intended to validate measure-level savings estimates.

For Energy Trust programs, we found one inconsistency in reported measure-level savings. The measure "RNTWAGFAF" (or "Gas Furnace- WA Rentals") appears to be using the correct incentive level but the savings estimate from the "HEGASFURN95" measure ("Gas Furnace SW WA 95%+ AFUE"). The value we anticipated to see for the measure is 91.81 therms but the measure level tables use 112.6 therms. However, Energy Trust staff clarified that, "MAD ID 23

version 5 is the MAD that was in place from 2024 through 2025. This version has savings for both measures at 112.6 therms per unit using 95%+ as the efficient case." We find that this is reasonable and do not recommend any adjustments.

For the low-income program, information from NW Natural was not granular in terms of the measures provided to customers or the per measure savings assigned to individual projects. As a result, it was not possible to validate project-level savings estimates based on the aggregation of measure-level savings for each project, or that the measure-level savings estimates were properly applied to each project. We advise that more granular information should be made available for subsequent evaluations so that evaluators can review the composition of project-level savings.

It is not possible to evaluate the Bidgely-led Home Energy Report Program for measure-level savings. Ongoing M&V of behavioral programs is required to validate savings estimates. The "EM&V Report: NW Natural Behavioral Energy Efficiency Program" report from ADM covers PY2024 and serves as a good example of the type of validation required for new behavioral programs of this type. The Biennial Report uses the correct 2024 savings value established in the EM&V report.

Evaluation Review

Energy Trust is responsible for 2024-2025 program year program evaluations and finished eight evaluations and research studies in 2024 and 16 studies in 2025 (counts include impact evaluations, process evaluations, pilot evaluations, market research, and surveys). Of these, there were four impact, process or pilot evaluations in 2024 and eight in 2025.

Evaluations released in 2024 included two impact evaluations (Multifamily Weatherization[1] and Residential Heat Pump Water Heater billing analysis[2]), one mid-year impact evaluation

[1] https://www.energytrust.org/wp-content/uploads/2024/07/ETO-MF-Weatherization-Draft-Report_Final_wSR.pdf
[2] https://www.energytrust.org/wp-content/uploads/2024/03/Summary-of-Heat-Pump-Water-Heater-Savings-Results-from-REBA-Tool-Final.pdf

(Residential Ductless Heat Pump billing analysis[3]), one annual economic impacts study,[4] and four pieces of supporting market research and surveys.[5]

Evaluations released in 2025 included impact evaluations of the 2022 and 2023 Production Efficiency programs,[6] the 2023 Existing Buildings program,[7] the 2021-2022 New Buildings program,[8] and the 2019-2023 Smart Thermostat billing analysis,[9] alongside process evaluations of the 2022-2023 Existing Buildings program,[10] the 2023-2024 Production Efficiency program,[11] a combined impact and process evaluation of the Home Energy Report initiative,[12] the Honeywell Smart Thermostat Pilot evaluation,[13] the 2024 Fast Feedback end-of-year survey,[14] and supporting market research on LED grow lights, independent restaurants, indoor agriculture dehumidifiers, greenhouse measures, adjustable wattage fixtures, and the Irrigation Modernization Program market transformation study update.

The cadence of these evaluations has improved meaningfully since the prior biennium. The 2021-2022 New Buildings impact evaluation was released in April 2025, evaluating program years that ended only 2.5 to 3.5 years prior—a sharp contrast to the New Homes evaluation referenced in the 2022-2023 review, which covered program years 2012-2019 and was not released until 2023. Likewise, the 2022 Production Efficiency impact evaluation was posted in January 2025 (covering a program year only two years prior), the 2023 Production Efficiency

[3] https://www.energytrust.org/wp-content/uploads/2024/08/FINAL-REBA-DHP-Report-Memo-with-Output-Summaries.pdf
[4] https://www.energytrust.org/wp-content/uploads/2024/10/ETO-PY2023-Final-04_29_2024.pdf
[5] Includes the Irrigation Measure Market Research Report (09/18/2024), the 2023 Trade Ally Interviews (07/01/2024), the 2023 Fast Feedback Annual Report (06/21/2024), and the 2010-2022 Industrial Plant Closure Study (06/05/2024).
[6] https://www.energytrust.org/wp-content/uploads/2025/01/2022-PE-Impact-Evaluation-Report_Final-wSR.pdf
[7] https://www.energytrust.org/wp-content/uploads/2025/09/Energy-Trust-2023-Existing-Buildings-Impact-Evaluation-Final-Report-with-SR.pdf
[8] https://www.energytrust.org/wp-content/uploads/2025/04/ETO-Impact-Eval-of-NB-Program-2021-2022-final_wSR.pdf
[9] https://www.energytrust.org/wp-content/uploads/2025/11/2019-2023-Smart-Thermostats-Billing-Analysis-Report_wSR-and-Appendix.pdf
[10] https://www.energytrust.org/wp-content/uploads/2025/03/Energy-Trust-2022-23-Existing-Buildings-Program-Process-Evaluation_Final-wSR.pdf
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[12] https://www.energytrust.org/wp-content/uploads/2025/01/ET-HER-Evaluation.pdf
[13] https://www.energytrust.org/wp-content/uploads/2025/09/ETO_Honeywell_Tstat_Final_Report_wSR.pdf
[14] https://www.energytrust.org/wp-content/uploads/2025/05/Energy-Trust-2024-Fast-Feedback-EOY-Report-FINAL.pdf

impact evaluation was posted in November 2025 (also a two-year lag), and the 2023 Existing Buildings impact evaluation was posted in September 2025. The Home Energy Report impact and process evaluation (posted January 2025) addresses an initiative launched in 2020 and covers PY2020 through PY2023. This represents a reasonable lag for a behavioral program that requires multi-year usage data to evaluate. The 2022-2023 Existing Buildings process evaluation, posted March 2025, and the 2023-2024 Production Efficiency process evaluation, posted August 2025, both demonstrate similar timeliness. This faster turnaround is a positive development because it allows program implementers to act on findings before the underlying program design has aged out.

Among the 2024-2025 evaluations, the Multifamily Weatherization evaluation produced findings significant enough to warrant program design attention. The evaluation, which assessed installations from 2016-2021, found a realization rate of approximately 10 percent for window upgrades in gas-heated buildings. The evaluators noted that the window upgrade ex ante savings were measured against market baselines while the evaluation estimated savings against existing conditions. Even with that caveat, the window upgrade results are statistically below ex ante values and merit either a measure-level adjustment, a baseline reconsideration, or a discontinuation analysis. A realization rate of roughly 10 percent is low enough that the program should evaluate whether the measure can remain cost-effective under evaluated savings, particularly given the long measure life and substantial incremental cost of window installations.

In summary, Energy Trust's 2024-2025 evaluation portfolio shows meaningful improvement on the timing concerns raised for the 2022-2023 cycle, while the Multifamily Weatherization findings on window upgrades surface a low-realization measure category that warrants scrutiny.

MEMO

Date: November 3, 2025
To: Energy Trust Board of Directors
From: Leila Shokat – Evaluation Project Manager
Giang Proepper – Data Analyst, Planning & Evaluation
Marshall Johnson – Senior Program Manager, Residential

Subject: Billing Analysis of Residential Smart Thermostats, 2019-2023

Executive Summary

Energy Trust analyzed the energy impacts of smart thermostats installed in both natural gas and electric-heated homes in Oregon from 2019 to 2023. This analysis used Energy Trust's in-house Residential Energy Billing Analysis tool (REBA). This tool estimates whole-home natural gas and electricity savings based on normalized monthly utility billing data.

Smart thermostats allow users to program heating and cooling schedules and optimize them based on user behavior and environmental conditions. Energy Trust's Residential program also requires incentivized smart thermostats to have occupancy detection capabilities. Energy Trust maintains a qualified product list of models that meet these criteria, with the most popular brands being ecobee and Google Nest.[1]

Energy Trust incentivizes smart thermostats through two primary channels: directly installed by a contractor or field technician ("contractor install"), and self-installed by customers ("self-install"). These smart thermostats are installed in homes with gas furnaces, electric forced air furnaces and heat pump systems to save natural gas and electricity.

The analysis found consistent and statistically significant savings for natural gas heated homes that installed smart thermostats. From 2022 to 2023, self-installed thermostats in natural gas heated homes saved an average of 22 therms (±4 therms) annually, which represents a realization rate of 56% (n = 13,762). These savings were consistent across heating zones and thermostat manufacturers (Nest and ecobee).

The analysis did not find consistent or statistically significant electricity savings from smart thermostats installed in electric heated homes. We analyzed savings over time, different heating systems (electric furnace or heat pump), heating zones and manufacturers and did not observe significant savings for any conditions. Our analysis indicates that smart thermostats did not lead to reliable electricity savings in electric heated homes.

[1] Energy Trusty Qualifying Smart Thermostat Models

Overall, the report supports continued investment in smart thermostats for homes heated with natural gas, where therm savings are reliable and consistent. The program will continue to support do-it-yourself (DIY), program and/or contractor installed smart thermostats for natural gas heated homes, and the savings estimates presented in this report will be an input into the program's measure update. On the electric side, evaluators and program staff agree that these results indicate that smart thermostats do not reliably lead to kilowatt hour savings in electric heated homes in Oregon. The program plans to stop providing incentives or promoting smart thermostats in electric heated homes for this reason.

The program will maintain a focus on ensuring efficient control of auxiliary strip heat and operation of heat pumps and will work to ensure that heat pump systems are installed and configured to operate efficiently in customer homes. Controlling heat pump systems remains important for their efficient operation, and the program will continue to prioritize this work to ensure that customers can realize the full savings potential of their heat pump systems.

Further investigation into smart thermostat savings in electric-heated homes should explore the impacts of cooling adoption in the Northwest, particular features that might improve savings and energy behaviors associated with smart thermostat adoption.

Table 1. Savings from smart thermostats installed in natural gas and electric heated homes[2]

Fuel	Analysis Group	Sample N	Annual Baseline Usage[3]	Average Estimated Savings[4]	RR[5]	% Savings[6]	Reliability Rating[7]
Natural gas	**Self-installed smart thermostat, 2022-2023**	13,762	698 therms	22 therms	56%	3%	**Moderate**
	Self-installed smart thermostat, heating zone 1, site-built homes, 2022-2023	12,109	685 therms	22 therms	56%	3%	**Moderate**
	Contractor installed smart thermostat, 2022-2023	237	716 therms	34 therms[8]	87%	5%	**Very Low**
Electricity	**Self-installed smart thermostat, 2020-2023**	2,990	14,178 kWh	-173 kWh	--	-1%	**Very Low**

[2] Analysis files for these four analysis results are included as an appendix at the end of this report.
[3] Mean weather normalized annual energy usage in kWh or therms during the baseline period
[4] Estimated weather normalized annual electricity savings in kWh or therms. Positive number indicates energy saved, negative indicates an increase in energy usage.
[5] Realization rate. The estimated energy savings expressed as a percentage of the claimed savings.
[6] Energy savings as a percentage of average baseline annual usage.
[7] Reliability rating of savings estimates, based on relative precision and sample size.
[8] This estimate is not significantly different from the savings for self-installed smart thermostats.

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Introduction

Energy Trust developed a Residential Energy Billing Analysis (REBA) tool to evaluate energy savings from efficiency measures it funds in residential buildings. This report summarizes the results of the REBA tool analysis of savings from smart thermostat installations in gas and electric heated homes in Oregon.

Smart thermostats allow users to program heating and cooling schedules and use occupancy sensing to optimize heating and cooling. Smart thermostats have been a key component of residential energy efficiency strategies. Energy Trust incentivizes smart thermostats through two primary channels: directly installed by a contractor or field technician ("contractor install"), and self-installed by customers ("self-install"). The install rate of the program's self-installed smart thermostats has been consistently high: 89% in 2021, 95% in 2022, and 98% in 2023, according to Energy Trust surveys. Both self-install and contractor install mechanisms contribute to Energy Trust's broader strategy to promote energy-efficient technologies across diverse customer segments.

Energy Trust recently evaluated smart thermostat savings in a 2020 billing analysis conducted by Recurve, analyzing measures installed between 2015 and 2017.[8] The present study focuses on installations from 2017 through 2023, with particular emphasis on more recent years. In this period Energy Trust claimed a variety of savings values per smart thermostat based on the installation type (contractor install or self-install) and heating system type.[9] Average expected, or claimed, savings values are noted throughout this report for each analysis, and may vary slightly due to measure updates from year to year.

In this analysis, we apply two methods of comparison group construction, described in detail in the Methods section. We aim to provide a comprehensive understanding of the overall energy impacts associated with Energy Trust's smart thermostat offers. We also analyze differences in energy impacts between contractor install and self-install, as well as differences by thermostat manufacturer and heating zone where possible.

Methodology

The REBA tool establishes energy savings using monthly energy usage data from utility bills to conduct pre-post analysis of whole home energy usage. The REBA tool relies on monthly utility billing data and applies weather normalization using site-level regression models and Typical Meteorological Year (TMY) data,[10] following approaches similar to those established by CalTRACK.[11] This normalization ensures that seasonal and climate-related variations are accounted for, allowing for a more accurate comparison of energy usage before and after installation.

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[8] Summary of Recurve Residential Smart Thermostat Impact Analysis

[9] Energy Trust does not claim different savings by heating zone or home type (site built or manufactured) but rather uses a weighted average value for these factors.

[10] TMYx data files are typical meteorological data derived from hourly weather data through 2021 from NOAA's Integrated Surface Database using the TMY/ISO 15927-4:2005 methodologies. https://climate.onebuilding.org/

[11] CalTRACK methods describe a process of arriving at a calculation of avoided energy use related to the implementation of one or more energy efficiency measures, such as an energy efficiency retrofit, using monthly billing data, as well as interval data from smart meters. https://www.caltrack.org/

This study employs two versions of the REBA tool, with distinct methods for comparison site selection:

- **Non-participant method:** This approach selects comparison sites from homes that did not install a smart thermostat through Energy Trust within the treatment or analysis period. Comparison homes are matched with treatment homes within the same census tract based on similarity of pre-installation energy usage patterns.
- **Future participant method:** This approach identifies comparison homes from a pool of participants who installed a smart thermostat after the treatment group and analysis period. The analysis period is defined as the calendar year before and calendar year after a site installed a smart thermostat. In addition to matching based on similarity of pre-installation energy use patterns, this method can improve the match between treatment and comparison sites by partly controlling for self-selection bias. This method matches comparison homes to treatment homes within the same heating zone.

For both natural gas and electric savings analyses, we begin with a comparison of these two methods. Outside of those direct comparisons of the methods, we rely on the non-participant comparison group analysis method. We chose to primarily use the non-participant comparison group analysis method for two reasons.

First, we did not observe meaningful differences between the results from the non-participant and the future-participant comparison group methods. Bigger differences in the results between these methods would indicate that there is stronger self-selection bias that the non-participant comparison group is unable to control for. Were that the case, we would consider relying more on the future participant comparison group method. In the present analysis, we did not observe meaningful differences.

Second, we did observe some difference, though not quite significant, between installations in 2020-2021 and 2022-2023, particularly for natural gas savings. The non-participant comparison group method allows us to analyze more recent installation years than the future participant method. Given the changes that may have occurred from 2020-2021 to 2022-2023 in home occupancy behavior due to the Covid pandemic, we felt it was particularly important to focus on recent years where possible, and the non-participant comparison group method allows us to do so.[12] The two methods are explained in further detail below.

Non-participant Comparison Method

Treated homes—those that received smart thermostats—are compared to a matched comparison group of untreated homes—those that did not receive any Energy Trust-funded efficiency measures during the analysis period. Each treated home is matched with between one and ten comparison homes using a nearest-neighbor algorithm based on baseline energy

[12] Our electric analysis focuses on a larger year range of 2020-2023, in order to achieve a larger treatment group size.

usage and geographic location.[13] To make sure the comparison group is a good match, we check whether its energy use before installation is similar to the treatment groups.

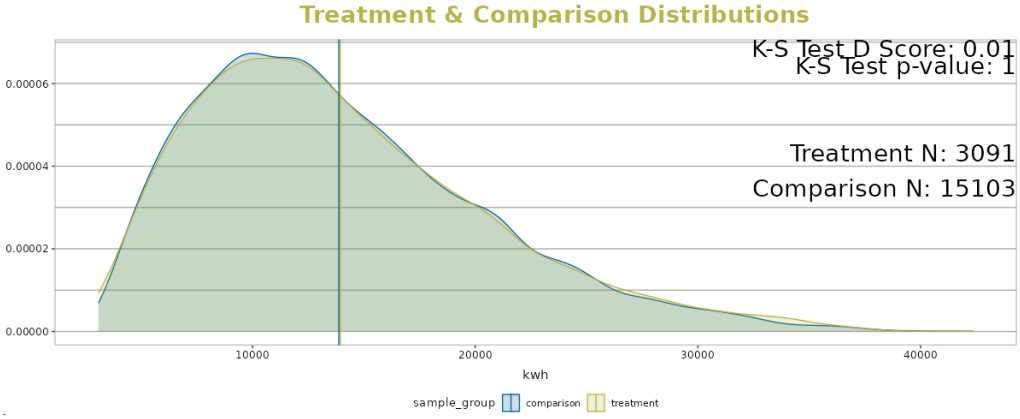


Figure 1. Example distribution of treatment and comparison group baseline annual electricity consumption

For both treated and comparison homes, normalized annual energy usage is calculated for the year prior to installation (pre-treatment) and the year following installation (post-treatment). The difference between these two periods determines the change in energy usage.

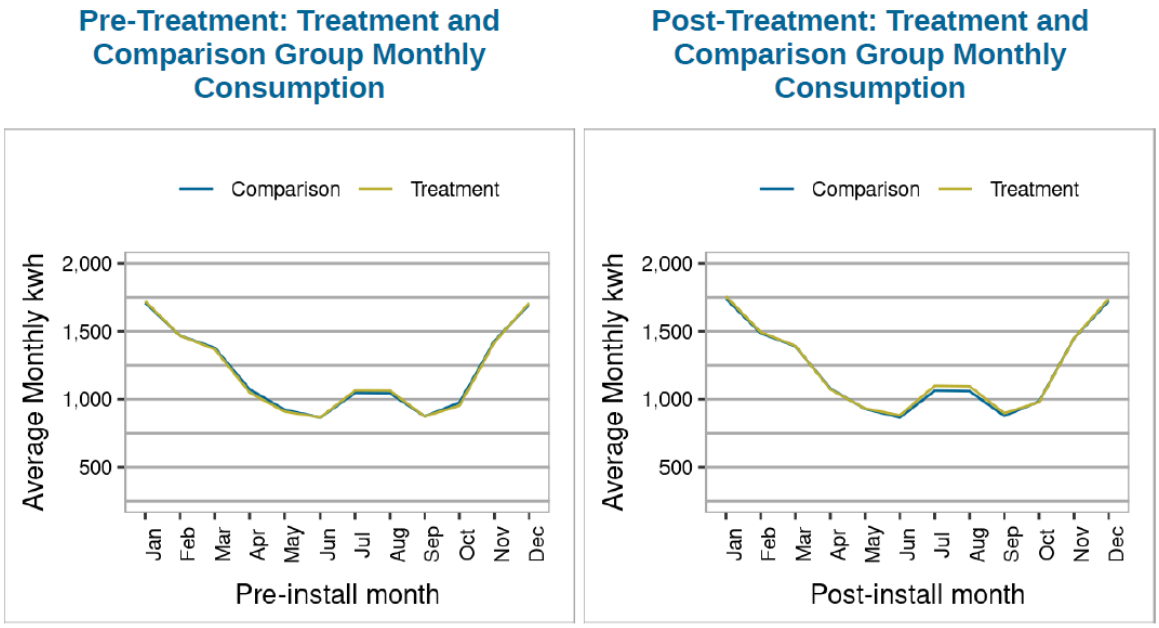


Figure 2. Example of treatment and comparison group average monthly usage for pre and post period

Energy savings are then estimated using a difference-in-differences approach, comparing the average change in energy usage between treated and comparison groups to isolate the impact

[13] Analysts select the number of comparison sites to match per treatment home, depending on the availability of quality matches in the comparison home pool. Each treatment home gets the same number of comparison homes.

of the smart thermostat. Figure 3 shows the distribution of post-install consumption changes for the treatment and comparison groups, using Difference in Normalized Annual Consumption (DNAC). DNAC measures a customer's annual energy usage change before and after an intervention, in this case installing a smart thermostat, while adjusting for external factors like weather and seasonal variation. This normalization ensures that observed changes in energy use are more likely to reflect behavioral or program-driven effects, rather than environmental fluctuations.

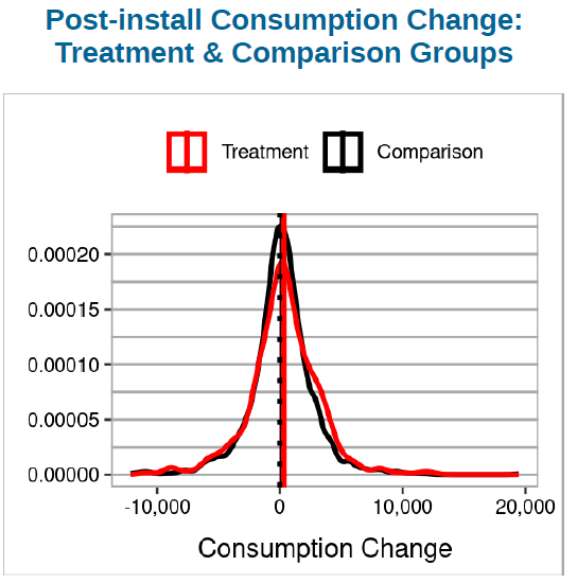


Figure 3. Example of treatment and comparison group DNAC distribution

The treatment group (shown in red) and the comparison group (shown in black) both exhibit distributions centered near zero, indicating that most customers experienced minimal or no changes in normalized consumption.

Our billing analysis excludes homes with missing or incomplete billing data, outliers, inconsistent occupancy, or unusual usage patterns. These data screens are applied consistently across treatment and comparison groups to maintain analytical rigor. Below are the details of factors that would lead to a site being excluded from sample selection:

- Utility billing data not found for the site.
- Less than 9 months of valid billing data available for either baseline or post-install year.
- Weather normalization process failed for either baseline or post-install year.
- Baseline electric or natural gas[14] usage in the top or bottom 1 percent of treated sites.
- Post-install annual electric or natural gas usage is more than double or less than half of baseline year.

[14] These are applied to the fuel being analyzed: for analysis of natural gas savings, sites with natural gas usage in the top or bottom 1 percent of treated sites are removed, for example. The same applies for other fuel-specific criteria in this list.

- Weather regression model has R-squared value less than analyst-defined threshold, typically <0.75, for either baseline or post-install year.
- Other measures installed during analysis period with aggregate deemed electricity savings >0 kWh or natural gas savings >0 therms per year.

This non-participant comparison method has a few limitations. The nearest-neighbor matching process may not perfectly control all differences between treated and comparison homes, including factors like occupant behavior, thermostat settings, or home size. In addition, comparison homes may adopt similar energy-saving behaviors or technologies outside of Energy Trust programs, which could reduce the observed difference in energy usage between groups.

Future Participant Comparison Method

In the future participant comparison group construction, the tool selects homes that did not receive a smart thermostat from Energy Trust during the analysis period, but that did receive a smart thermostat from Energy Trust after the analysis period. These are referred to as "future participants." This method helps to reduce self-selection bias from the non-participant comparison method.

This comparison group selection process begins by identifying a pool of potential comparison homes that have received an Energy Trust-funded smart thermostat after the analysis window. The tool then uses the same nearest-neighbor matching algorithm to pair each treated home with comparison homes that exhibited similar monthly electric usage profiles during the baseline year. This method matches homes within the same heating zone[15] to allow for a larger pool of available comparison sites per treatment site while controlling regional weather effects.

Similar to the non-participant approach, the future participant tool matches each treated home with between one and ten comparison homes (with the precise number of matches defined by the analyst) to increase statistical power and reduce the influence of outliers. The same weather normalization and pre- / post-analysis procedures are applied to both groups to ensure consistency. The future participant method uses the same site attrition criteria listed above for the non-participant comparison method.

Using future participants for the comparison group helps isolate the impact of smart thermostat installations by mitigating self-selection effects on the analysis. Self-selection bias refers to the idea that participants who choose to install a particular measure may also choose other behaviors that non-participants are less likely to engage in; this effect can skew results.

One key limitation of using future participants as a comparison group is that it requires a stable, long-running program with sufficient historical data. Without a consistent stream of participants over time, and relatively stable program design, future participants may not offer the best comparison group for past participants. Additionally, sample sizes may be limited, especially when adding new products or delivery channels, which can reduce the statistical power of the

[15] Heating zones are geographic classifications established by the Regional Technical Forum, based on the typical number of heating degree-days experienced during winter. Zone 1 includes regions with milder winters, such as Western Oregon, while Zones 2 and 3 cover colder areas like the mountains and Central or Eastern Oregon.

analysis and make it harder to detect meaningful energy savings. These constraints can impact on the reliability and generalizability of the findings.

Data

The analysis estimates whole-home energy savings by combining utility billing data, weather data, and project tracking information. These data sources are detailed below.

Utility Billing Data

The core of the billing analysis is monthly utility usage data, which provides a continuous record of energy consumption for both treated and comparison homes. This data is obtained directly from Energy Trust's partners for electric and gas utilities through data-sharing agreements. For each site, the tool requires at least 12 months of usage data prior to the installation of the smart thermostat (baseline period) and 12 months following installation (post-installation period). The data includes: monthly energy usage (kWh or therms), billing period start and end dates, and meter read types (actual vs. estimated). This information allows REBA to calculate normalized annual energy usage and detect changes in consumption patterns over time. Homes with incomplete, estimated, or irregular billing records are excluded from the analysis to maintain data integrity.

Weather Data

To account for the influence of weather on energy consumption, particularly for heating and cooling loads, REBA incorporates site-level weather normalization. This applied the Typical Meteorological Year (TMY) data: a standardized dataset representing average weather conditions for a given location, compiled from historical weather records.

Site-level regression models relate each home's energy usage to local temperature data, such as heating and cooling degree days. This allows the tool to adjust energy usage to reflect typical weather conditions. The normalization process ensures that observed changes in energy usage are due to the installed measure rather than seasonal or year-to-year weather variability.

Project Tracking Data

Data from Energy Trust's Project Tracking system offers a record of installation dates, product types, and attributes such as direct install, contractor install, or self-installed thermostats for gas- or electric-heated homes. Project Tracking data is also used to screen out homes that participated in other Energy Trust incentive offers during the analysis period. These integrated data sources enable REBA to produce accurate, weather-adjusted energy savings estimates across diverse participant groups.

Results

We present analysis results first for natural gas savings, and then for electric savings. A detailed table of all analysis results presented in this report is included as an Appendix, as are REBA tool analysis summary reports for key analyses for natural gas and electric savings.

Note that the annual expected savings[16] may differ for each analysis, even within the same study period and measure type, as these values are the average of the expected savings for all measures included in the treatment group. The different annual expected savings throughout

[16] Throughout this report, "expected savings" refers to the weighted average claimed savings for all treatment sites in the billing analysis.

the report result from small changes in the treatment group composition from analysis to analysis.

Gas Savings for Smart Thermostats

Analysis method comparison

Energy Trust developed the future participant comparison group tool in part to understand the potential magnitude of self-selection bias effects on our billing analysis results, and to mitigate these effects where possible. Figure 4 below presents results comparing the two billing analysis methods for self-installed smart thermostats in 2021. 2021 was the last install year available to analyze with the future participant comparison group method.

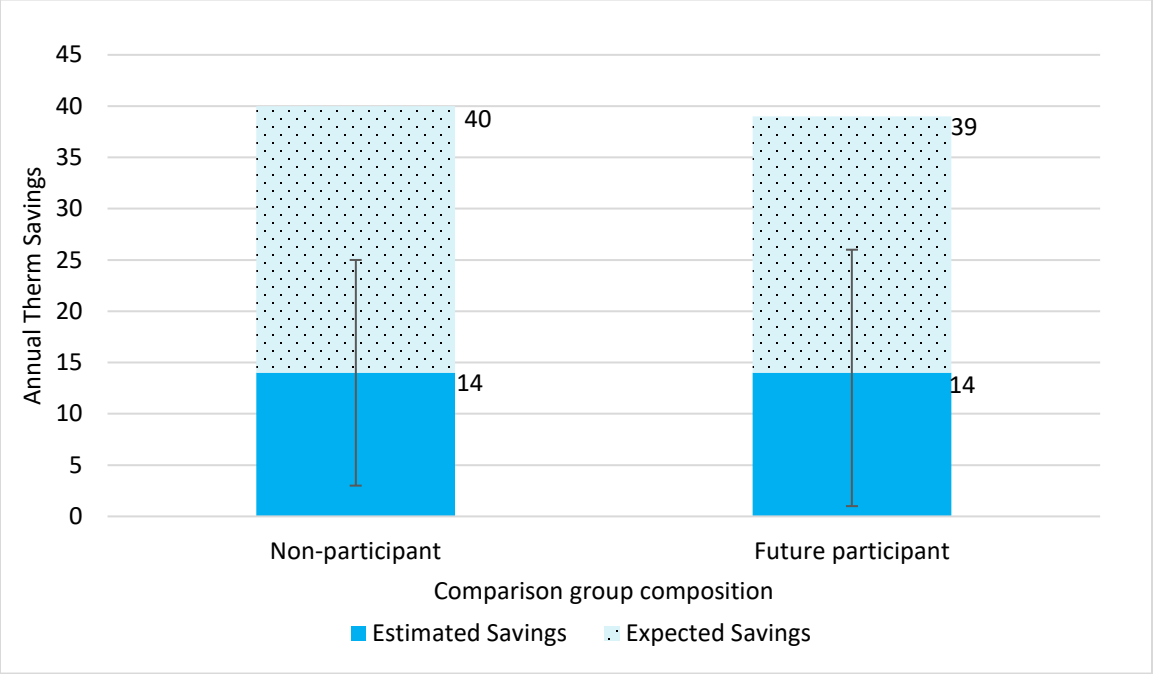


Figure 4. Natural gas savings for self-installed smart thermostats by comparison group methodology, 2021 installs

The non-participant comparison group analysis showed an evaluated savings of 14 therms per year (± 7 therms), with an expected savings of 40 therms (n=3,566). The future participant comparison group analysis showed an evaluated savings of 14 therms per year (± 8 therms), with an expected savings of 39 therms (n=3,223). These results are very similar, with large sample sizes for both analyses.

A similar comparison of methods was performed for contractor-installed smart thermostats installed from 2019 through 2021. A larger year range was used to have a larger number of treatment sites for the analysis, due to fewer customers participating through the contractor install delivery channel.

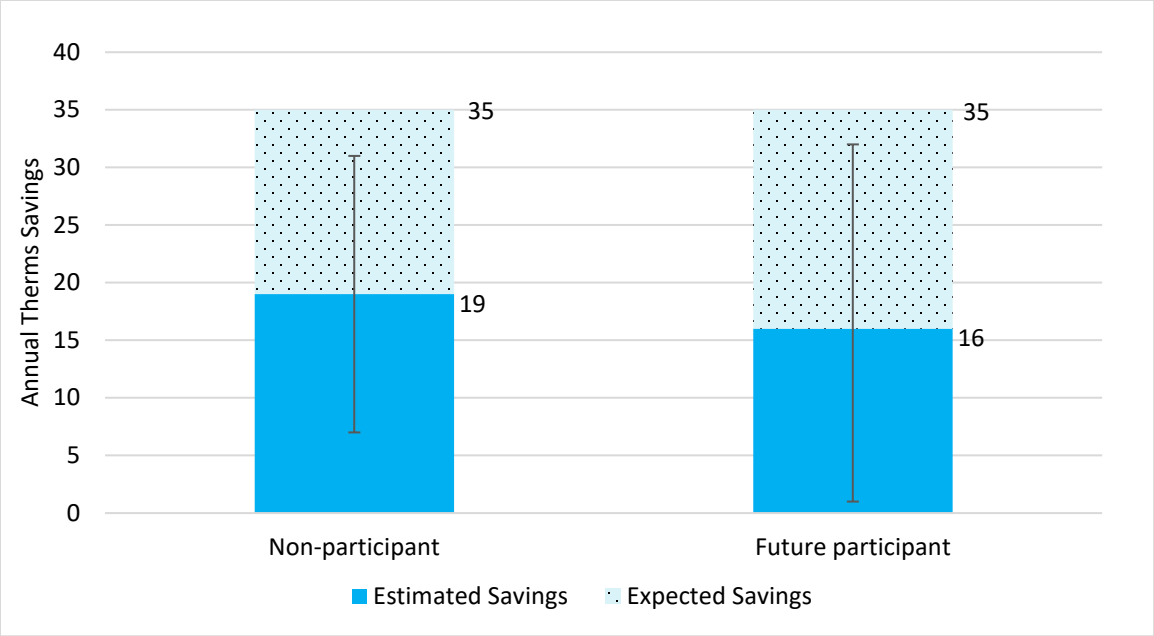


Figure 5. Natural gas savings for contractor-installed smart thermostats by comparison group methodology, 2019-2021 installs.[17]

Figure 5 again shows that the results from our analysis with the non-participant and future participant comparison group methods were very similar. The non-participant comparison group analysis showed average estimated savings of 19 therms per year (± 8 therms), compared to an expected savings of 35 therms (n = 3,021). The future participant comparison group method showed average estimated savings of 16 therms per year (± 9 therms), compared to expected savings of 35 therms (n = 2,962).

There were minimal differences in the evaluated savings between the analysis methods, for both self-installed and contractor-installed smart thermostats. For the remainder of the natural gas results section, we focus on results analyzed with the non-participant comparison group tool, as it allows us to analyze more recent installations.

Savings by delivery method, 2022-2023

We analyzed natural gas savings from smart thermostats in gas heated homes between the program's main methods of delivering these products: self-installed and contractor-installed. This analysis sought to understand if there are meaningful differences in savings when a customer installed their own smart thermostat, compared to when a contractor or other program representative installed it for them. Figure 6 shows these results.

[17] We included installs from 2019 through 2021 to achieve a larger treatment group, to better compare the results from these two comparison group methods.

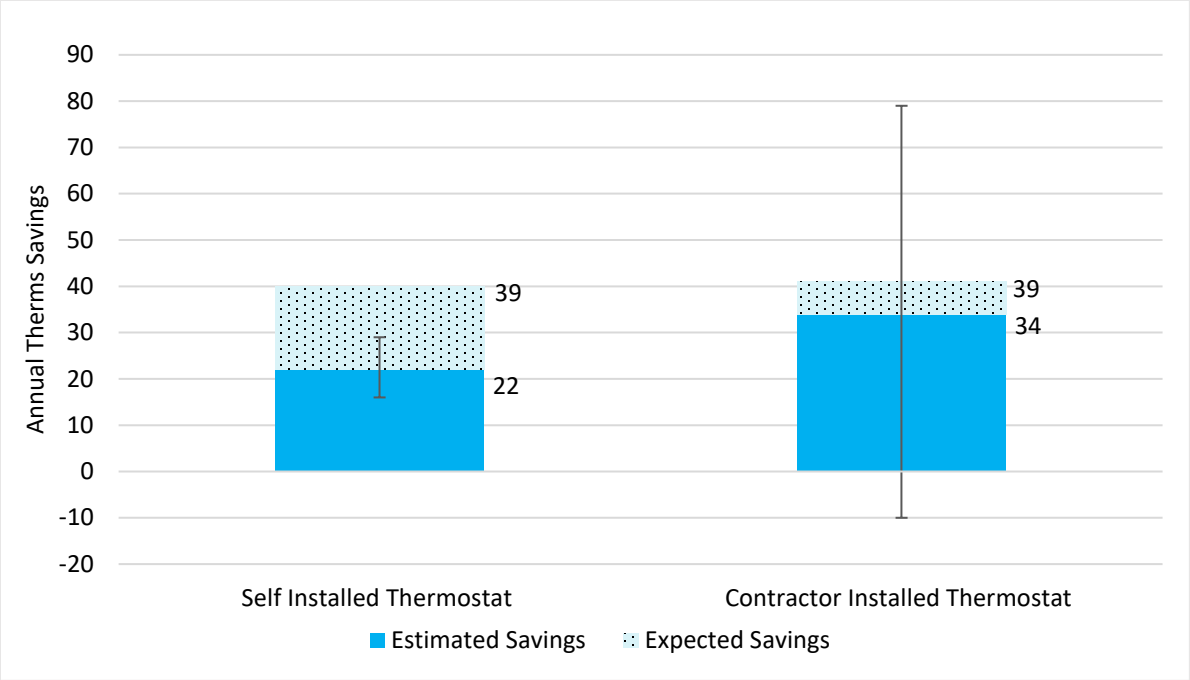


Figure 6. Natural gas savings for smart thermostats by delivery channel, 2022-2023 installs

There were very few smart thermostats delivered through the contractor-installed delivery channel during this period (n = 237), and as such we were not able to make any conclusions about significant differences in savings between self-installed and contractor-installed smart thermostats.

Savings over time, 2019-2023

We analyzed self-installed smart thermostat savings by installation year over time, from 2020 to 2023, to observe whether savings appear to have changed over time. The results of this analysis are shown in Figure 7 below.

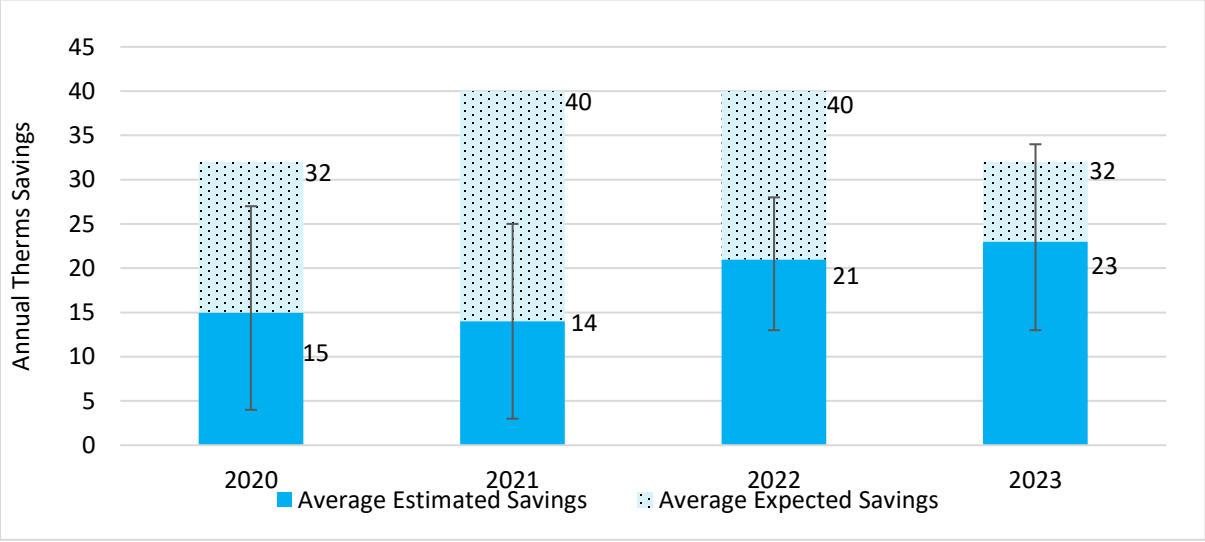


Figure 7. Natural gas savings from self-installed smart thermostats over time, 2020-2023 installs

Households that received smart thermostat incentives from Energy Trust show average annual energy savings from smart thermostats of 15 therms (± 7 therms) in 2020 (n = 2,787), compared to 23 therms (± 7 therms) in 2023 (n= 3,977). While there is a difference between these point estimates, the estimated savings in 2023 are not significantly different from any other past year. This overall trend shows consistent savings from smart thermostats in gas heated homes, though the estimated savings are lower than the expected savings. In 2020-2022, average estimated savings were significantly lower than the expected savings value, whereas in 2023 the estimated savings are not significantly different from the expected savings.

We also analyzed savings from contractor installed smart thermostats over time. Smaller sample sizes limited our ability to compare year-over-year. Instead, we analyzed 2019-2021 installs, compared to 2022-2023 installs. This analysis is presented below in Figure 8.

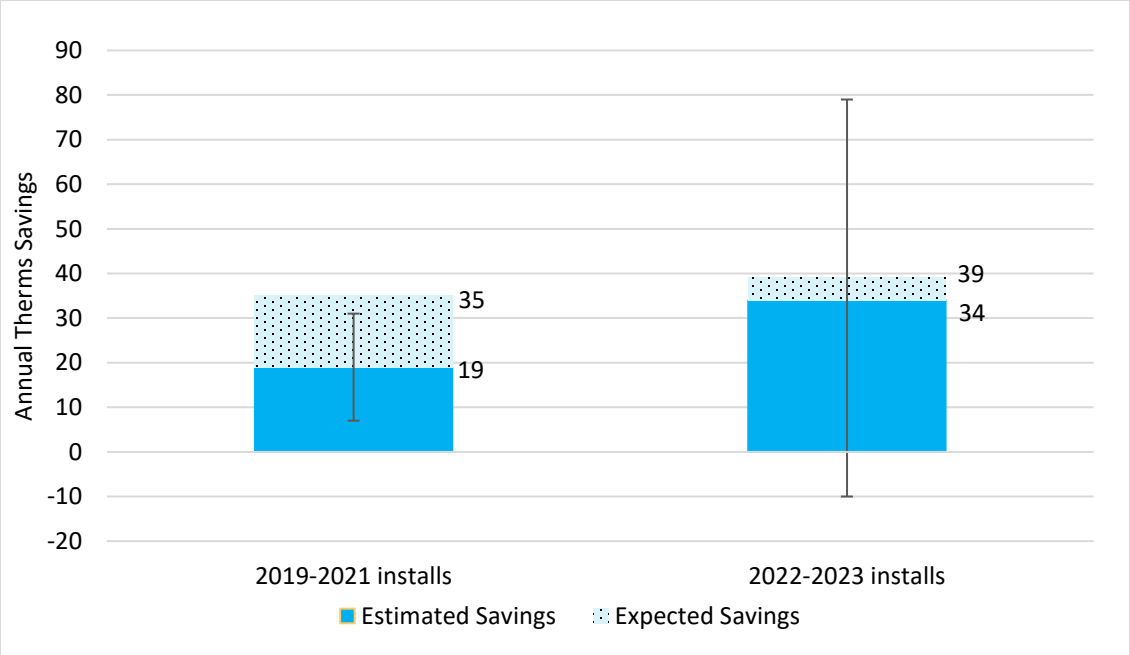


Figure 8. Natural gas savings from contractor installed smart thermostats over time, 2019-2023 installs

While there appears to be a similar trend of slightly higher savings in more recent years, these results are not significantly different from one another. Households that received contractor installed smart thermostats from 2019-2021 showed average annual savings of 19 therms (± 12 therms, n = 3,021), while the 2022-2023 analysis did not yield reliable results, as shown above by the large confidence interval.

Savings by heating zone, 2022-2023

We analyzed smart thermostat natural gas savings by heating zone. Energy Trust does not claim different savings for smart thermostats by heating zone, however it is beneficial to understand whether there are observable differences in the achieved savings from smart thermostats in homes by heating zone. Most Energy Trust participants fall within heating zone 1, encompassing the Willamette Valley and coastal regions of western Oregon, characterized by moderate winter temperatures. Heating zones 2 and 3 cover Central, Eastern, and Southern Oregon, where winters are more severe and heating demands are higher.

Annual natural gas savings for self-installed smart thermostats were evaluated across heating zones for the 2022-2023 period. These results are shown in Figure 9 below.

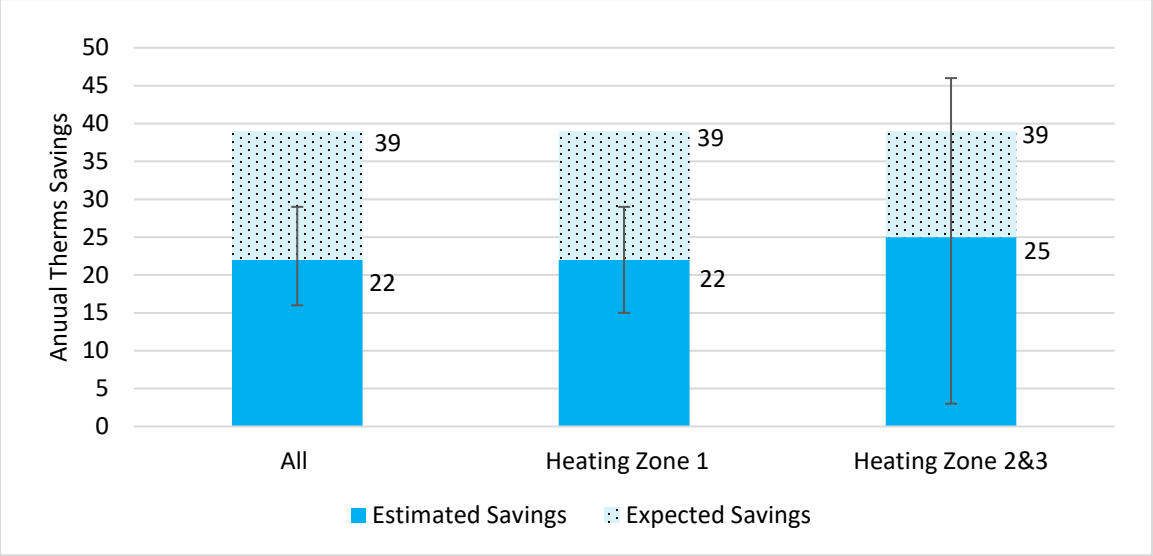


Figure 9. Natural gas savings from self-installed smart thermostats by heating zone, 2022-2023 installs

The overall estimated savings for all heating zones was 22 therms (±4 therms, n = 13,762). Heating zone 1 showed very similar results, which is expected as the majority of the program's installations occur in this heating zone (n = 12,109). Heating zones 2 and 3 showed slightly higher estimated savings of 25 therms (±13 therms, n = 1,148), though this result has low confidence and is not significantly different from the overall or heating zone 1 results. Though this general trend does align with expectations of smart thermostats generating greater natural gas savings in colder climates, these results are not statistically different from one another. The smaller sample size for homes in heating zones 2 and 3 results in low reliability.

Savings by thermostat manufacturer, 2022-2023

We analyzed savings by thermostat manufacturer for homes that installed their smart thermostat between 2022 and 2023. This analysis focuses on ecobee and Google Nest thermostats, as these were the most popular manufacturers of thermostats installed through the program. We were unable to analyze by model numbers or separate our analysis by particular features of the smart thermostats. Because we were trying to analyze small differences between these manufacturers, we limited our analysis to homes in heating zone 1. The results are shown in Figure 10 below.

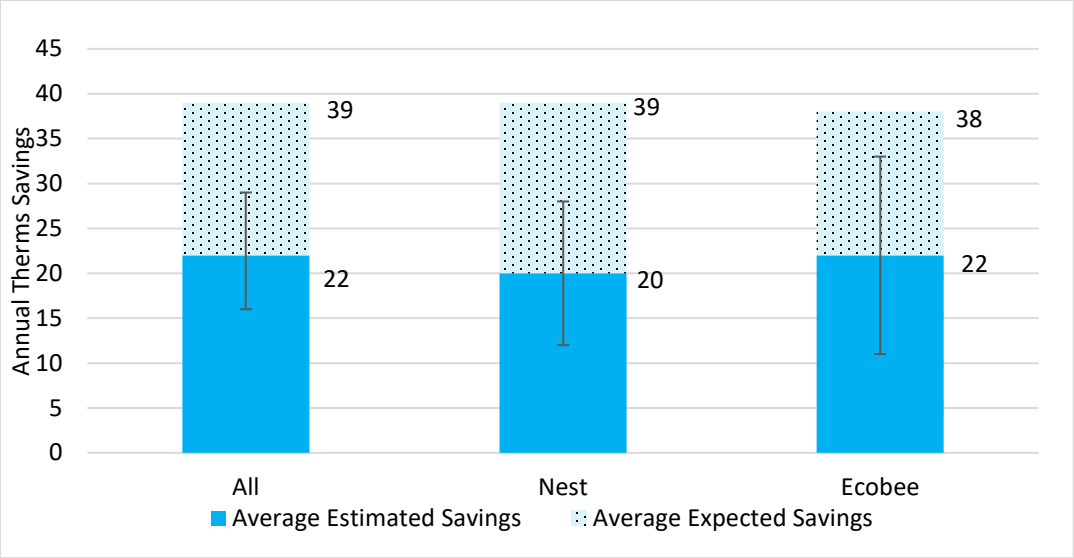


Figure 10. Natural gas savings for self-installed smart thermostats by manufacturer in heating zone 1, 2022-2023 installs

Estimated natural gas savings for homes installing Nest thermostats were 20 therms (± 5 therms, n = 7,926). In the same period, estimated savings for homes installing Ecobee thermostats were 22 therms (± 7 therms, n = 3,786).[18] There were no significant differences in natural gas savings between the two manufacturers.

Savings by building type, 2022-2023

We assessed the impact of smart thermostats on gas-heated site-built homes compared to manufactured homes. Manufactured homes can sometimes show more consistent and predictable savings than site-built homes, as they are more consistently constructed. Figure 11 below shows these results.

[18] It is important to note that Energy Trust does not claim different savings for Google Nest and ecobee smart thermostats. The different expected savings values result from other variances in the make-up of the treatment groups, most influenced by year-to-year changes in expected savings values which may be changed as part of regular measure updates. Different proportions of 2022 and 2023 installations in the Google Nest and ecobee treatment groups result in different average expected savings values for these analyses.

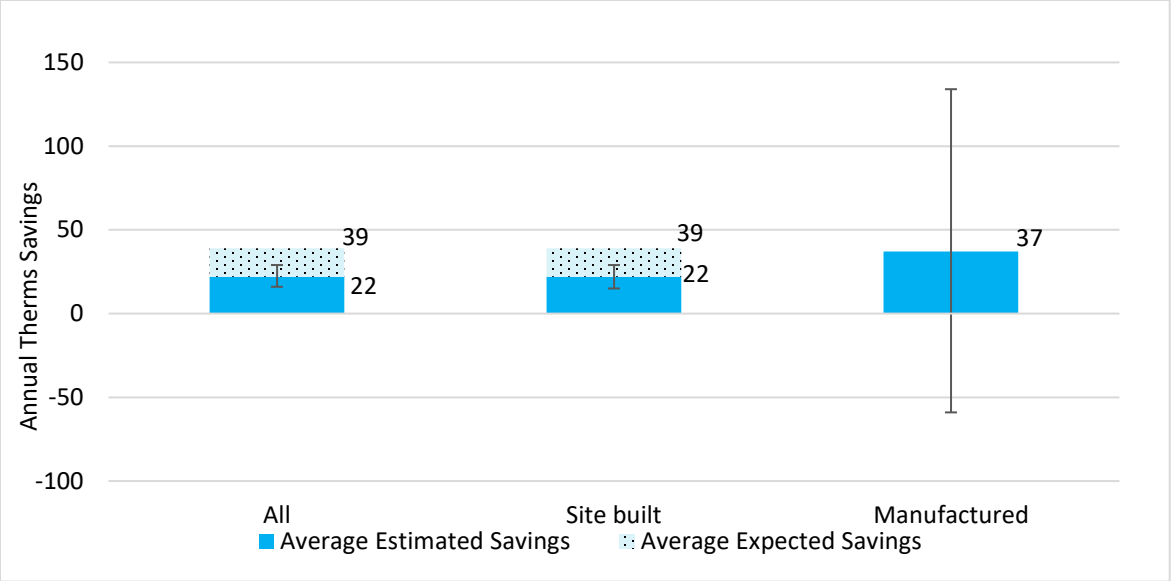


Figure 11. Natural gas savings for self-installed smart thermostats by home type in heating zone 1, 2022-2023

In this analysis, site-built homes showed an average estimated savings of 22 therms (± 4 therms) annually, compared to an expected savings of 39 therms (n = 12,109). The results for manufactured homes were not significant due to a low number of treatment sites (n = 46). The large confidence range for savings in manufactured homes results from this very small sample size, and more sites are needed to understand how smart thermostats perform in manufactured homes.

Electric Savings for Smart Thermostats

Analysis method comparison

As with the gas analysis, we compared the two comparison group construction methods for electric savings from smart thermostats installed in electric-heated homes. These analyses focused on smart thermostats installed from 2020-2021, and we compared the future participant comparison group method with the non-participant group comparison method.

The non-participant comparison group method estimated savings of -53 kWh (± 264 kWh, n = 1,349), compared to expected savings of 430kWh, with low confidence in this result. The future participant comparison group method tool estimated savings of 112 kWh (± 310 kWh, 1,359), compared to expected savings of 520 kWh, also with low confidence in this result. Results from the two analysis methods revealed no significant electric savings for self-installed thermostats in 2020-2021. These results are shown in Figure 12 below.

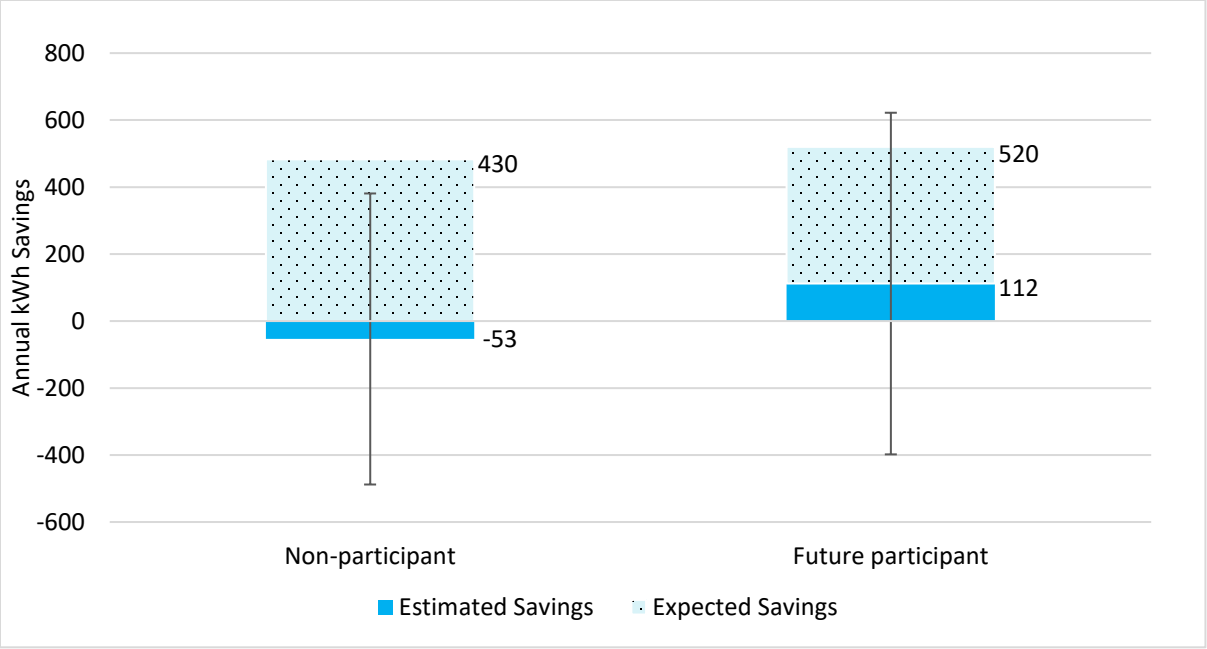


Figure 12. Electric savings from self-installed smart thermostats in electric-heated homes by comparison group methodology, 2020-2021 installs

For remaining analyses of electric savings from smart thermostats, we focus on the non-participant comparison group methodology as it allows us to analyze more recent installation years.

Electric savings from smart thermostats installed in gas-heated homes

Energy Trust claims electric savings from smart thermostats installed in gas heated homes. These savings result from reduced furnace fan run times, as well as a small amount of savings from cooling in the summer. We analyzed electric savings from smart thermostats installed in gas heated homes from 2020-2023, using the non-participant comparison methodology. For this analysis, we focused on self-installed smart thermostats, as there were more sites available for analysis.

Table 2. Electric savings from self-installed smart thermostats in gas heated homes

Product Description	Heating Fuel	Sample Years	Sample N	Baseline Energy	Expected Savings	Estimated Savings	90% CI
Self-Install Thermostat	Gas	2020-2023	5,697	9,165	41	27	(-111,166)

The analysis estimated average annual electricity savings at 27 kWh (± 84 kWh, n = 5,697), compared to an expected savings of 41 kWh. While this analysis included a large number of treatment sites, the result is not significantly different from zero or from the expected value.

Savings over time, 2020-2023

We analyzed electric savings from smart thermostats over time, from 2020 to 2023, using the non-participant comparison group methodology. These results showed no significant electric savings over these years. These results are shown in Figure below. The samples for these

analyses were 1,058 in 2020, 367 in 2021, 1,007 in 2022, and 312 in 2023. The overall result shown on the left includes 2020-2023 installs, with a treatment group size of 2,990 sites.

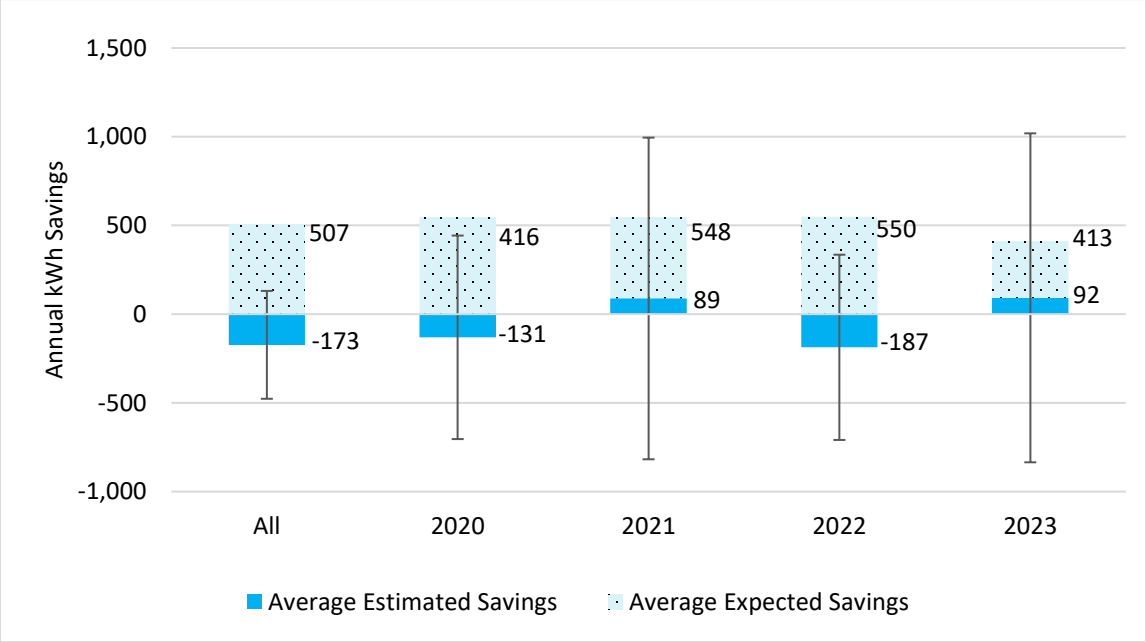


Figure . Electric savings from self-installed smart thermostats over time, 2020-2023 installs

These results show no clear trend over time, but do show that we consistently do not detect significant electric savings for smart thermostats in electric heated homes.

Savings by heating system type, 2020-2023

For electric-heated homes, Energy Trust expects different savings for homes with a heat pump than for those with other electric heating systems. We analyzed savings for participants who received self-installed thermostat incentives from 2020 to 2023 and indicated their heating system as either a heat pump, or an electric forced air furnace.

Figure 13 presents a comparative analysis of smart thermostat annual electricity savings between different electric heating systems: all mixed electric (n = 2,990), heat pumps (n = 252), and electric furnaces (n = 414). The heat pump and electric furnace analyses were not significantly different from one another and had wide confidence intervals.

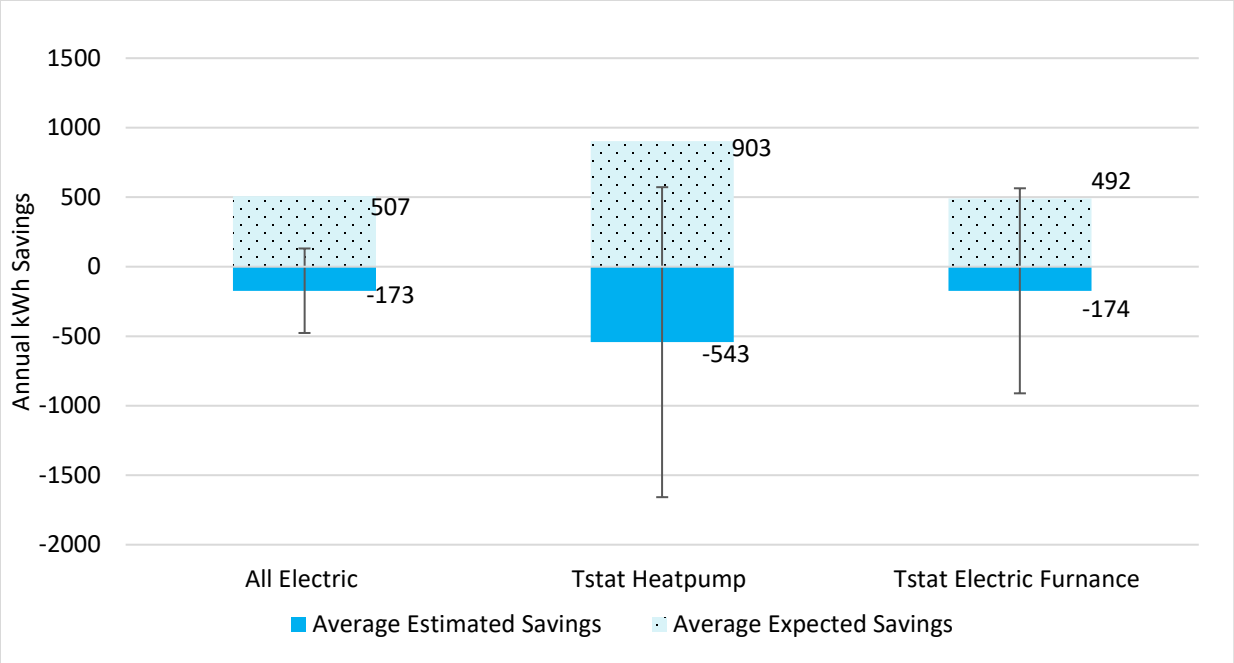


Figure 13. Electric savings from self-installed smart thermostats by electric heating system type, 2020-2023 installs[19]

We also analyzed savings from contractor installed smart thermostats by heating system type, because of the possibility that customers could be misidentifying their precise heating system type. This analysis yielded no significant results and is not presented here because of a very low sample size (n = 103 for heat pump heated homes, n = 32 for electric furnace heated homes).

Savings by thermostat manufacturer, 2020-2023

We analyzed electric savings by thermostat manufacturer, focusing on self-installed smart thermostats from 2020-2023. In this period, Energy Trust offered thermostats from two major manufacturers: ecobee and Google Nest. Our analysis showed no significant differences in electric savings from these two manufacturers. This analysis is shown in Figure 14 below.

[19] We focus on 2020-2023 installs for our electric analysis in order to have a sufficient treatment group to analyze.

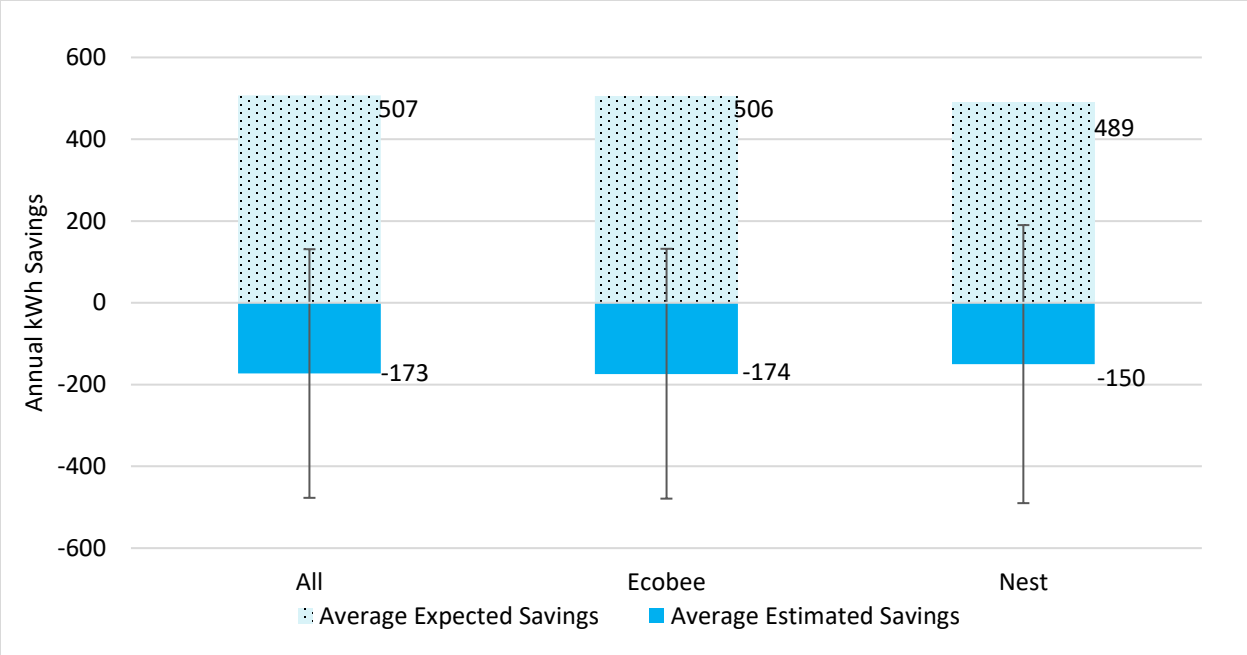


Figure 14. Electric savings from self-installed smart thermostats by manufacturer, 2020-2023 installs

Conclusions

Our billing analysis found consistent gas savings of 22 therms annually between 2022 and 2023, or a 56% realization rate. Self-installed thermostats installed in 2022 and 2023 showed slight variance in their performance between heating zones, manufacturers, and building types, though the analysis did not identify significant differences by any of these characteristics.

Our electric analysis showed no significant savings across all analysis methods, heating systems, manufacturers, and years, with wide variability and often negative point estimates. These results are consistent with other studies such as the 2020 Recurve Residential Smart Thermostat Impact Analysis (analyzing installations from 2015 to 2017)[20] and Puget Sound Energy's recent Smart Thermostat impact analysis (analyzing installations from 2022-2023).[21]

Some key limitations of this analysis are worth pointing out, particularly in the electric analysis. The billing analysis tool filters out sites that receive Energy Trust funded measures during the analysis period, but cannot filter out sites that may make other changes outside of an Energy Trust project during that time. In addition, smart thermostat devices typically contribute modest savings compared to household energy use. Therefore, Advanced Metering Infrastructure (AMI) meter consumption data is usually recommended, which helps control external factors like

[20] Summary of Recurve Residential Smart Thermostat Impact Analysis. 2020, Energy Trust of Oregon. Recurve-Smart-Thermostat-Impact-Analysis-Reports-2015-2017.pdf

[21] The Smart Thermostat Program Final Report 2022-2023 Impact and Process Evaluation. 2024, Puget Sound Energy. Filing UG – 210823, Exhibit 6 Supplement 1. https://www.utc.wa.gov/casedocket/2021/210823/docsets

weather, solar, or EV usage.[22] In addition, more information on the exact heating system type in electric heated homes would have made our analysis more robust.

Another factor that could have influenced our electric analysis is the growing prevalence of cooling systems in Oregon homes. The share of homes with cooling in Oregon continues to grow, with 51% of homes having cooling in 2011, 59% in 2017, and 68% in 2022.[23] This backdrop of increasing cooling prevalence in the state may partly contribute to the absence of detectable savings from smart thermostats installed in electric heated homes. On average, the impact of adding cooling to a house is estimated to be around 215 kWh annually.[24] This could be contributing to the low point estimates, and could also introduce variability from home to home, reducing the confidence of the electric results. Even considering this uncertainty, we find it unlikely that smart thermostats are resulting in electric savings close to the level Energy Trust expects.

[22] Smart Thermostat Evaluation Protocol Dec 2016 – May 2023 https://docs.nrel.gov/docs/fy23osti/86175.pdf

[23] 2022 Residential Building Stock Assessment. Northwest Energy Efficiency Alliance. 2022-Residential-Building-Stock-Assessment.pdf. p 21.

[24] Energy Trust Measure Approval Document for Residential Ducted Heat Pump Conversions, using Regional Technical Forum estimates for electricity usage in homes with and without cooling.

Appendix

Table 3. Gas Saving Results Summary

Figure[25]	Sample Description	Method	Sample Years	Sample N	Annual Baseline Usage	Average Expected Savings	Average Estimated Savings	RR	% Savings	90% CI[26]	Reliability Rating
Figure 4	Self-install Thermostat Gas	Future participant	2021	4,088	686	39	14	36%	2%	(1,26)	Low
Figure 4	Self-install Thermostat Gas	Non-participant	2021	3,566	707	40	14	35%	2%	(3,25)	Low
Figure 5	Contractor install Thermostat Gas Furnace	Future participant	2019-2021	2,962	724	35	16	46%	2%	(1,32)	Low
Figure 5, 8	Contractor install Thermostat Gas	Non-participant	2019-2021	3,021	748	35	19	54%	3%	(7,31)	Low
Figure 6, 9	Self-install Thermostat Gas	Non-participant	2022-2023	13,762	698	39	22	56%	3%	(16,29)	Moderate
Figure 6, 8	Contractor-installed Tstat Gas	Non-participant	2022-2023	237	716	39	34	87%	5%	(-10, 79)	Very Low
Figure 7	Self-install Thermostat Gas	Non-participant	2020	2,787	640	32	15	47%	2%	(4, 27)	Low
Figure 7	Self-install Thermostat Gas	Non-participant	2021	4,482	706	40	14	35%	2%	(4,24)	Low
Figure 7	Self-install thermostat gas	Non-participant	2022	9,340	695	40	21	53%	3%	(13,28)	Moderate
Figure 7	Self-install Thermostat Gas	Non-participant	2023	3,977	681	32	23	72%	3%	(13,34)	Moderate
Figure 9	Self-install Tstat Gas, Heating Zone 2&3, Site Built Home	Non-participant	2022-2023	1,148	804	39	25	64%	3%	(3,46)	Low

[25] The Figure number where this result was used
[26] Confidence interval of savings estimate at 90% confidence level.

Figure 9, 11	Self-install Thermostat Gas, Heating Zone 1, Site Built Home	Non-participant	2022-2023	12,109	685	39	22	56%	3%	(16,29)	Moderate
Figure 10	Self-install Tstat Gas, Nest, Heating Zone 1, Site Built	Non-participant	2022-2023	7,926	683	39	20	51%	3%	(12,28)	Moderate
Figure 10	Self-install Tstat Gas, Ecobee, Heating Zone 1, Site Built	Non-participant	2022-2023	3,786	672	38	22	58%	3%	(11,33)	Moderate
Figure 11	Self-install Tstat Gas, Manufacture Home, Heating Zone 1	Non-participant	2022-2023	46	583	37	37	100 %	6%	(-59,134)	Very Low

Table 4. Electric Saving for Gas-Heated Home Results Summary

Figure	Sample Description	Method	Sample Years	Sample N	Annual Baseline Usage	Average Expected Savings	Average Estimated Savings	RR	% Savings	90% CI	Reliability Rating
Table 2	Self-Install Thermostat Gas	Future participant	2021	1,094	8977	41	107	261%	1%	(-182, 396)	Very Low
Table 2	Self-Install Thermostat Gas	Non-participant	2020-2023	5,697	9,165	41	27	66%	0%	(-111, 166)	Very Low

Table 5. Electric Savings for Electric Heated Home Results Summary

Figure	Sample Description	Method	Sample Years	Sample N	Annual Baseline Usage	Average Expected Savings	Average Estimated Savings	RR	% Savings	90% CI	Reliability Rating
Figure 12	Self-Install Thermostat Electric	Future participant	2020-2021	1,359	14,136	520	112	22%	1%	(-398,622)	Very Low
Figure 12	Self-install Thermostat Electric	Non-participant	2020-2021	1,349	14,578	430	-53	-12%	0%	(-488,381)	Very Low
Figure 13	Self-Install Thermostat Electric	Non-participant	2020	1,058	14,542	416	-131	-31%	-1%	(-605,342)	Very Low
Figure 13	Self-Install Thermostat Electric	Non-participant	2021	367	14,843	548	89	16%	1%	(-818,995)	Very Low
Figure 13	Self-Install Thermostat Electric	Non-participant	2022	1,007	14,256	550	-187	-34%	-1%	(-709,335)	Very Low
Figure 13	Self-Install Thermostat Electric	Non-participant	2023	312	13,427	413	92	22%	1%	(-835, 1,019)	Very Low
Figure 13, 14, 15	Self-Install Thermostat Electric	Non-participant	2020-2023	2,990	14,178	507	-173	-34%	-1%	(-477,131)	Very Low
Figure 14	Self-Install Thermostat Electric Furnace	Non-participant	2020-2023	414	14,492	492	-174	-35%	-1%	(-911,564)	Very Low
Figure 14	Self-Install Thermostat Electric Heat Pump	Non-participant	2020-2023	252	14,649	903	-543	-60%	-4%	(-1,658, 572)	Very Low

Figure 15	Self-Install Thermostat Electric, Nest	Non-participant	2020-2023	2,333	14,022	489	-150	-31%	-1%	(-490,190)	Very Low
Figure 15	Self-Install Thermostat Electric, Ecobee	Non-participant	2020-2023	2,956	14,158	506	-174	-34%	-1%	(-479,132)	Very Low

Thermostat measures installed between 2022 and 2023

Introduction

Energy Trust developed a billing analysis tool to evaluate energy savings from efficiency measures it funds that are installed in residential buildings. This report summarizes our analysis of gas savings conducted on treated homes that installed **Thermostat from 2022 to 2023** in homes with the following shared characteristic(s): .

The billing analysis tool uses monthly energy usage data from utility bills to conduct pre-post analysis of whole home energy usage. Energy usage data are weather normalized using site-level weather regression models and typical meteorological year data, similar to the methods established by CalTRACK. Normalized annual energy usage is computed for each site in both the year prior to measure installation (baseline) and the year following installation (post-install). The site-level change in annual energy usage is simply computed as the difference in usage between the baseline and post-install periods. The average change in annual energy usage among treated sites is then evaluated against the average change in energy usage during the same period in a comparison group of similar sites. The comparison group is selected from untreated homes using a site-level, nearest neighbor matching technique, based on baseline monthly energy usage of sites located in the same Census tract. The change in normalized annual energy usage for comparison group sites is arrived at using the same procedure as the treatment group. For this analysis, **10** matched comparison sites were selected for each treated site. The resulting difference in the change in annual energy usage (difference-in-differences) is the annual energy savings attributable to the measures installed at the treated sites. Several standard data screens are applied to remove homes from the analysis that are missing data, are outliers in energy usage, have inconsistent occupancy, have unusual usage patterns, or are otherwise unsuitable for billing analysis. These screens are applied symmetrically to all treatment and comparison sites. Sites are removed from the analysis for the following reasons:

- Utility billing data not found
- Less than 9 months of valid billing data available for either baseline or post-install year
- Weather normalization process failed for either baseline or post-install year
- Other measures installed during analysis period with aggregate deemed gas savings > **0** therms per year
- Baseline energy usage in the top or bottom 1 percent of treated sites
- Post-install annual energy usage is more than double or less than half of baseline year
- Weather regression model has R-square value < **0.75** for either baseline or post-install year

Site Attrition

Treament Sites	Analysis Stage
19,957	Initial list of all participants
18,464	Total participants with no other measures installed
18,464	Total participants filtered to selected measure combinations
18,464	Total participants filtered to selected measure attributes
18,056	Treatment sites matched to consumption data
16,050	Treatment sites with normalized consumption data
14,755	Treatment sites with R2 > 0.75
14,238	Treatment sites with full pre & post years of consumption
13,952	Treatment sites after removing top and bottom 1%
13,762	Final model treatment sites before filters
13,762	Final model treatment sites with filters

Expected Savings

39 Therms

Estimated Savings

22 Therms

Low Estimate

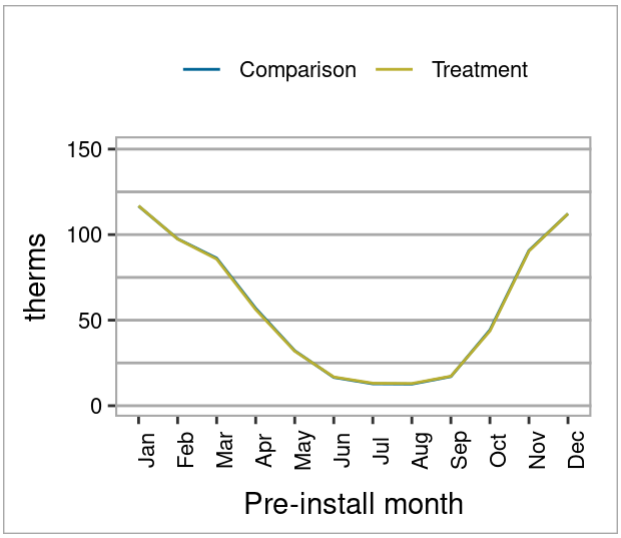
16 Therms

High Estimate

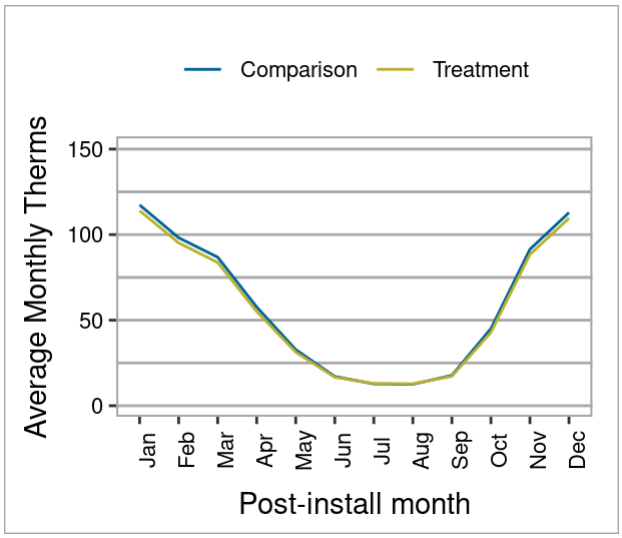
29 Therms

term	estimate	std.error	statistic	p.value	conf.low	conf.high
(Intercept)	698	1	957	0.00	697	699
sample_period	8	1	8	0.00	6	10
sample_group	−4	3	−1	0.16	−8	1
sample_period:sample_group	**−22**	**4**	**−6**	**0.00**	**−29**	**−16**

Pre-Treatment: Treatment and Comparison Group Monthly Consumption



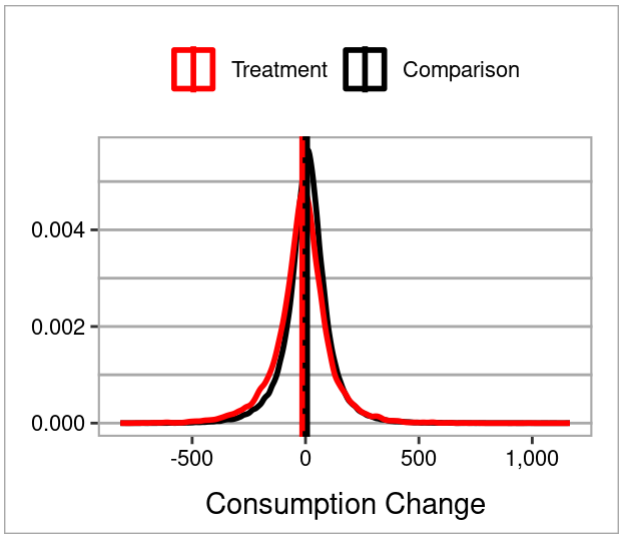
Post-Treatment: Treatment and Comparison Group Monthly Consumption



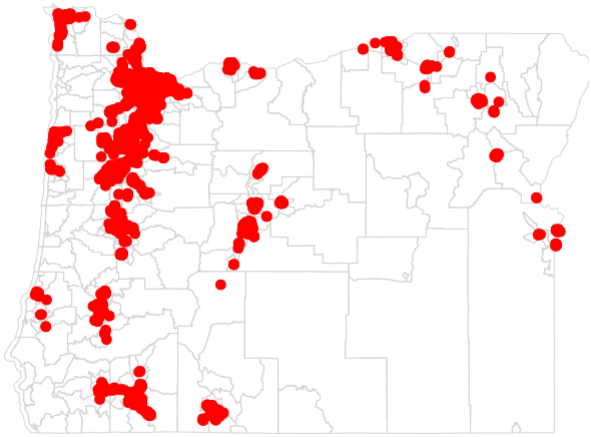
Pre-Post Treatment & Comparison Group Monthly Consumption

	Treatment		Comparison	
Month	Pre	Post	Pre	Post
1	117	114	117	117
2	97	95	98	98
3	86	84	86	87
4	56	55	57	58
5	32	31	32	33
6	17	17	17	17
7	13	13	13	13
8	13	13	13	13
9	17	17	17	18
10	44	43	44	45
11	90	88	91	91
12	112	110	112	113

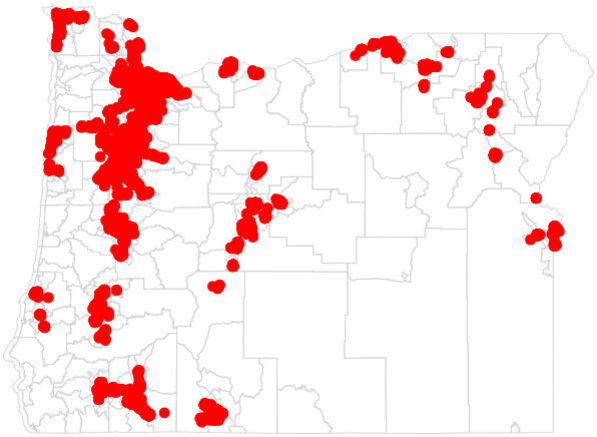
Post-install Consumption Change: Treatment & Comparison Groups



Treatment group spatial distribution



Comparison group spatial distribution



Model Adjusted r2	Model p-value
0	0

List of Measures in Analysis
Direct Ship Smart Thermostat Gas
Direct Ship Smart Thermostat Gas Only
Direct Ship Smart Thermostat Gas Only|Direct Ship Smart Thermostat Gas Only
Direct Ship Smart Thermostat Gas Only|Smart Thermostat - Gas Only Territory
Direct Ship Smart Thermostat Gas|Direct Ship Smart Thermostat Gas
Direct Ship Smart Thermostat Gas|Direct Ship Smart Thermostat Gas Only
Direct Ship Smart Thermostat Gas|Smart Thermostat - Gas Furnace
Direct Ship Smart Thermostat Gas|Smart Thermostat Instant Coupon - Gas Furnace
Smart Thermostat - Gas Furnace
Smart Thermostat - Gas Only Territory
Smart Thermostat Instant Coupon - Gas Furnace
Smart Thermostat Instant Coupon - Gas Only Territory

Thermostat measures installed between 2022 and 2023

Introduction

Energy Trust developed a billing analysis tool to evaluate energy savings from efficiency measures it funds that are installed in residential buildings. This report summarizes our analysis of gas savings conducted on treated homes that installed **Thermostat from 2022 to 2023** in homes with the following shared characteristic(s): HeatingZone is '1' & MarketName is 'Site Built Home'.

The billing analysis tool uses monthly energy usage data from utility bills to conduct pre-post analysis of whole home energy usage. Energy usage data are weather normalized using site-level weather regression models and typical meteorological year data, similar to the methods established by CalTRACK. Normalized annual energy usage is computed for each site in both the year prior to measure installation (baseline) and the year following installation (post-install). The site-level change in annual energy usage is simply computed as the difference in usage between the baseline and post-install periods. The average change in annual energy usage among treated sites is then evaluated against the average change in energy usage during the same period in a comparison group of similar sites. The comparison group is selected from untreated homes using a site-level, nearest neighbor matching technique, based on baseline monthly energy usage of sites located in the same Census tract. The change in normalized annual energy usage for comparison group sites is arrived at using the same procedure as the treatment group. For this analysis, **10** matched comparison sites were selected for each treated site. The resulting difference in the change in annual energy usage (difference-in-differences) is the annual energy savings attributable to the measures installed at the treated sites. Several standard data screens are applied to remove homes from the analysis that are missing data, are outliers in energy usage, have inconsistent occupancy, have unusual usage patterns, or are otherwise unsuitable for billing analysis. These screens are applied symmetrically to all treatment and comparison sites. Sites are removed from the analysis for the following reasons:

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- Weather normalization process failed for either baseline or post-install year
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- Baseline energy usage in the top or bottom 1 percent of treated sites
- Post-install annual energy usage is more than double or less than half of baseline year
- Weather regression model has R-square value < **0.75** for either baseline or post-install year

Site Attrition

Treament Sites	Analysis Stage
19,957	Initial list of all participants
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14,238	Treatment sites with full pre & post years of consumption
13,952	Treatment sites after removing top and bottom 1%
13,762	Final model treatment sites before filters
12,109	Final model treatment sites with filters

Expected Savings

39 Therms

Estimated Savings

22 Therms

Low Estimate

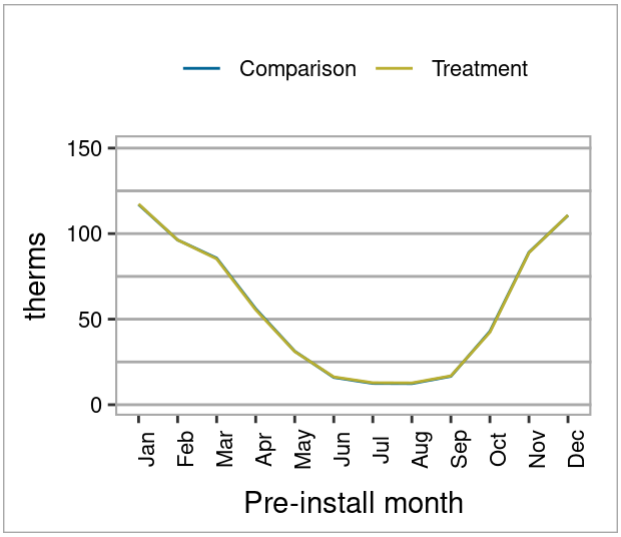
16 Therms

High Estimate

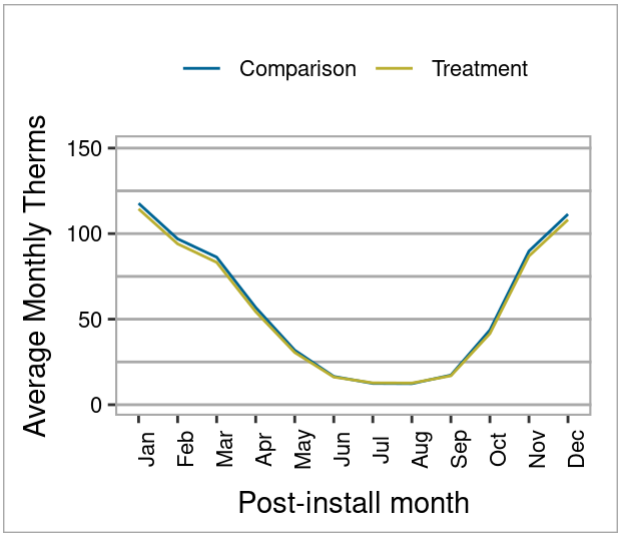
29 Therms

term	estimate	std.error	statistic	p.value	conf.low	conf.high
(Intercept)	685	1	884	0.00	684	686
sample_period	8	1	7	0.00	6	10
sample_group	1	3	0	0.67	−3	6
sample_period:sample_group	**−22**	**4**	**−6**	**0.00**	**−29**	**−16**

Pre-Treatment: Treatment and Comparison Group Monthly Consumption



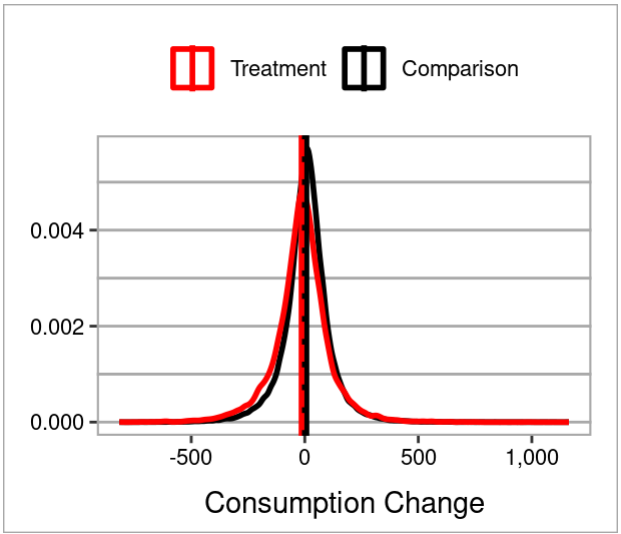
Post-Treatment: Treatment and Comparison Group Monthly Consumption



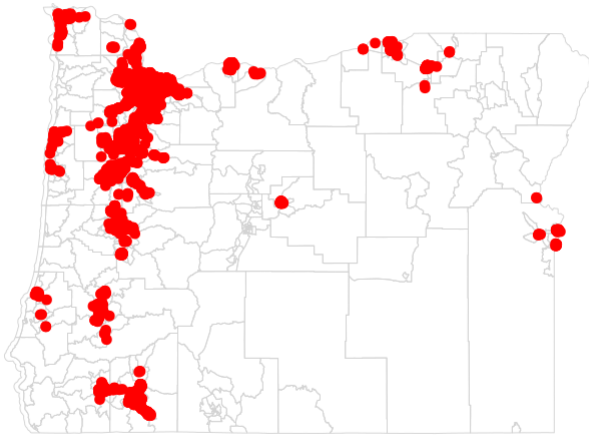
Pre-Post Treatment & Comparison Group Monthly Consumption

	Treatment		Comparison	
Month	Pre	Post	Pre	Post
1	117	114	117	118
2	96	94	96	97
3	85	83	86	86
4	55	54	56	57
5	31	31	31	32
6	16	16	16	17
7	13	13	12	12
8	13	13	12	12
9	17	17	17	17
10	42	42	43	44
11	89	87	89	90
12	111	108	111	111

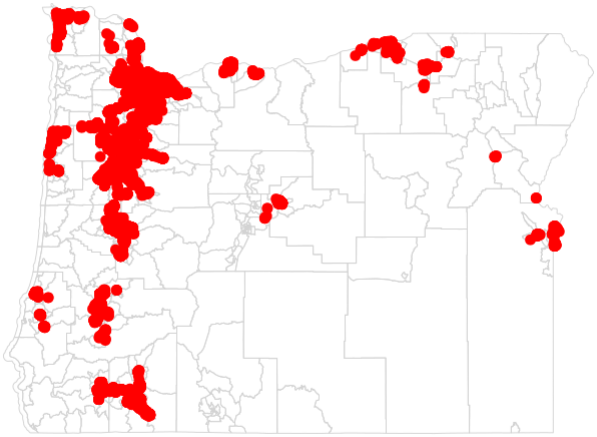
Post-install Consumption Change: Treatment & Comparison Groups



Treatment group spatial distribution



Comparison group spatial distribution



Model Adjusted r2	Model p-value
0	0

List of Measures in Analysis
Direct Ship Smart Thermostat Gas
Direct Ship Smart Thermostat Gas Only
Direct Ship Smart Thermostat Gas Only|Direct Ship Smart Thermostat Gas Only
Direct Ship Smart Thermostat Gas Only|Smart Thermostat - Gas Only Territory
Direct Ship Smart Thermostat Gas|Direct Ship Smart Thermostat Gas
Direct Ship Smart Thermostat Gas|Direct Ship Smart Thermostat Gas Only
Direct Ship Smart Thermostat Gas|Smart Thermostat - Gas Furnace
Direct Ship Smart Thermostat Gas|Smart Thermostat Instant Coupon - Gas Furnace
Smart Thermostat - Gas Furnace
Smart Thermostat - Gas Only Territory
Smart Thermostat Instant Coupon - Gas Furnace
Smart Thermostat Instant Coupon - Gas Only Territory

Thermostat measures installed between 2022 and 2023

Introduction

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- Baseline energy usage in the top or bottom 1 percent of treated sites
- Post-install annual energy usage is more than double or less than half of baseline year
- Weather regression model has R-square value < **0.75** for either baseline or post-install year

Site Attrition

Treament Sites	Analysis Stage
433	Initial list of all participants
323	Total participants with no other measures installed
323	Total participants filtered to selected measure combinations
323	Total participants filtered to selected measure attributes
315	Treatment sites matched to consumption data
277	Treatment sites with normalized consumption data
259	Treatment sites with R2 > 0.75
245	Treatment sites with full pre & post years of consumption
239	Treatment sites after removing top and bottom 1%
237	Final model treatment sites before filters
237	Final model treatment sites with filters

Expected Savings

39 Therms

Estimated Savings

34 Therms

Low Estimate

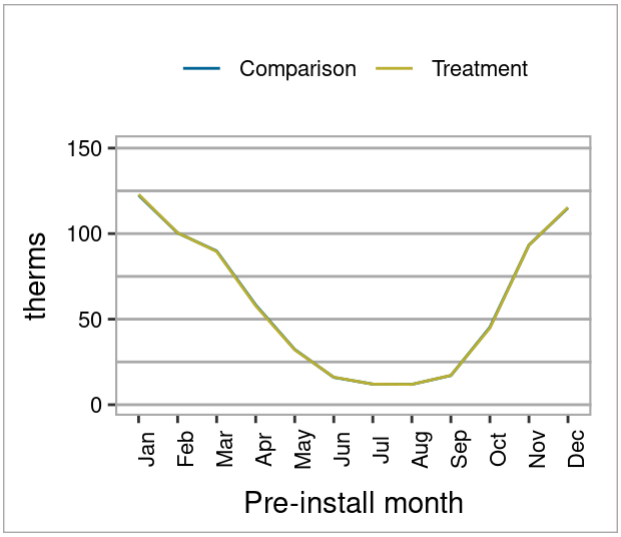
-10 Therms

High Estimate

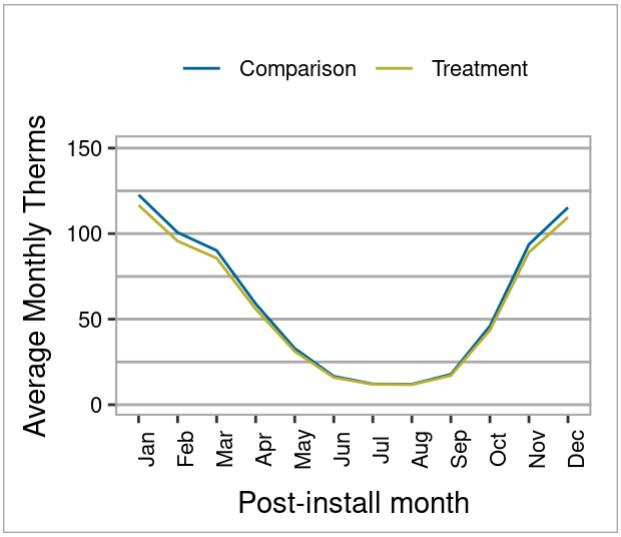
79 Therms

term	estimate	std.error	statistic	p.value	conf.low	conf.high
(Intercept)	716	6	122	0.00	706	725
sample_period	5	8	1	0.55	−9	19
sample_group	−2	19	0	0.90	−34	29
sample_period:sample_group	**−34**	**27**	**−1**	**0.20**	**−79**	**10**

Pre-Treatment: Treatment and Comparison Group Monthly Consumption



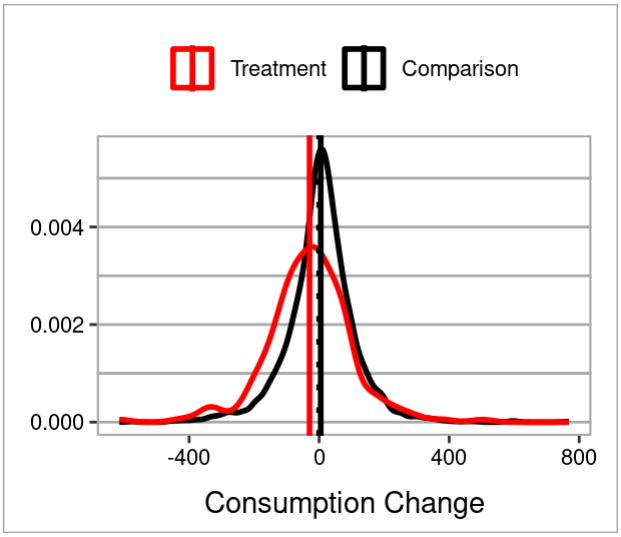
Post-Treatment: Treatment and Comparison Group Monthly Consumption



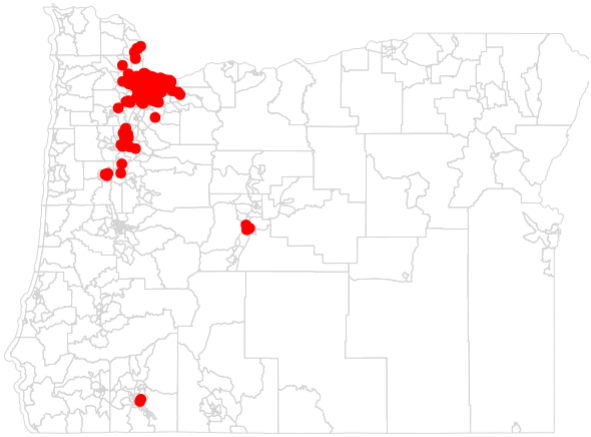
Pre-Post Treatment & Comparison Group Monthly Consumption

	Treatment		Comparison	
Month	Pre	Post	Pre	Post
1	123	117	122	123
2	100	96	100	101
3	90	86	90	90
4	58	56	58	59
5	32	31	32	33
6	16	16	16	17
7	12	12	12	12
8	12	12	12	12
9	17	17	17	18
10	45	44	45	46
11	93	89	93	94
12	115	110	115	115

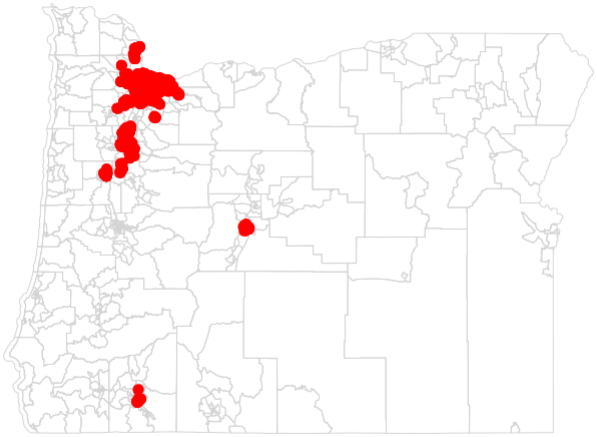
Post-install Consumption Change: Treatment & Comparison Groups



Treatment group spatial distribution



Comparison group spatial distribution



Model Adjusted r2	Model p-value
0	0.28

List of Measures in Analysis
Funding Partner DI SmartStat- Gas Furnace w/AC
Funding Partner DI SmartStat- Gas Furnace w/AC|Funding Partner DI SmartStat- Gas Furnace w/AC
Smart Thermostat Contractor Installed - Gas Furnace
Smart Thermostat Contractor Installed - Gas Only Territory

Thermostat measures installed between 2020 and 2023

Introduction

Energy Trust developed a billing analysis tool to evaluate energy savings from efficiency measures it funds that are installed in residential buildings. This report summarizes our analysis of electric savings conducted on treated homes that installed **Thermostat from 2020 to 2023** .

The billing analysis tool uses monthly energy usage data from utility bills to conduct pre-post analysis of whole home energy usage. Energy usage data are weather normalized using site-level weather regression models and typical meteorological year data, similar to the methods established by CalTRACK. Normalized annual energy usage is computed for each site in both the year prior to measure installation (baseline) and the year following installation (post-install). The site-level change in annual energy usage is simply computed as the difference in usage between the baseline and post-install periods. The average change in annual energy usage among treated sites is then evaluated against the average change in energy usage during the same period in a comparison group of similar sites. The comparison group is selected from untreated homes using a site-level, nearest neighbor matching technique, based on baseline monthly energy usage of sites located in the same Census tract. The change in normalized annual energy usage for comparison group sites is arrived at using the same procedure as the treatment group. For this analysis, **5** matched comparison sites were selected for each treated site. The resulting difference in the change in annual energy usage (difference-in-differences) is the annual energy savings attributable to the measures installed at the treated sites. Several standard data screens are applied to remove homes from the analysis that are missing data, are outliers in energy usage, have inconsistent occupancy, have unusual usage patterns, or are otherwise unsuitable for billing analysis. These screens are applied symmetrically to all treatment and comparison sites. Sites are removed from the analysis for the following reasons:

- Utility billing data not found
- Less than 9 months of valid billing data available for either baseline or post-install year
- Weather normalization process failed for either baseline or post-install year
- Other measures installed during analysis period with aggregate deemed electricity savings > **0** kWh per year
- Baseline energy usage in the top or bottom 1 percent of treated sites
- Post-install annual energy usage is more than double or less than half of baseline year
- Weather regression model has R-square value < **0.5** for either baseline or post-install year

Site Attrition

Treament Sites	Analysis Stage
8,447	Initial list of all participants
6,850	Total participants with no other measures installed
6,845	Total participants filtered to selected measure combinations
6,845	Total participants filtered to selected measure attributes
6,645	Treatment sites matched to consumption data
4,854	Treatment sites with normalized consumption data
3,172	Treatment sites with R2 > 0.5
3,144	Treatment sites with full pre & post years of consumption
3,080	Treatment sites after removing top and bottom 1%
2,990	Final model treatment sites before filters
2,990	Final model treatment sites with filters

Expected Savings

507 kWh

Estimated Savings

-173 kWh

Low Estimate

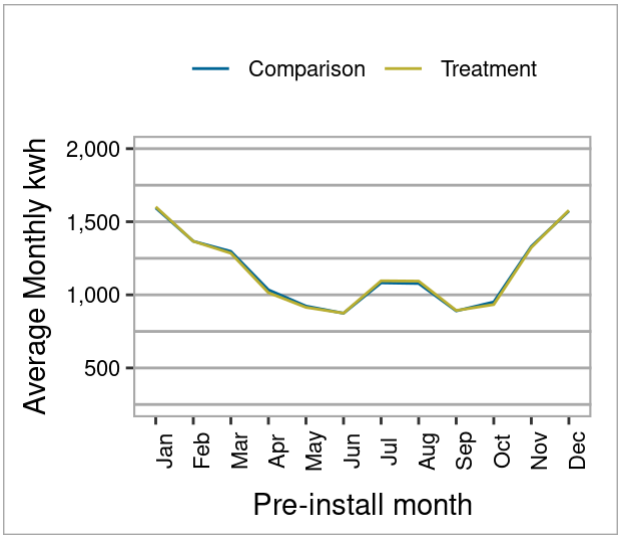
-477 kWh

High Estimate

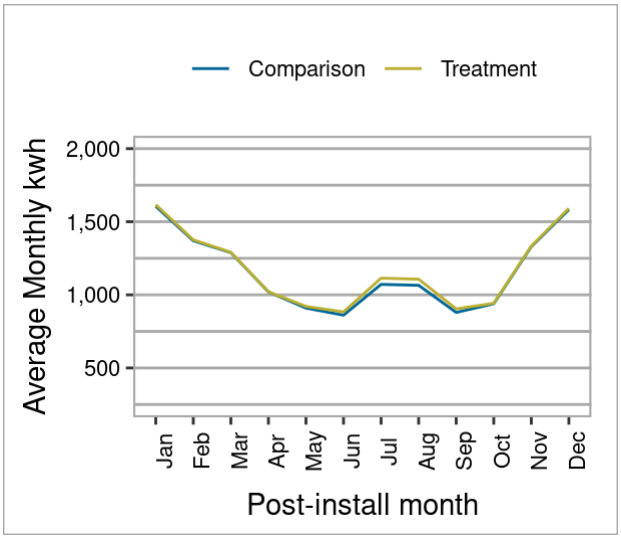
131 kWh

term	estimate	std.error	statistic	p.value	conf.low	conf.high
(Intercept)	14,178	41	347	0.00	14,111	14,245
sample_period	−48	58	−1	0.41	−143	47
sample_group	−202	131	−2	0.12	−417	13
sample_period:sample_group	**173**	**185**	**1**	**0.35**	**−131**	**477**

Pre-Treatment: Treatment and Comparison Group Monthly Consumption



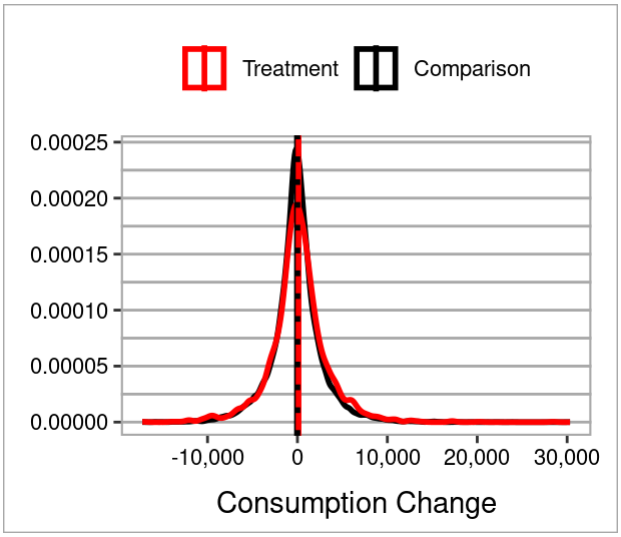
Post-Treatment: Treatment and Comparison Group Monthly Consumption



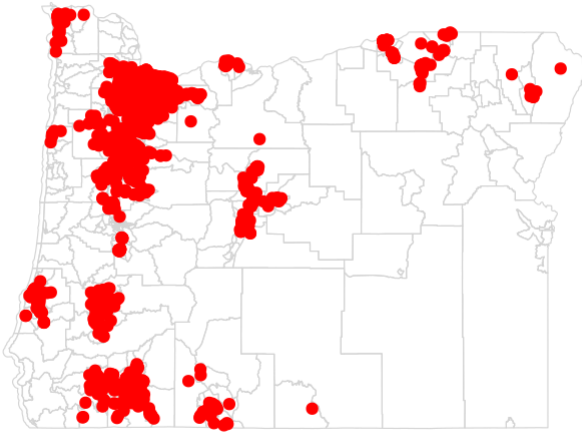
Pre-Post Treatment & Comparison Group Monthly Consumption

	Treatment		Comparison	
Month	Pre	Post	Pre	Post
1	1,602	1,616	1,594	1,605
2	1,366	1,376	1,367	1,370
3	1,285	1,291	1,297	1,288
4	1,015	1,021	1,034	1,020
5	915	921	923	910
6	875	883	874	861
7	1,096	1,114	1,082	1,072
8	1,094	1,107	1,078	1,065
9	893	904	890	880
10	934	942	951	939
11	1,324	1,334	1,331	1,330
12	1,578	1,592	1,573	1,583

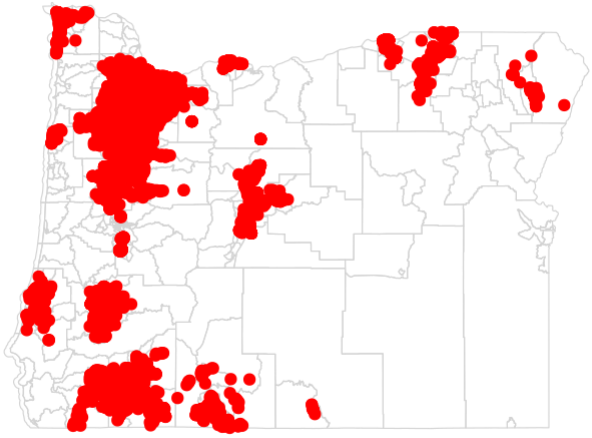
Post-install Consumption Change: Treatment & Comparison Groups



Treatment group spatial distribution



Comparison group spatial distribution



Model Adjusted r2	Model p-value
0	0.43

List of Individual Measures in Analysis

Direct Ship Smart Thermostat Electric

Process Evaluation of Energy Trust 2022-2023 Existing Buildings Program

Prepared for:

Energy Trust of Oregon
February 24, 2025

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1 Executive Summary

This report covers the process evaluation of the 2022 and 2023 Existing Buildings Program ("the EB Program" or "the Program"), which provides financial incentives and technical support for energy-saving projects to qualifying businesses in Oregon and Washington. This is the first process evaluation of the EB Program since the 2019 evaluation of the 2017 and 2018 program years.

The program is implemented by a Program Management Contractor (PMC) with oversight by Energy Trust program management and marketing staff and operates through a network of trade allies and Allied Technical Assistance Contractors (ATACs) who help identify and implement energy efficient measures. In addition, Energy Trust coordinates and collaborates with funding utilities, certain state agencies, and community-based organizations (CBOs) that help Energy Trust serve their constituencies.

The goal of this process evaluation was to obtain feedback on program design and implementation that can be used by Energy Trust to deliver the Existing Buildings Program more effectively and efficiently. This included evaluating the effects of three key changes that occurred in 2021: the transition to a new PMC; the inclusion of multifamily projects, previously served by a separate program; and the removal of lighting measures from the Program for inclusion in a new Business Lighting Program.

Energy Trust identified multiple research questions, organized under four topic areas: program history, program operations, program experience, and future opportunities. This process evaluation addressed the research questions through a review of program documentation and activities and interviews with multiple groups: 25 program and implementer staff, 9 contacts from key stakeholder groups (funding utilities, collaborating state agencies, and CBOs), 10 ATACs, 48 non-lighting trade ally and non-trade-ally contractors, and 67 program participants.[1]

The findings are organized under the four research question topic areas.

1.1 Program History

The ADM team investigated the effects of the transition to a new PMC (TRC) and the two major Program changes – the establishment of a separate Business Lighting Program and the incorporation of the multifamily sector into the Existing Buildings Program.

Findings from interviews with staff, ATACs, and contractors largely indicated satisfaction with the transition to a new PMC. Some challenges were identified relating to: 1) initial bottlenecks in serving customers, resulting from a compressed transition timeline; and 2) the quantity and complexity of subcontracts associated with complying with Energy Trust's new, as of 2021, Supplier Diversity Policy (SDP).

Staff reported that removing lighting from Existing Buildings and creating a stand-alone Business Lighting Program in 2021 was very disruptive to staff and customers and ultimately, Energy Trust chose to fold

[1] Lighting contractors were not interviewed for this evaluation as lighting projects in 2022 and 2023 were managed through the Business Lighting Program rather than the Existing Buildings Program.

downstream lighting measures back into Existing Buildings in Q3 of 2023 with full implementation happening in January 2024. Our data collection with market actors and participants (Section 6) did not indicate any challenges related to removing downstream lighting measures from Existing Buildings, although, as noted above, this evaluation excluded lighting contractors and so may not be able to present a complete picture from the market's perspective. Multiple Energy Trust and TRC staff persons, however, reported that removing lighting from the Program made it harder to engage with customers as lighting was often a "gateway" to other energy-saving projects. According to staff, prior to 2021, lighting served as an initial and accessible step for businesses to take before committing to other energy saving projects. Merging downstream lighting back into Existing Buildings provides that gateway from lighting to other energy saving projects subsequently and the possibility of recruiting more comprehensive energy saving projects.

According to staff, incorporating multifamily buildings measures into Existing Buildings has been challenging. Initially, multifamily properties and measures did not receive enough Program support, largely because the Program did not fully realize that the newly served populations would require a different approach compared to the Program's traditional populations. Staff reported recent efforts to increase support for the multifamily component of the program and they indicated that multifamily work has gone more smoothly in the latter half of 2023 and early 2024 compared to the 2021-22 timeframe. This is a result of the attention program staff have paid to multifamily including working with the residential program on outreach efforts. Feedback from the interviewed ATACs and contractors identified few or no downsides to the incorporation of multifamily projects into the Existing Buildings Program.

1.2 Program Operations

The research produced several key findings relating to program operations.

Contacts identified multiple Program successes. In particular, program staff were positive about efforts to achieve DEI goals, citing TRC's use of diverse suppliers for program implementation and TRC's outreach to priority populations, including non-English speakers, tribal populations, and rural populations. Contacts cited success in working with community-based organizations (CBOs) and affordable housing community staff and developing non-English collateral and hiring Spanish-speaking energy advisors.

Program staff also were largely positive about cross-program collaboration and referrals, and information from some market actor and program participant interviews provides evidence of successful cross-program referrals, although opportunities for improvement exist.

Feedback also pointed to successes with: 1) increasing interest in smart thermostats; 2) trade ally development; and 3) increasing the diversity of offerings in Southwest Washington.

Some difficulties existed relating to the transition to the new PMC, including with communication between Energy Trust and the PMC shortly after the transition. These included issues outside the control of the new PMC (a large backlog of projects from the outgoing PMC) as well as others more directly related to the new implementation team. The PMC has struggled to manage the quantity and complexity of its multiple subcontracts it engaged in to meet Energy Trust's 2021 Supplier Diversity Policy (SDP). This has had impacts on coordination between Energy Trust and outreach subcontractors, outreach contractor

performance, and measure development. For example, one staff person noted that one subcontractor needed training specific to working with tribes.

The Program also has had challenges in efforts to reach small businesses. They have tried developing a no-cost pilot program for commercial heat pumps in rural areas, providing smart thermostats via a direct install effort, and collaborating with the Business Lighting program on outreach efforts to small businesses. The no-cost pilot has been partially successful but would require a co-funding arrangement with other agencies to be cost effective, and some staff expressed concern about the ability to transition to a co-funded arrangement. While the pilot phase has led to installations of efficient equipment in rural areas, it is unclear whether those types of projects will persist without a co-funder. Outreach efforts with Business Lighting were well-intentioned but often difficult to operationalize, and finding affordable measures that comply with cost-effectiveness tests has been difficult.

Another challenge related to the use of community-based liaisons (CBLs) to help guide the Program to achieve its DEI goals. Program staff reported the purpose of CBLs was to help provide ways to better serve priority customers, including by reviewing program marketing material to make sure they were culturally appropriate. Staff indicated there was a misalignment between what the program was expecting from the CBLs and the feedback they were receiving from CBLs. Ultimately, the CBL network was paused in 2024 because the CBL process was not working as envisioned.

Other identified operational challenges related to the establishment and tracking of DEI goals and metrics, carrying out timely process revisions and database updates needed to merge multifamily into the Program, and changes to incentive check processing that made it difficult for customers to document the receipt of incentives.

1.3 Experience of Customers, Market Actors, and Collaborators

The research produced the following key findings relating to the experiences of customers, market actors, and program collaborators.

Customers. Interviews with program participants provided insights into how customers learn about the program and make decisions about equipment upgrades. Consistent with prior research, results showed that contractors and vendors – typically found through online searches – are key players in making customers aware of the Program. They also are key players in helping identify equipment to install for Standard projects but are less involved in Custom and Direct Install projects. Program representatives played larger roles in the latter project types, conducting site assessments to identify needs, assessing savings potential through technical studies or less formal means, and identifying available incentives.

Contractors and program representatives frequently helped with incentive applications. The types of assistance ranged from providing instructions on how to complete the application to providing supporting documentation to completing the application on behalf of the customer, and a large majority of customers said such assistance was helpful.

Participating customers indicated generally positive experiences with the overall participation experience, and nearly all those with plans for additional energy upgrades said they would work with Energy Trust on such projects.

Finally, analysis of the participant interviews found that a higher percentage of Direct Install participants were first-time participants. Thus, the Direct Install offering has been successful at reaching out to one group of priority customers – small businesses. As indicated below, feedback from ATACs and contractors suggests some additional efforts to reach small businesses may be valuable.

ATACs. ATACs largely reported positive experiences with the current PMC. Most indicated the transition to the new PMC was uneventful or even "seamless." Eight of the 10 interviewed ATACs offered positive or neutral comments about the new PMC, with the positive comments focusing on improvements to forms and templates or more generally to improved operations. The context of comments suggests that the primary value of these improvements has been to make clearer what is expected in a technical study.

However, five interviewed ATACs noted various concerns, two of whom appeared, on balance, to be dissatisfied with the new PMC. Specific concerns related to the consistency of the staff's skill level, a perceived change in how studies were assigned, and long project review times.

Half of the interviewed ATACs were unaware of any specific program goals regarding outreach to reach priority populations, and those who were aware of such goals did not recall receiving specialized training about identifying minority-owned businesses. Eight respondents were unaware of any specific Energy Trust outreach strategies for reaching priority populations, although two noted that studies targeting priority communities received a higher priority from the Program than did some other studies.

Four of the 10 interviewed ATACs described specific instances when Program staff referred the customer to another Energy Trust program to do additional work, all four of whom reported that the referral process was smooth.

ATACs also largely reported that their customers were satisfied with the technical studies, although a few ATACs identified some challenges, mainly relating to communication from the PMC or its subcontractors.

Trade allies and other contractors. Consistent with customer reports, trade allies and other contractors often reported assisting with incentive applications – Program trade allies were much more likely to complete the applications for customers than were other contractors, and HVAC contractors were more likely to do so than other contractors.

Contractors generally reported positive experiences with the Program. In particular, Program trade allies said working with the Program helped their business. About one-third of the interviewed contractors highlighted their interactions with Program staff as helpful or responsive to questions.

However, about one in six interviewed contractors (trade allies as well as non-trade allies) said that at least some incentives were insufficient. This made up about half of the contractors who reported doing building shell work.

The same number of contractors (mainly trade allies but some non-trade allies) offered comments about the application process. The nature of the comments tended to differ for the two groups, with trade allies more likely to indicate a desire for an online portal for completing or checking the status of completed applications, and non-trade allies more likely to comment that more generally about the long or complicated application forms or process.

Nearly as many reported some level of insufficiency in communication with Energy Trust. Again, both trade allies and non-trade allies offered such comments, with the nature of the comments tending to

differ for the two groups. Trade allies' comments tended to be more specific, focusing on not knowing who the key program contact is for a specific type of project, while the non-trade allies' comments were more about a lack of program information or delays in communication from Energy Trust.

Community Based Organizations (CBOs). CBO contacts reported good communication with Energy Trust and an effective approach to engaging priority populations. Contacts pointed to hands-on engagement with program participants and frequent communication with Energy Trust and PMC staff. They also particularly highlighted the fact that Energy Trust gave them the lead in outreach and customer engagement but provides them the resources they need to carry out those activities. Their strong relationships with community members and their position as a trusted source of information and services means that community members are more likely to receive services through engagement with CBOs than through engagement with Energy Trust. Contacts suggested that application materials be made available in additional languages, and one contact also suggested that Energy Trust share more promotional materials with CBOs.

Funding utilities. Utility contacts characterized their relationship with Energy Trust and the Existing Buildings program positively and generally indicated that Energy Trust is doing a good job targeting priority populations. Two respondents, however, indicated suggested some changes to the nature of their communication with Energy Trust (e.g., including program staff in meetings) to provide more information into when and why programmatic changes are occurring and more input into the planned changes.

Collaborating state agencies. Representatives from the two collaborating state agencies underscored how much simpler and easier programs have become because of their formal partnerships with Energy Trust. Contacts pointed to greater clarity about available services for their customers (school districts and housing managers), a streamlined application process, and increased benefits to the communities served, as working together toward shared goals has allowed them to not only serve more customers but also provide more comprehensive and robust offerings. The primary concern they identified was that Energy Trust sometimes changes incentive amounts mid-project, due to funding cycle schedules.

1.4 Future Opportunities

Program staff identified several energy savings measures or services that are in development or being considered. These include continuation and expansion of efforts that are currently ongoing, such as the recently implemented Multifamily SEM effort and carrying out lighting and smart thermostat direct-install efforts in rural areas. It also includes the possibility of transitioning the no-cost pilot program for commercial heat pumps in rural areas to a regular offering, co-funded by other agencies. Staff also identified some possibilities that are not necessarily in current planning but may be part of future efforts. These included using utility usage data to identify energy saving opportunities and targeting customers with marketing to realize those opportunities; working with schools and other institutions that are pursuing electrification projects; and working to understand how the Program can be leveraged to support Energy Trust's work on Solar For All.[2]

[2] Energy Trust received grant money from the U.S. Environmental Protection Agency (EPA) to support adding solar projects across Oregon, including in multifamily properties. Source: *Oregon receives $86 million to help more*

Both ATACs and contractors identified that saving money continues to be the primary driver of investing in energy efficiency. Several ATACs also identified stronger building codes as a driver, and one ATAC suggested that concerns about climate change and the social impacts of high-energy buildings will motivate greater efforts to reduce energy use, particularly among institutions with health- or social-oriented missions.

ATACs and contractors identified a range of opportunity areas for energy savings. Some of the suggestions related to specific customer types, such as K-12 schools, multifamily properties, and high energy users, such as data centers and server farms. Other opportunity areas were broadly related to specific end uses, such as more advanced building management systems, improved refrigerants, continued use of heat pumps to replace other heating technologies, and improvements in electric heating technologies in general to facilitate increased building electrification. In two cases, the suggestion was about achieving certain needs through improved equipment – specifically, achieving better indoor air quality and noise reduction through equipment improvements. Respondents also identified retro commissioning as an opportunity area.

1.5 Conclusions and Recommendations

The information collected from our research points to a generally successful program despite some challenges with the transition to a new PMC and with some of the program changes that occurred in 2021. The findings summarized above and detailed in the body of this report produced the following conclusions and recommendations.

Conclusion 1: The Program has made achievements towards addressing Energy Trust's DEI goals. Energy Trust and the implementer have supported DEI work by doing things like hiring bilingual energy advisors, expanding their work with CBOs, providing marketing collateral in multiple languages, offering food and childcare services along with the multifamily SEM offering, and establishing relationships with affordable housing agencies. Furthermore, the PMC sought to work with a range of diverse suppliers to implement the program and worked with CBLs to inform program development. These efforts began a process that can be built on in the future. However, some of the many efforts taken did not go as smoothly as hoped, in particular: 1) the use of CBLs to help develop culturally appropriate outreach material; and 2) field staff's interactions with tribal communities. The decision to pause the CBL network in 2024 allows Energy Trust and TRC to assess whether and how CBLs can be used more effectively or whether a different approach may be appropriate. While several staff contacts suggested the Program has had success in developing culturally appropriate collateral (which the CBLs were meant to assist with), it may still be possible to use outside assistance to improve on them as well as to help with training field staff to work with tribal groups.

> **Recommendation 1a:** Energy Trust and TRC should assess whether it may still be valuable to use the CBL network for the purpose of helping develop cultural appropriate outreach material or should examine alternative approaches to doing so; if it is concluded that the CBL network is still

households add solar. Accessed on January 29, 2025. https://blog.energytrust.org/oregon-receives-86-million-to-help-more-households-add-solar/

valuable, Energy Trust and TRC should ensure that the scope of work and expected deliverables are clearly understood.

Recommendation 1b: Energy Trust and TRC also should assess the training needs of field staff in how to work with tribal communities and identify the most appropriate training sources, including whether the CBLs may be among those sources.

Conclusion 2: The addition of multifamily measures and exclusion of lighting measures – which started in 2021 at the same time as the transition to the new PMC – resulted in many challenges for program staff. Although the changes in the program implementation did not appear to affect how trade allies and non-trade ally contractors worked with Energy Trust, the challenges that program staff experienced could have been exacerbated by the simultaneous change in implementers. Recent staff efforts, including working with the residential program on outreach efforts, appear to have decreased the challenges relating to the multifamily component of the Program in the latter half of 2023 and early 2024 compared to the 2021-22 timeframe. Further, feedback from the interviewed ATACs and contractors identified few or no downsides to the incorporation of multifamily projects into the Existing Buildings Program.[3]

Recommendation 2: Energy Trust should consider limiting the number of program changes that are implemented at any given time, to allow program staff to absorb and adapt to the changes. Program staff should prioritize planned changes and roll them out over a period of time – perhaps a minimum of 6 months and as much as a year for each change. If feasible, it may be advisable to engage a change management consultant to ensure that proposed program changes are thoroughly discussed internally, with all potentially involved program staff, to identify and plan to mitigate potential internal challenges.

Conclusion 3: Incorporating multifamily measures and properties into Existing Buildings has mostly worked well. There were some initial challenges to incorporating multifamily work into Existing Buildings, such as a lack of marketing resources directed at multifamily, but the Program is addressing those challenges. Additionally, the Program is working on identifying measures and services that work for multifamily, including the SEM for multifamily services, and continuing to work with state agencies to find co-funding opportunities for measures that do not meet cost-effectiveness tests when funded solely by one organization.

Recommendation 3: Continue to look for co-funding opportunities and processes that will support adoption of efficiency measures in multifamily properties. Energy Trust and state agencies have started the process to work together towards this end, however, the state agencies funding cycles differ from Energy Trust's funding cycle which has resulted in changes in incentives mid-project, which can cause confusion and frustration among participants. Continue to look for ways to overcome these funding cycle challenges such as locking in an incentive amount early in the process and not changing that incentive amount mid-project.

[3] We also note that the COVID pandemic also could have exacerbated the situation, as it affected how work was done (more remote working and meeting). This possibly contributed to the shortened transition timeframe or the turnover in PMC staff. However, we are not certain how this would affect our recommendations, other than to avoid significant program changes when major external events are occurring.

Conclusion 4: Contractors and ATACs are generally satisfied with their participation with Energy Trust, but Energy Trust may be able to improve contractors' program experience. Most trade allies noted that their involvement with Energy Trust has helped their business opportunities, and many contractors appreciated the helpful interactions they had with Energy Trust representatives. However, a subset of contractors (both trade allies and non-trade allies) offered some suggestions for improvement, the most common of which were to increase incentives (especially for windows), improve communication with Energy Trust, and improve the application process in various ways (e.g., offering online applications and improving explanations of what qualifies).

> **Recommendation 4a:** With the understanding that Energy Trust and TRC attempt to establish incentive levels that are high enough to induce the adoption of energy efficient technologies in a cost-effective manner, we encourage Energy Trust and TRC to review incentives for windows and possibly other shell measures.
>
> **Recommendation 4b:** Energy Trust and TRC should review outreach to non-trade allies to identify opportunities for improvement. In particular, the program may consider sending periodic e-blasts to *all* known non-trade ally contractors – or, at least, all those that have done any Energy Trust projects – with current program information. The e-blasts should include an option to unsubscribe from further contact.
>
> **Recommendation 4c:** Energy Trust and TRC should review the information included on outreach materials (e.g., *The Insider* e-newsletter) sent to trade allies to ensure that they identify all key program contacts for various project types, if they do not already do so.
>
> **Recommendation 4d:** Energy Trust and TRC should continue to review the application forms and processes to ensure they are clear and as easy to complete as possible. This may particularly help with obtaining more applications through non-trade ally contractors, as they were more likely to comment on this concern. This may also argue for more proactive communication with this group (see Recommendation 4b) to provide clear information on the application process.
>
> **Recommendation 4e:** Energy Trust and TRC should consider the feasibility and benefits of creating an online portal to allow contractors to check the status of submitted applications.

Conclusion 5: Non-HVAC contractors, especially building shell contractors, are not as likely to complete incentive applications for customers, something almost all HVAC contractors do. In some cases, this may reflect important differences in the contractor-client relationship between HVAC and other contractors. HVAC contractors may be willing to invest the time to assist with application because doing so represents a small proportion of the project cost and may help ensure continued work with the client (e.g., to maintain the equipment). By contrast, the commodity-like nature of some other measure types may mean that additional time and effort beyond installation may cut into a contractor's margin.

> **Recommendation 5:** Energy Trust may want to investigate reasons why non-HVAC contractors are less likely to help complete incentive applications. What is it about building shell projects or contractors that make them resistant to completing incentive paperwork, or why do HVAC contractors see it as important to complete the incentive paperwork? Learning this may help Energy Trust and the PMC devise approaches to incent such contractors to assist with

applications, increasing customer satisfaction and possibly increasing the number of projects completed.

Conclusion 6: Energy Trust decided to apply the SDP to the EB contract in 2021, requiring the implementer to use at least 20% of its contract award with diverse suppliers. To satisfy that requirement, the new implementer engaged 17 different firms, many which had not worked with Energy Trust before and may not have had a full understanding of Energy Trust and their programs. The implementer showed commitment to complying with the SDP by finding so many suppliers. However, in that process, they may have selected more supplier subcontractors than they could reasonably manage. Furthermore, some of these subcontractors may have needed more guidance or support, especially in the early phases of the implementer's overseeing of the Program. Progress has been made in improving some of the challenges with subcontractors for the current contract, but the potential remains for similar challenges to arise in future contracts.

Recommendation 6: Energy Trust should require that proposals to provide implementation services include plans to provide adequate orientation, training, and support to subcontractors that may be unfamiliar with Energy Trust programs and requirements. The proposal should further demonstrate that the primary contractor and any proposed subcontractors have the capacity to provide the required orientation, training, and support.

MEMO

Date: 3/25/2025
To: Energy Trust Board of Directors
From: Patrick Urain, Senior Program Manager, Commercial
Amanda Zuniga, Program Manager, Commercial
Leila Shokat, Evaluation Project Manager

Subject: Staff Response to Process Evaluation of the 2022-2023 Existing Buildings Program

The Process Evaluation of the Existing Buildings Program (the EB program or the program), conducted by ADM, sought to understand how the program has evolved in recent years, document key successes and challenges, and identify opportunity areas for the program. To address these objectives, ADM interviewed Energy Trust and Program Management Contractor (PMC) staff, and external collaborators the program works with on marketing, co-funding efficiency projects, and promoting offers to priority customers. Additionally, ADM interviewed allied technical assistance contractors (ATACs), trade ally and non-trade ally installation contractors, and customers who participated in the program between 2022 and 2023. All interviews were conducted in the second half of 2024. Findings and recommendations from this evaluation will inform the development of the upcoming request for proposals for program management, especially with regards to subcontractor training and internal resource planning, discussed below.

The evaluation found overall, customers, collaborators and market actors have very positive experiences with the program. While the program experienced some internal challenges in recent years with organizational changes and a transition to a new PMC, interviews indicated the support customers and trade allies receive from the program was not noticeably disrupted.

In 2021, the Existing Buildings Program expanded to include multifamily customers, previously served by a standalone program. The transition presented some initial challenges, with not enough internal resources focused on the multifamily sector. However, staff reported improvements as the program strengthened its multifamily focus, introduced new offers like Strategic Energy Management (SEM) and collaborated with the Residential Program on marketing efforts. The integration of multifamily into Existing Buildings went largely unnoticed externally, highlighting the program's ability to adapt while keeping the market stable. Looking ahead, ensuring the program has the resources it needs will be key to sustaining its success and continuing to serve the multifamily sector effectively.

An area of emphasis for the Existing Buildings Program in recent years has been evolving the program's approach to Anti-racism, Equity and Inclusion (AEI). Based on guidance from community partners in 2022, the program shifted to the use of the term AEI to focus beyond diverse representation and highlight that lack of racial diversity in both program delivery and participation may be due to systemic inequities such as discrimination, structural inequalities and bias. The program's AEI work spans multiple areas of the program including outreach, marketing and the design of offers.

The evaluation highlighted areas where the program has worked to advance AEI goals and where the program is continuing to develop and improve on this work. Success areas included expansion of language access in outreach materials, hiring bilingual outreach staff and energy advisors, and working alongside and deferring to community-based organizations (CBOs) to reach priority customers through trusted, established networks. The program is constantly learning and improving how it brings in diverse perspectives to shape its design. Although the Community-Based Liaison (CBL) Network was discontinued in 2024, program staff and management continue to work with small businesses and CBOs to help ensure offers reflect the needs and experiences of historically underserved communities. This approach is evolving as the program innovates and learns best practices, aiming to create more inclusive, effective solutions while staying committed to AEI.

Energy Trust's Supplier Diversity Program plays a crucial role in its commitment to better serving underserved and underrepresented communities while creating more opportunities for small, diverse and community-based businesses. Existing Buildings was the first major Energy Trust program to adopt new supplier diversity guidelines in 2021. This evaluation highlights opportunities to further improve how programs can work with diverse suppliers, benefiting both customers and workforce development in our industry. The program will ensure program management contractors have clear internal communication channels, a robust training and onboarding process for newer subcontractors, and will explore opportunities to simplify contracting processes.

The evaluation also identified opportunities to improve trade ally experience with the program. These include streamlining forms and application processes, providing an online application tracking portal, and offer program contact points for trade allies to reach out to with specific questions. The program is exploring options to improve the customer and trade ally experience through digitization. This feedback and the related recommendations will help the program understand how digitization could improve the trade ally experience.

The evaluation demonstrated the Existing Buildings Program's co-funding relationships with state agencies and CBOs have strengthened in recent years. Collaborators report positive experiences working with Energy Trust and believe these strong co-funding relationships have enabled customers to pursue efficiency projects more easily. One challenge highlighted in the evaluation is Energy Trust's budgeting timelines do not always match project timelines, which can sometimes lead to changes in incentive levels mid-project. With a transition to multiyear planning and a focus on digitization, the program will explore ways of addressing this challenge, possibly including a process to reserve incentives for a project, to avoid mid-project incentive level changes. Addressing administrative challenges will continue to be important as the program seeks additional co-funding opportunities in the future.

One area that continues to be a challenge for the program is serving small business customers. The evaluation highlighted the direct install channel as a success area in reaching new small business customers, and the program continues to explore new direct install offers. The program is researching best practices and innovative approaches used by energy efficiency initiatives at the local, regional and national levels to serve small business customers. This includes examining outreach strategies, tailored incentive structures and program delivery models that effectively engage these customers in other markets.

2 Introduction

This report covers the process evaluation of the 2022 and 2023 Existing Buildings Program ("the EB Program" or "the Program"). This is the sixth process evaluation of the EB Program and the first since the evaluation of the 2017 and 2018 program years, completed in 2019. The EB Program now includes the multifamily sector, which is covered in this evaluation. The Existing Multifamily Program was a separate program until 2021. Its most recent process evaluation was completed in 2020 and covered the 2018 and 2019 program years.

Implemented by a Program Management Contractor (PMC), with oversight by Energy Trust program management and marketing staff, the Program provides financial incentives and technical support to qualifying businesses in Oregon and Washington, focusing on energy-saving projects. It operates through a network of trade allies and Allied Technical Assistance Contractors (ATACs) who help identify and implement measures for various types of facilities, including offices, multifamily housing, and government buildings. In SW Washington, the Program offers specific gas-saving measures for NW Natural customers, functioning under a different regulatory framework.

The Program features both custom and prescriptive measures for energy savings. Custom projects undergo energy studies conducted by ATACs, while prescriptive measures use established savings estimates reviewed by Energy Trust engineers. Direct Install measures were available, primarily for lighting and smart thermostats, but the Program is now exploring new direct install opportunities.

The Program also includes Energy Performance Management services, which comprises Commercial Strategic Energy Management, Commercial Pay-for-Performance, and Building Operator Certification. However, those services are being evaluated separately and were not included in the scope of this evaluation.

Energy Trust coordinates and collaborates with several outside organizations to leverage the support that each offers to increase energy efficiency in a variety of building types:

- Energy Trust coordinates with Clark Public Utilities to promote custom projects in Southwest Washington and share costs and savings from those projects.
- Since 2020, the EB Program has worked with the Oregon Department of Energy's (ODOE) Energy Efficient Schools Program to support energy efficiency projects in K-12 public schools.
- Since 2020, the EB Program has worked with the Oregon Housing and Community Services' (OHCS) Oregon Multifamily Energy Program to support efficiency upgrades for income-qualified electric multifamily customers.
- The EB program collaborates with community-based organizations (CBOs) to increase access to program offerings.

The Program underwent several changes in 2021. First, Energy Trust selected a new PMC, TRC, to implement the Program in January of 2021, taking over from the previous implementer, ICF. Currently, TRC works with over 17 subcontractors to deliver program services.

TRC took over the Program as the COVID-19 pandemic was disrupting business operations and while the Program was undergoing two notable changes in design and approach:

1. Separation of lighting into a new stand-alone program. Prior to 2021, commercial lighting measures were part of Existing Buildings and in 2021 Energy Trust split those measures into a new program called Business Lighting. Lighting represented most Existing Buildings projects prior to 2021. In 2020 Energy Trust offered bonus lighting incentives to encourage projects during the height of the pandemic. These bonuses resulted in a flood of projects that carried over to 2021 causing further disruption to the transition.
2. Inclusion of Multifamily properties and measures into Existing Buildings. Prior to 2021, Energy Trust maintained a stand-alone program for Multifamily properties and measures. This changed in 2021 when Energy Trust chose to integrate these properties and measures into the Existing Buildings Program.

Additionally, in 2021, Energy Trust renewed its focus across all programs, including Existing Buildings, on recruiting individuals and businesses that have historically been underserved by their programs. Energy Trust published a DEI Operations Plan in 2018 and revised it in 2021, around the time TRC took over implementing the Existing Buildings Program. Energy Trust published a DEI Operations Plan in 2018 and revised it in in 2021, around the time TRC took over implementing the Existing Buildings Program. As part of these efforts, Energy Trust developed a Supplier Diversity Policy (SDP) to increase contracts with diverse businesses certified through the Certification Office for Business Inclusion and Diversity (COBID). The SDP[4] was included in the contracting requirements for the 2021 Existing Buildings Program Management Contract request for proposals, requiring a certain percentage of the value of the contract to go towards SDP qualifying firms. Therefore, the Existing Buildings' PMC contract with TRC was the first program management contract for which the SDP was implemented. The SDP was implemented more widely across large Energy Trust contracts in 2022, and was updated in 2024 to expand the qualification criteria beyond COBID-certified businesses.[5]

This process evaluation documents program changes since the last process evaluations; gives an overview of the Program's current structure, delivery and implementation strategy, and effectiveness in serving customers; and takes a forward-looking approach to understand how the Program needs to evolve to be successful in the future.

The goal of this process evaluation was to obtain feedback on program design and implementation that can be used by Energy Trust to deliver the Existing Buildings Program more effectively and efficiently. Specifically, the evaluation aims to answer the research questions and objectives identified in Table 2-1.

This process evaluation addressed these research questions and objectives through the following data sources and research activities: a review of program documentation and activities and interviews with

[4] Energy Trust officially adopted the Supplier Diversity Policy in 2022. As they developed the policy in 2020 and 2021, Energy Trust decided to make key parts of it, like the 20% spend on diverse suppliers, part of the contract for the Existing Buildings evaluation.

[5] COBID is an Oregon program that aims to promote diversity, inclusion, and economic opportunities for disadvantaged business enterprises, minority-owned businesses, woman-owned businesses, businesses owned by service-disabled veterans and emerging small businesses.

program and implementer staff, a variety of external collaborators and stakeholders, program participants, both trade ally and non-trade-ally contractors, and ATACs. Lighting contractors were not interviewed for this evaluation as lighting projects in 2022 and 2023 were managed through the Business Lighting Program rather than the Existing Buildings Program .

The remainder of this report is divided into six sections. Immediately following this section, Section 3 describes the research methods. Sections 4 through 7 present the results and findings from the data collection as they pertain to four primary topics identified in in Table 2-1. Finally, Section 8 presents our conclusions from those findings and the recommendations for continued program success.

Table 2-1: Evaluation Research Questions

TOPIC	RESEARCH QUESTION
Program History	How has the transition to a new PMC for Existing Buildings and a separate program for Business Lighting affected the Program? How has the incorporation of Existing Multifamily into Existing Buildings affected the Program? What recent changes have been made to the Program, and what changes are planned for the next year?
Program Operations	What successes has the Program experienced? What challenges has the Program encountered? How did they, or do they, plan to address them? Is communication between Energy Trust and the PMC effective and timely? Are the right people included in communications and program planning? How is the PMC managing its subcontractors? Are roles and responsibilities clearly defined, and is communication flowing well? How has subcontracting affected current operational processes such as program design, marketing, measure development, and outreach? How is the Program supporting Energy Trust's Diversity, Equity and Inclusion Operations Plan and ensuring equity in its program offerings? How does the EB program support referrals and customer participation in other Energy Trust programs, such as the Residential program, Business Lighting and Renewable Energy? How can Energy Trust and/or the PMC improve processes to increase efficiency for the organization and equity for customers?
Experience of Customers, Market Actors, and Collaborators	What strategies is the Program using to reach out to priority customers and trade allies, and how effective have those strategies been? What are the experiences of different customers (such as individual market segments, business sizes, etc.) when participating in various EB program offerings and services? What do they see as working well and what could be improved? What are the current experiences of the various market actors interacting with the Program – trade allies, non-trade ally contractors, distributors, ATACs, community-based organizations, etc. – and how might they be improved? How is the Existing Buildings program working with utilities to promote offerings? What do they see as working well and what could be improved? How is Energy Trust working with the Oregon Department of Energy (ODOE) to support energy efficiency upgrades in K-12 public schools? Is the collaboration enabling more measures to be completed?

TOPIC	RESEARCH QUESTION
Future Opportunities	What are the largest forced on energy efficient projects in the commercial and multifamily market segments right now? What additional drivers are anticipated over the next few years? Where are the biggest opportunities – in terms of market segments, geographic areas, and measures – for the Program over the next five years? What energy saving measures or services is the Program developing? Does the Program have the right mix of measures or offerings to achieve its goals?

3 Methods

The ADM team used the following primary data sources to conduct the research discussed in this report:

- Review of program documentation.
- Analysis of program data.
- Interviews with program staff and implementers.
- Interviews with trade ally and non-trade ally contractors.
- Interviews with staff from utilities, ODOE, OHCS, and CBOs.
- Interviews with Allied Technical Assistance Contractors (ATACs).
- Surveys of program participants.

The team used these data sources to address the overall market and program related research themes Energy Trust identified for this project in Section 2.

The next sections describe how we conducted each of these research tasks.

3.1 Document Review

The first task of this research project was to identify, obtain, and review a variety of reports and other program-related documentation. These documents informed our development of the interview guides and provided the evaluation team with important background information throughout the course of the evaluation.

3.2 Program Staff Interviews

One of the early tasks in the evaluation was to conduct interviews with program and implementer staff. In total, the ADM team conducted 11 interviews with 25 staff in roles related to program operations, new initiatives, marketing, outreach, and coordination.

Energy Trust provided the ADM team with a list of 27 potential interviewees: 15 were Energy Trust program staff, one was a consultant to Energy Trust, and 11 were employees of the Program implementer, TRC. The 27 identified staff covered all functional areas related to Program management and delivery:

- Management and operations.
- Engineering and measure development.
- Marketing and outreach.
- Coordination with other Energy Trust programs.
- Coordination with other agencies and with CBOs.

Multiple individuals were identified for each of the above areas.

In consultation with the Energy Trust evaluation staff, we developed in-depth interview guides that covered all topics related to the pertinent research questions identified in Table 2-1, specifically:

- The effect of the transition to a new PMC for Existing Buildings.

- The effect of the removal of lighting from the Program.
- The effect of the incorporation of Existing Multifamily into the Program.
- Recent and planned changes to the Program.
- Program successes and challenges.
- Communication between Energy Trust and the PMC.
- PMC management of its subcontractors.
- Support for referrals and customer participation in other Energy Trust programs.
- Ways to improve processes to increase efficiency and equity.
- Strategies to reach out to priority customers and trade allies, and their effectiveness.
- Coordination and collaboration with utilities, ODOE, OHCS, and CBOs.

The interview guide is included in the APPENDIX.

The ADM team completed interviews with 25 of the 27 identified staff, covering all the functional areas identified above. We conducted all interviews via MS Teams between late June and late August 2024.

In addition to addressing the above-identified topics, these interviews informed the development of interview guides and surveys used in primary data collection.

3.3 Interviews with Utilities and Collaborators

ADM conducted interviews with nine contacts of Energy Trust's utility partners, collaborating state agencies, and CBOs.

3.3.1 Instrument Development

In consultation with the Energy Trust evaluation staff, we developed interview guides that covered utilities' and collaborators' perspectives on:

- The nature of their collaboration with Energy Trust.
- The Program's ability to engage priority populations.
- The quality of and satisfaction with their relationship with Energy Trust.
- Suggestions for programmatic changes.

The guides included open-ended questions that allowed the interviewer to ask probing and follow up questions based on interviewees' responses. We created four interview guides: one for the utilities, one for ODOE, one for OHCS, and one for the CBOs. The interview guides are included in the APPENDIX.

3.3.2 Respondent Recruitment and Interview Completion

ADM's goal was to complete interviews with 10 to 11 interviews with the utility and collaborator staff. Energy Trust provided ADM with contact information of representatives from five utilities, three CBOs, and the two government agencies.

The ADM team fielded the interviews in September and October 2024. Energy Trust facilitated warm introductions for all the contacts via email, and then ADM reached out to each contact up to four

additional times via phone and email to request an interview. CBO contacts were provided a $100 gift card as a thank you for their time. Utility and government agency representatives were not provided gift cards, as they typically are not allowed to accept them.

ADM completed nine interviews across the 10 contacts (Table 3-1). Interviews were conducted over Microsoft Teams.

Table 3-1: Recruitment Efforts

	CONTACTS PROVIDED	INTERVIEWS CONDUCTED
Utilities	5	5
Community based organizations	3	2
Government agencies	2	2
Total	10	9

3.3.1 Data Analyses

The ADM team content coded interview responses to identify themes. Analyses are largely descriptive and related to respondents' characterization of their organization's collaboration with Energy Trust, the Program's efficacy in engaging priority populations, and suggestions for improvement.

3.4 Interviews with ATACs

The ADM team identified, recruited, and interviewed 10 ATACs, from a list of 25 current active ATACs that were not also sampled for the separate trade ally interview project.

Interviews focused on their current and recent experiences with the Program and how those experiences could be improved. In particular, the interviews addressed the following topics:

- Respondents' roles with the Program and project development and their perspectives on program processes and communication with program staff.
- Respondents' perspectives on whether and how the addition of the multifamily sector to the Program has had any impact on the types of projects they have done.
- If pertinent, how respondents' experiences working with the current PMC compared to their experiences with the former PMC.
- How projects are assigned to ATACs, what factors affect whether or not they install the projects they do the studies for.
- Respondents' perspectives on market trends over the past several years.
- Respondents' perspectives on the Program's DEI goals and objectives and how their work might relate to those goals and objectives.
- Respondents' perspectives on their customers' experiences with the Program.

The interview guide is included in the APPENDIX.

In addition to the above, the interviews collected respondent firmographics, information on the types of customers the respondents serve, any changes that have occurred over the past several years in the types served, and whether any reported changes have been influenced by working with the Program.

The ADM team attempted to schedule interviews with ATACs that had represented a variety of customer types and geographies. The team contacted all potential respondents using mail, email, and phone. To encourage participation and thank respondents for their time, we offered a $100 gift card to all who completed an interview with us. The ADM team interviewed 10 ATACs during September and October 2024.

3.5 Interviews with Contractors

ADM conducted interviews with 48 knowledgeable representatives from trade allies (TAs) and non-TA contractors that had completed Existing Buildings projects in 2022 or 2023.

3.5.1 Instrument Development

In consultation with the Energy Trust evaluation staff, we developed an interview guide that covered contractors' perspectives on:

- Program outreach.
- Experiences working with Program staff.
- Program processes.
- Implementers.
- Program changes.
- Future opportunities for the Program.

The guide consisted largely of open-ended questions, with some close-ended questions to assess awareness of Energy Trust communication types, attitudes about the Program's usefulness to their business, and to collect firmographics.

The majority of the questions were the same for TAs and non-TA contractors. Exceptions were:

- Non-TA contractors were asked whether they had considered becoming a registered TA with Energy Trust and, if not, why not.
- TAs were asked about information received from Energy Trust about changes to the Program and about upcoming program changes and events.

The interview guide is included in the APPENDIX.

3.5.2 Sampling

ADM's goal was to complete interviews with 30 TA contractors and 30 non-TA contractors, with the Custom and Standard program tracks and the Non-multifamily and Multifamily market sectors well represented in both groups.

Energy Trust provided ADM with files identifying contractors that had done Existing Buildings projects in 2022-2023, together with information on whether they were registered as Program trade allies during that time period. ADM removed contractors that had not done projects in either target track or sector as well as contractors that are also ATACs (who were interviewed as a separate group) or were sampled to be interviewed for a separate research project. ADM then deduplicated the remaining lists on company name so that no contractor company could be represented in interviews more than once. The above resulted in TA and non-TA contractor populations of 125 and 435, respectively. Table 3-2 shows how both contractor groups were distributed across program tracks and sectors and the completion targets that ADM set based on those distributions. As the table shows, the TA completion targets for the Custom track and Multifamily sector were hopeful. ADM planned to achieve the overall targets even if unable to obtain the specific track and sector targets.

Table 3-2: TA and Non-TA Contractor Interview Sampling Plan

Stratum	Population		Completion Target		% of N	
	TA	non-TA	TA	non-TA	TA	non-TA
Total	125	435	30	30	24%	6%
By Program Track						
Custom	12	47	≥4	≥8	≥33%	≥17%
Standard	118	403	≥16	≥16	≥14%	≥4%
By Sector						
Non-MF	107	278	≥12	≥8	≥11%	≥3%
Multifamily	40	171	≥14	≥16	≥35%	≥9%

[1] The completions across type (Custom or Standard) and across sector (Non-multifamily or Multifamily) do not sum to the total because some contractors do both types and/or work in both sectors.

During the contractor interviews, 10 respondents whom we had classified as non-TA contractors, based on information received from Energy Trust, self-reported that they were TAs. We describe below how we handled those cases.

3.5.3 Respondent Recruitment

The ADM team fielded the interviews in September and October 2024. We began recruitment by sending an advance letter on August 30 to all 125 TAs and all 435 non-TA contractors to let them know about the upcoming research. The letter explained the purpose and the expected duration of the interview and identified Energy Trust as the research sponsor. It explained the importance of each recipient's response in providing representative information and stated that respondents would receive a $50 gift card for completing the interview. It provided ADM contact information (name, phone, email) that recipients could use to get additional information or to schedule an interview. The letter also identified an Energy Trust contact to provide *bona fides* for the interview. Finally, the letter stated that the ADM team would follow up with an email and phone call if the recipient did not reach out to the ADM team.

ADM staff followed up the advance letter with emails on September 5 to all TAs and non-TA contractors for whom email addresses were available. The follow-up email provided the same information as the

letter. About three days later, ADM staff began phone calls to TAs and non-TA contractors for whom phone numbers were available. We made up to three phone calls to each contractor, prioritizing phone contact with contractors that completed multiple projects in the 2022-2023 timeframe.

During data collection, ADM obtained information that led to the reclassification of some of the contractors contacted for interviews. Ten individuals that had been identified as non-TA contractors in the Program data reported they were registered TAs. Contractors may register as trade allies for one or multiple Energy Trust programs and can complete projects with any program regardless of their status as a trade ally or not. This fact possibly could explain at least some of the misclassifications. ADM used an updated file of all registered TAs for all Energy Trust programs to confirm that those 10 respondents were registered Energy Trust TAs – for Existing Buildings in some cases and for other programs in other cases (most commonly, the Existing Homes Program). In discussion with Energy Trust, ADM decided to accept their self-reports and, further, to use the updated file of registered TAs to revise contractors' status, as needed, in our recruitment data.

Table 3-3 shows the disposition of contact efforts, by type of contractor. This shows that 120 of the contractors originally classified as non-TA contractors were reclassified – 22 as Existing Buildings TAs and 98 as TAs for other Energy Trust programs (mainly residential). In total, the ADM team completed or partially completed interviews with 48 contractors. Of those, 25 were Existing Buildings TAs, 5 were TAs for another Energy Trust program, and 18 were non-TA contractors.

In discussion with Energy Trust staff, the ADM team decided to retain the data from the five interview completions with TAs for an Energy Trust program other than Existing Buildings, as their responses to questions about their experiences with the Existing Buildings projects they completed would be as meaningful as responses from any other contractors. However, Energy Trust and the ADM team agreed to examine their responses to questions about their experience as TAs separately from the responses of Existing Buildings TAs, as those responses may partly reflect their interactions with the implementers of the Programs for which they were registered as TAs rather than with the Existing Buildings PMC. This is discussed in more detail in the Results section.

3.5.4 Data Analyses

The ADM team content coded interview responses to identify themes. Analyses are largely descriptive, with some cross-tabulation by contractor type. As noted above, the analyses relating to respondents' experiences as TAs (information received from Energy Trust) were done separately for the Existing Buildings TAs and the five TAs for other Energy Trust programs.

Table 3-3: Disposition Summary

	Existing Building TA	TA, Not Existing Building	Non-TA Contractor	Total
Classification of Contractors and Contact Information Available				
Original Count	125	0	435	560
Reclassified	+22	+98	-120	n/a
Total, after reclassification	147	98	315	560
Email address available	124	83	135	342
Phone number available	130	83	220	433
Recruitment Results				
Completion or partial[1]	25	5	18	48
Completion	24	5	18	47
Partial Complete	1	0	0	1
Contacted, no completion	11	0	32	43
Refusal	2	0	6	8
Did not pass screening[2]	9	0	25	34
No show, could not reschedule	0	0	1	1
Not contacted	94	78	170	342
Attempted, unable to reach	84	2	113	199
Bad contact information	2	0	15	17
Duplicate information	0	0	2	2
Did not attempt[3]	8	76	40	124

[1] Includes 10 completed with contractors who contacted the ADM team in response to the email recruitment.

[2] Typically indicated they could not recall doing any Energy Trust projects.

[3] Those not attempted either had completed only one or two projects or had been determined to be TAs for Energy Trust residential programs during the reclassification process and therefore were not prioritized for contact.

3.6 Interviews with Participants

The ADM team interviewed 67 participants from a stratified random sample of recent Existing Buildings Custom, Standard, or Direct Install projects. This yields at least 10% precision at 90% confidence for overall results.

3.6.1 Instrument

In consultation with the Energy Trust evaluation staff, the ADM team developed an interview guide that covered participants' perspectives on:

- History of program participation.
- Program marketing and awareness.

- Project identification.
- Program processes, including assistance received with the application.
- Future program opportunities.
- Firmographics.

The guide consisted of a mix of close- and open-ended questions. Close-ended questions were used to assess objective experiences (e.g., *How did you learn about the Energy Trust Incentive program? Did someone come to your workplace and identify ways to save energy?*) Open-ended questions were used to assess subjective experiences (e.g., *Please tell me why and how you decided to install equipment that would qualify for Energy Trust incentives.*) or to obtain additional details about responses to close-ended questions. The interview guide is included in the APPENDIX.

3.6.2 Sampling

ADM drew a sample from all participants with any non-lighting Custom, Standard, or Direct Install projects from Q4 2022 through 2023. Participants with only Midstream/Buydown projects were excluded, as contact information was not available for such participants. In addition, 130 Custom and Standard projects selected for the Existing Buildings impact evaluation, which overlapped in time with the process evaluation, were removed from the process evaluation sampling frame before sample selection. This was done to allow the impact evaluation to select and recruit high-impact projects while avoiding contacting the same individuals for both research efforts. We discuss the implications of this, below.

The objective of the current research was to interview participants about their most recent project. The ADM team identified all unique program participant contacts, together with each contact's most recent project. We identified 3,094 unique contacts associated with Custom, Standard, or Direct Install projects. However, some projects had multiple contacts. Deduplicating on multiple contacts associated with a given project reduced the count to 2,910 unique associations between one participant and one Custom, Standard, or Direct Install project. Completing interviews with 67 respondents would yield 90/10 confidence/precision for that size population.

One of the research objectives was to provide meaningful information relating to different project types (Custom or Standard), sectors (Multifamily or Non-multifamily), and states (Oregon or Washington). However, the projects were not evenly distributed across type, sector, or state – specifically, Standard projects were much more common than Custom, Multifamily were more common than Non-multifamily, and Oregon were more common than Washington (Table 3-4).

Table 3-4: Distribution of Projects by State, Sector, and Track

State	Sector	Track		
		Standard	Custom	Direct Install
OR	Multifamily	2,267	6	0
OR	Non-multifamily	494	82	30
WA	Multifamily	1	0	0
WA	Non-multifamily	28	8	0

Based on the distribution of projects as well as the patterns of co-occurrence of project type, sector, and state, ADM identified the following strata for sampling and analysis:

- OR-Standard-Multifamily
- OR-Standard-Non-multifamily
- OR Custom
- WA-all tracks, sectors
- OR-Direct Install

Generally, each participant belonged to a single stratum. Twenty-five participants had projects in two of the above strata; we assigned each of those to the stratum with the smaller population.

Table 3-5 shows the total count of unique participants in the sample frame, together with the target number of completions (*n*) needed to achieve 90% confidence at 10% precision. The table also shows the target completion count we established for each stratum and the 80% confidence interval (precision) that achieving the target count would produce for each. As the confidence interval, or precision, for a given sample size is affected by the proportion (P) of any given response to any given question, we show a confidence interval range that assumes P ranges from 0.2 to 0.5. Thus, for example, if we obtain 16 responses in the OR-Standard-Multifamily stratum and somewhere from 20% to 50% of them provide a certain response to a question, the 80% confidence interval for that response will range from ±6% to ±16%.[6]

Table 3-5: Participant Interview Sampling Plan

Strata	N	Target n	Target Confidence	Confidence Interval (P = 0.2 to 0.5)	% of N
Total	2,910	67	90%	4% to 10%	2%
OR-Standard-Multifamily	2,264	16	80%	6% to 16%	1%
OR-Standard-Non-multifamily	492	15	80%	6% to 16%	3%
OR Custom	88	15	80%	6% to 14%	12%
WA-all tracks, sectors	36	11	80%	5% to 14%	31%
OR–Direct Install	30	10	80%	5% to 14%	32%

The table also shows the percentage of each stratum ("% of N") needed to interview to achieve the target completion counts under proportional sampling. As this shows, target number of completions for the first two strata represented a small share of the respective sample frames, which allowed for sampling from those strata. The other strata were much smaller and required that we include all available participants in the sample.

3.6.3 Respondent Recruitment

The ADM team began recruitment with an email to sampled contacts with available email addresses (88% of the sample). The email explained the purpose, duration, and importance of participation; offered a $50

[6] The confidence and precision estimates incorporate the finite population correction coefficient.

gift card for completing the interview; requested available interview times; provided a phone number and ADM contact for information or to schedule or complete the interview; identified an Energy Trust contact to provide *bona fides*; and stated that we would follow up with a phone call.

About three days after the emails, we followed with phone calls to schedule and complete interviews. The phone calls followed a script similar to the recruitment email, including the promise of a $50 gift card for completions.

As noted above, 130 projects that were reserved for the impact evaluation and removed from the process evaluation sample frame. Those projects were larger, on average, than those remaining for the process evaluation (169,211 vs 14,749 kWh; 7,462 vs. 572 therms). To attempt to offset this difference as much as possible, ADM prioritized recruitment of larger projects within each stratum during the phone survey. To accomplish this, each phone contact was assigned a random number weighted by the project size and the call lists were ordered by that weighted random number.

Table 3-6 shows the disposition of contact attempts.

Table 3-6: Disposition Summary: Participants

Disposition	OR-Standard		OR Custom	WA	OR Direct Install	Total
	Multi-family	Not Multi-family				
Email address available	74	68	70	35	22	269
Phone number available	110	69	57	34	30	300
Email or phone available	125	75	75	36	30	341
Completion[1]	16	18	17	6	10	67
Refusal	8	2	6	7	1	24
No show	1	0	2	0	0	3
Not contacted	100	28	51	23	19	221
Unable to reach[2]	96	27	46	22	18	209
Bad contact info.	4	1	5	1	1	12

[1] Includes six completed with participants who contacted the ADM team in response to the email recruitment.

[2] For about 80% of these participants, attempts were discontinued because the completion quota for the pertinent group was achieved.

As seen in Table 3-7, prioritizing larger projects for interview recruitment did reduce the mean size difference between the impact and process evaluation samples; however, the projects in the impact evaluation sample did remain substantially larger, on average, than did those represented in the process evaluation interviews.

Table 3-7: Mean kWh and Therms for Process Evaluation Sample Frame and Survey Completions, Compared to Impact Evaluation Sample

Energy Savings Unit	Process Evaluation		Impact Evaluation
	Sample Frame	Survey Completions	
kWh	14,749	40,540	169,211
Therms	572	1,305	7,462

Table 3-8 shows the sample frame and completion totals by stratum, together with the confidence intervals for each stratum. As with Table 3-5, above, this table shows the confidence interval range for items with P (the proportion of respondents providing a given response to a question) ranging from 0.2 to 0.5.[7]

Table 3-8: Confidence Intervals for Participant Interview Completions

Strata	N	Achieved n	Confidence	Confidence Interval (P = 0.2 to 0.5)
Total	2,910	67	90%	4% to 10%
OR-Standard-Multifamily	2,264	16	80%	6% to 16%
OR-Standard-Non-multifamily	492	18	80%	6% to 15%
OR Custom	88	17	80%	6% to 16%
WA-all tracks, sectors	36	6	80%	10% to 26%
OR-Direct Install	30	10	80%	8% to 20%

Our recruitment and completion targets did not consider business or industry type, aside from whether the project occurred in the Multifamily or Non-multifamily sector. However, we examined whether completion rates differed by business type, which was available in the project tracking data. One group that stood out from the rest was Grocery: we achieved zero interview completions from the 161 participants in that category we attempted to interview. Thus, participants classified as the Grocery are not represented in our results. Completion rates varied from 18% to 35% for all other groups. Thus, among those represented, those identified in the tracking data as Retail, Office, and K-12 School are somewhat overrepresented and those classified as other types are somewhat underrepresented.

3.6.4 Data Analyses

The ADM team content coded interview responses to identify themes. Descriptive (i.e., univariate) analyses are shown for each stratum as well as combined across strata. As can be seen above in Table 3-8, the number of responses in the various strata represent widely ranging fractions of their respective populations. Therefore, in the combined results, the data are weighted so that the results more accurately represent the combined population. The weight for each stratum is calculated as the ratio of that stratum's share of the population divided by stratum's share of the survey completions (Table 3-9).

[7] The confidence and precision estimates incorporate the finite population correction coefficient.

Table 3-9: Stratum Weights

Strata	*N*	Achieved *n*	% of Sample Frame	% of Achieved *n*	Weight
Total	2,910	67	100%	100%	n/a
OR-Standard-Multifamily	2,264	16	78%	24%	3.26
OR-Standard-Non-multifamily	492	18	17%	27%	0.63
OR Custom	88	17	3%	25%	0.12
WA-all tracks, sectors	36	6	1%	9%	0.14
OR-Direct Install	30	10	1%	15%	0.07

The team used *chi-square* analysis to examine some relationships within the data. Such analyses used weighted data except when examining relationships between survey responses and strata. Analyses comparing strata used unweighted data since all respondents in a given stratum have the same weight.

4 Program History

This section focuses on three research questions relating to the 2021 transition to a new PMC and other changes that may have affected the Program.

> ***How has the transition to a new PMC for Existing Buildings and a separate program for Business Lighting affected the Program?***
>
> ***How has the incorporation of Existing Multifamily into Existing Buildings affected the Program?***
>
> ***What recent changes have been made to the Program, and what changes are planned for the next year?***

The responses to these questions are informed largely by the interviews with Energy Trust and TRC staff, along with feedback from market actors.

4.1 Transition to New PMC

Staff identified both positive and negative aspects to the transition to TRC as the new PMC. On the positive side, the staff contacts were largely complimentary about TRC's performance. Contacts were particularly complimentary about TRC's efforts to achieve DEI goals, their improvements in communication with Energy Trust over time, marketing efforts related to smart thermostats, their development of energy saving opportunities for SW Washington customers, and their adaptability to change over the tumultuous three years they have been implementing the program (see Section 5 for more details). However, some staff noted some challenges during the transition period and to the management of the Program established in the current contract. Staff reported inheriting a backlog of projects from the previous implementer and they reported a reduced transition timeline from the planned five months to two months due to contract issues between TRC and Energy Trust. This had an adverse impact on the incoming implementer's ability to serve customers as quickly as desired and cut into the time needed for a handoff from the old implementer to the new implementer. The eventual hiring of a transition manager helped to mitigate some of these challenges. In addition to the above, staff reported that TRC has struggled to manage the quantity and complexity of subcontracts associated with implementing the Program. As detailed in Section 5, the current PMC has 17 subcontractors (in response to a contract requirement for supplier diversity), which led to logistical challenges and delays in finalizing contracts, some confusion about the reporting structure, a cumbersome annual contract amendment process, and some performance issues. The overall impression from interviews was general satisfaction with the new PMC, though some aspects of the transition and new contracting structures presented challenges.

As detailed in Section 6.3.1, feedback from ATACs largely pointed to a straightforward transition. Eight of the 10 interviewed ATACs either reported a smooth process or said they were not aware of the change in PMC. The other two respondents discussed challenges with the current PMC and study review process, which are discussed further in Section 6.3.1.

Similarly, as discussed in Section 6.3.2, few contractors reported noticing the change in the PMC: only five of the 48 interview respondents expressed an awareness of the change in the PMC. Few responses

suggested any changes since 2021 in the time it takes to process applications or the frequency of communication with the Program.

4.2 Transition to Separate Business Lighting Program

Staff reported that removing lighting from Existing Buildings and creating a stand-alone Business Lighting Program in 2021 was very disruptive to staff and customers and ultimately, Energy Trust chose to fold downstream lighting measures back into Existing Buildings in Q3 of 2023 with full implementation of the change happening in January 2024. Multiple Energy Trust and TRC staff persons reported that removing lighting from the Program made it harder to engage with customers as lighting was often a "gateway" to other energy-saving projects. Outreach staff, those that directly communicate and engage with businesses, no longer had lighting as a tool to convince customers to do energy saving projects. According to staff, prior to 2021, lighting served as an initial and accessible step for businesses to take before committing to other energy saving projects. Having lighting split into another program then required Existing Buildings field staff to coordinate with Business Lighting staff. According to staff, this resulted in missed opportunities for comprehensive energy-saving projects for customers and could confuse customers interested in doing a lighting and non-lighting project. To correct for this, Energy Trust chose to re-integrate downstream lighting into the Existing Buildings Program starting in 2024.

None of the interviewed ATACs reported any impact of the creation of a separate Business Lighting Program, as they were not directly involved with lighting projects (Section 6.3.1). Some ATACs mentioned being involved in referrals involving lighting projects, but there was no indication that this process was affected by the creation of the Business Lighting Program.

Similarly, interviewed contractors – none of whom deal with lighting measures or interact directly with lighting contractors – reported no effect of creating a separate Business Lighting Program on their business or their customers (Section 6.3.1).

4.3 Incorporation of Existing Multifamily into Existing Buildings

Staff reported that incorporating multifamily buildings measures into Existing Buildings resulted in Multifamily properties and measures not receiving enough program support, at least initially. According to staff, incorporating multifamily has been challenging. Staff indicated that TRC and Energy Trust did not fully appreciate the work required to integrate multifamily properties and measures in 2021. "Everyone thought Multifamily would just roll up into Existing Buildings, but [Multifamily] is uniquely different. The audiences are different, completely different than any of the Existing Building's audiences." According to staff, the Multifamily aspects of the Program needed dedicated support and over the course of the last year or so, staff have worked to address this issue. For example, in 2024, Energy Trust staff worked across commercial and residential programs to develop a marketing plan that both program implementers, TRC for commercial and CLEAResult for residential, can use to market to multifamily properties. This approach was taken because multifamily properties often do not neatly fall into the commercial or residential categorization.

Feedback from the interviewed ATACs generally suggested few impacts from the incorporation of multifamily projects into the Existing Buildings Program, although it may have increased multifamily work

for some (Section 0). Six of the 10 interviewed ATACs reported doing little to no multifamily projects, so this program enhancement did not affect their projects. The other four were split between two who said the change led to more multifamily work and two who said it had no impact.

Most interviewed contractors reported no or little effect of incorporating multifamily properties into the Existing Buildings program on their business or their customers (Section 6.3.1). Most were not aware of the change. Six contractors reported awareness of the change, none of whom reported significant impacts.

4.4 Recent and Planned Changes

In the last few years, staff reported expanding the Program's range of services and measures to better meet the diverse needs of its customers.

Multifamily Strategic Energy Management (SEM) offering. Staff reported that the Multifamily SEM offering has made notable progress in supporting renters by coordinating and collaborating with the residential program to highlight no-cost offers for renters to help them save money on their energy bills. Additionally, this offering engages landlords and property managers to help them identify no- and low-cost ways they can save energy for both the tenants and the property owners.

No-cost Multifamily Ductless Heat Pumps Outside the Portland Metro area. One staff contact noted that funds had been allocated to a pilot that provides no-cost ductless heat pumps to multifamily properties in areas falling outside the Portland Metro area, including rural areas.

Diversification of offerings in Southwest Washington. One contact indicated that, prior to 2021, the measures offered in this area were limited to boilers and gas fryers, but currently the Program offers "a lot of" measures. This change has been tied to an improvement at TRC "on the engineering side of things for measure development."

Expansion of the Direct Install offering. One staff contact pointed to the Program's "really great success" with expanding the Direct Install offering with commercial businesses. According to this contact, that expansion was aided by "lots of coordination across the Programs, which has been really great."

Staff contacts also described several ways in which the Program has been able to expand the reach of existing offerings, through operational improvements. This is discussed in Section 5.

Staff reported the following plans for the Program in the next few years:

- Developing new measures like a no-cost pilot program for commercial heat pumps in rural areas. This initiative is starting with no-cost installations and then will gradually transition to co-funded opportunities – that is, Energy Trust and other agencies will support the cost of installation with the customers – allowing more small businesses to receive heat pumps with limited financial burden. This pilot began with the assistance of rural CBOs and is targeted at rural and non-Portland metro areas.
- Using utility usage data to identify energy saving opportunities and targeting customers with marketing to realize those opportunities. AMI data allows customers to be segmented based on

their energy usage profiles, allowing for personalized communication and tailored energy-saving recommendations.

- Continuing support for the recently implemented Multifamily SEM effort. Staff indicated that the Multifamily SEM effort has initially been successful and they noted that there are many opportunities to conduct this offering at facilities throughout the service territory. In coming years, they are planning to continue to increase participation in this offering.
- Carrying out direct-install efforts in rural areas.

5 Program Operations

This section focuses on six research questions relating to program operations:

> ***Is communication between Energy Trust and the PMC effective and timely? Are the right people included in communications and program planning?***
>
> ***How is the PMC managing its subcontractors? Are roles and responsibilities clearly defined, and is communication flowing well? How has subcontracting affected current operational processes such as program design, marketing, measure development, and outreach?***
>
> ***How can Energy Trust and/or the PMC improve processes to increase efficiency for the organization and equity for customers?***
>
> ***How is the Program supporting Energy Trust's Diversity, Equity and Inclusion Operations Plan and ensuring equity in its program offerings?***
>
> ***How does the EB program support referrals and customer participation in other Energy Trust programs, such as the Residential program, Business Lighting and Renewable Energy?***
>
> ***What successes has the Program experienced? What challenges has the Program encountered? How did they, or do they, plan to address them?***

The responses to some of these questions are informed exclusively by the interviews with Energy Trust and TRC staff, while feedback from market actors also inform some responses.

5.1 Program Management and Communication

As detailed in the following paragraphs, the Program has experienced challenges related to managing the quantity and complexity of subcontracts associated with implementing the Existing Buildings Program. Managing numerous subcontractors has increased the complexity of implementing the Program. The need for coordination among multiple subcontractors has led to logistical challenges and delays in finalizing contracts, which can affect the timely implementation of program elements. Further, staff reported that at times subcontractors were not sure if they should be reporting to the implementer or Energy Trust, resulting in miscommunication across the groups.

Energy Trust and TRC Staff experienced challenges in communication and coordination early in the transition, which have largely improved over time. Energy Trust and TRC Staff reported there are regular interactions between corresponding groups at each organization and that these regular meetings help in maintaining a steady flow of information. Staff from both organizations reported that there were some difficulties in communication in 2021. For example, some staff contacts reported some confusion among subcontractors about whether they should report to TRC or Energy Trust, which may have resulted from miscommunication between TRC and Energy Trust. One key Energy Trust staff person described the communication between the two groups as a "mix" of positive and negative and another key staff person noted that TRC seemed to develop new measure offerings without the input of the processing team, which resulted in miscommunication between the groups and "issues." (This is discussed immediately

below.) However, as the groups started to work together more, they developed processes and systems that facilitated communication better as the Program evolved.

Having 17 different firms as part of the implementer contract with Energy Trust became an administrative burden. Staff reported logistical difficulties in managing yearly contract amendments between TRC and Energy Trust, with TRC often not receiving their prime contract until the end of December or early January. TRC then must execute 17 subcontracts quickly so the subcontractors can get paid or the subcontractors wind up working for weeks or months without getting paid, operating on the hope they will get paid eventually. This creates a cash flow problem, especially for smaller firms, with an adverse impact on the ability to maintain consistent program operations. Staff indicated a need to simplify and move up the yearly amendment process for subcontracting to ensure timely execution of subcontracts and reduce administrative burdens.

The complexity of subcontractor management contributed to misunderstandings about correct lines of communication. Several staff reported that subcontractors were not always clear as to who they answered to, sometimes bypassing the PMC and going to Energy Trust. This resulted in miscommunication across the groups and in subcontractors' receiving different directions or guidance based on who they reported to or asked questions of, Energy Trust or TRC.

There were notable problems with two subcontractors in the key role of community engagement. According to a key staff person, those subcontractors struggled to coordinate with Energy Trust and other outreach subcontractors, resulting in their not adequately representing Energy Trust in front of customers and at community events. Furthermore, according to one staff person, one of these subcontractors struggled to hire outreach staff and, when they did, hired unqualified staff. As one contact noted:

> *"We need our field staff to go out and start meeting with these community based organizations and stakeholders and … there was no training provided to these staff. …So we were asking people who are not practitioners of community engagement to now start going out and interacting in communities."*

This contact in particular noted the effect of this issue in work with tribal communities:

> *"They feel they haven't had the training to work in a tribal community, so they go there and they treat a Housing Authority like it's a community based organization, not like a government department."*

Staff suggested these two subcontractors were not able to fulfill their roles; these staff did not provide an assessment as to why they were unable to fulfill their roles. However, during the draft review process of this report, staff reviewers suggested that additional training for each of these subcontractors may have been beneficial as they were each new to working with Energy Trust. Additionally, as noted below in Section 5.2, staff contacts reported improvements by the implementation team in community engagement over time.

Implementer and Energy Trust staff expressed frustration with developing new measures, especially for small businesses. Key implementer staff reported that the measure development process and the cost effectiveness tests applied to developing measures make it especially difficult to identify measures for inclusion in the program, especially measures for small business customers. The current process and cost effectiveness tests make it difficult to develop measure options for small business customers. Energy Trust

staff expressed frustration with the implementer for not identifying a strategy and thought process that could expand upon the list of useful measures for small businesses.

5.2 Diversity, Equity, and Inclusion

This research question is informed exclusively by the findings from interviews with program staff. However, note that Section 6.1, which addresses program outreach including outreach to priority populations, is informed also by findings from interviews with ATACs and contractors.

Staff interviews demonstrate that Energy Trust and TRC took several actions to make Existing Buildings a more equitable program. In general, Program staff were positive about TRC's efforts to achieve DEI goals:

> *"I have been impressed with [TRC's] efforts to meet our DEI goals."*
>
> *"[Working with TRC has] been positive. During the last rebid – there were a lot of calls to be more inclusive and raise equity. People have taken to heart the idea of supporting DEI work."*

In particular, staff respondents noted successes in community engagement, including through work with CBOs, to better serve low-income, rural, and non-English-speaking populations. However, the success of some efforts varied, and some respondents identified continuing challenges to achieving DEI goals. The following paragraphs summarize these comments, identifying actions the Program has taken to support Energy Trust's DEI efforts and the respondents' perspectives on how these actions fared through the course of implementation.

Establishing DEI goals and metrics is an ongoing effort. Several respondents spoke to the issue of goals and metrics, including how they can be applied to specific aspects of the Program. This is an ongoing effort, and some respondents identified challenges. One noted that Energy Trust was working to have metrics especially focused on tribal communities, which often get lumped into rural engagement despite having distinct needs and concerns. Another described efforts to track demographic information, noting that, at that time, there was no place to store that information digitally, which made it challenging to report. One respondent noted that Energy Trust was developing a memo to document the process for tracking participant demographics.

The Program has been generally effective in conducting outreach to priority populations. Program staff highlighted efforts to reach priority populations, including non-English-speakers as well as low-income and rural populations. Part of this comes from success in working with CBOs. Despite some initial challenges (see Section 5.1, above), one staff contact said:

> *"There seems to be some success in working with community based organizations to learn better about our customers and figure out better ways for program delivery to address the underserved populations that we have."*

Staff reported that the Program has been working on a language access plan to improve outreach to more communities. To date, the Program has produced marketing collateral in seven languages, with plans to revisit their efforts and possibly produce materials in other languages. According to staff, campaigns specific to Spanish-speakers have visually and culturally connected with Spanish-speaking communities, something they had not done as successfully prior to 2021. One staff contact also noted that the Program offers childcare and food as encouragements to come to SEM training. Staff contacts also noted having

established relationships within the affordable housing community and regional staff serving southern and eastern Oregon.

Staff noted that TRC and their subcontractors hiring Spanish-speaking energy advisors was a real success of the Program to support Latino-owned businesses. These staff members can overcome previously existing communication barriers between small Latino-owned businesses and the Program.

The Program has had mixed success with efforts to target small businesses and multifamily properties. The program targeted small businesses, a customer group that historically has been underrepresented in Energy Trust programs. Staff reported TRC struggled to develop a set of efficiency offerings that would be attractive to small businesses. Some Energy Trust staff noted that TRC was in a difficult position trying to create program offerings that would appeal to multiple audience types: small businesses, large businesses, and multifamily properties. Staff indicated that the Program has made some progress in reaching smaller businesses and multifamily properties in 2024, but they also noted they did not reach their savings goals for these groups in the first three years after TRC took over Program implementation.

Using diverse suppliers for program implementation addressed DEI objectives but created other challenges. Energy Trust's Supplier Diversity Requirement meant that the implementer had to use at least 20% of their contract to hire diverse subcontractors, and the implementer subcontracted with 17 firms to deliver the Program and meet this requirement. One staff respondent indicated this demonstrated TRC's efforts to meet DEI goals including increasing the number of diverse suppliers Energy Trust works with and expanding Energy Trust's ability to recruit new audiences to the Program. However, another staff respondent noted that, while bringing in diverse suppliers is good, it is not the long-term solution. That respondent noted that TRC needs more diverse *staff* within the Program. Another respondent noted that subcontractors did not all receive the same training and information about things like how to present themselves in the market. There were considerable challenges to getting consistent communication to all subcontractors and ensuring that all subcontractors had the information necessary to fulfill their obligations. Furthermore, some staff noted there appeared to be some confusion, especially during the first two years of TRC's implementation of the Program, about who should be leading the subcontractors, TRC or Energy Trust, which caused confusion among the subcontractors themselves.

Working with community-based liaisons (CBLs) to inform program development did not work as well as planned. The Program hired a group of CBLs organizations to help guide the Program to achieve its DEI goals. Based on staff interviews, there appeared to be a misalignment of what the CBLs saw as their role and what program staff saw as the role of the CBLs. For example, program staff reported CBLs were there to do things like review program marketing campaign material to make sure it was culturally appropriate. Instead, according to staff, the CBLs provide organizational-level critiques of how Energy Trust had failed to reach specific groups historically. Program staff were looking for actionable ways to drive targeted groups to the Program and the CBLs were offering guidance at an organizational or policy-level plane. Ultimately, the CBL network was paused in 2024 because the CBL process was not working as envisioned.

5.3 Cross-Program Collaboration and Referrals

Program staff were largely positive about cross-program collaboration and referrals, with some caveats. One contact noted that, "for the most part, Existing Buildings does a good job of handing off" projects to

other programs. In particular, "TRC does a good job when Energy Trust is the conduit." Some contacts observed in particular that referral to the Business Lighting Program "is handled well" and also pointed to program "crossover" relating to obtaining federal grants for renewables for tribal communities.

Staff noted two challenges. Some staff reported difficulties successfully coordinating with the Business Lighting Program to leverage one particular project at a customer site into other projects. Another contact noted that SEM coaches "could do more to identify opportunities beyond O&M and move to capital." According to that contact, "we refer people to go look at the website, which is essentially saying the customer won't do anything."

Feedback from market actors and program participants provides some evidence of successful cross-program referrals. Most ATACs reported positive experiences with the referral process (Section 6.3.1), and about one in seven interviewed participants reported speaking with a program representative about renewable energy or the lighting program (usually the latter; Section 6.2.8). Custom and multifamily participants, and those from large organizations, were more likely than others to report such conversations, suggesting that program representatives are making proactive efforts to identify referral opportunities, albeit mainly for lighting projects. Contractors provided no evidence of referring customers to other Energy Trust programs or other contractors that could help them save energy, but that appeared to reflect the nature of their work rather than to any impediments in the process itself (Section 6.3.2).

5.4 Program Successes and Challenges

As seen in the foregoing sections, staff reported both program successes and challenges. The following paragraphs summarize what the staff contacts themselves noted as the key successes and challenges.

One of the key successes was in the Program's DEI efforts, as detailed above. Several staff specified that the Program has made progress in supporting its DEI goals, including increased engagement with CBOs and tribal nations and providing culturally responsive communication. While there is still room to improve in this area, staff informants regarded these efforts as a key program success.

Other aspects of marketing and outreach were identified as successful. One contact noted that TRC did a "nice job" of marketing for commercial smart thermostats. The marketing team used unique methods to drive interest in smart thermostats by commercial customers, especially small businesses, which "has really driven interest in the Program." In addition, outreach staff noted that partnering with other implementers for outreach efforts has been a success. According to one: "The program used to be more siloed and now there is a more unified approach which is good. Customers are seeing they can be eligible for more than one program."

Several staff contacts indicated that contractor development has been a success. One characterized the management of trade allies as a "good focus on workforce development," and another pointed to an increased number of contractors in each cohort. One reason cited for this is the use of trade ally coordinators in various areas of the state, such as Eastern and Southern Oregon.

Another success was in the diversification of offerings in Southwest Washington and improvement in TRC's measure development staff in that area. According to one contact: "Their measure development team does fantastic job on that now."

Finally, an overall success was the staff's flexibility in adapting to change. A key staff leader reported that, since 2021, the Program has undergone changing requirements and dealt with conflicting guidance. Specifically, the economic impacts of the COVID pandemic resulted in a change in program priorities after new opportunity areas for the Program had already been established and budgeted for. Among the changes that occurred were the institution of incentive bonuses to keep the Program going. Those incentive bonuses had greater than anticipated results, which then shifted the emphasis to managing the budget. That staff contact identified the Program staff's flexibility and adaptability in the face of these changes as a "big success."

An overarching challenge relates to the transition to the new PMC. As noted in Section 4, outreach staff reported notable challenges related to inheriting the previous implementer's backlog of projects and a transition timeline that was three months shorter than planned. As a result of the backlog of projects, the implementer did not serve customers as quickly as desired. The eventual hiring of a transition manager helped to mitigate some of these challenges.

Managing subcontractors has been challenging. The implementer hired 17 subcontractors to manage and the quantity and complexity of these subcontracts has been challenging for the implementer to oversee and Energy Trust to understand.

Merging Multifamily into Existing Buildings also produced challenges. The acquisition of the Multifamily Program into Existing Buildings required extensive process revisions and database updates which took longer than anticipated.

Recent changes to incentive check processing have led to some customer confusion. Energy Trust changed how it processed incentive checks, and these changes included checks' being sent to customers without memo lines, meaning sometimes customers did not know they received the incentive check because it had been sent to a different department. This results in confusion for the customer and those customers sometimes report that confusion to the implementer.

Some challenges are of a "chronic" or ongoing nature and are often identified in process evaluations of efficiency programs in general, not just Energy Trust programs. Staff identified four such challenges: 1) a difficult measure development process because of standards imposed by the utility commission including complying with cost effectiveness standards; 2) reaching customers in rural locations; 3) lack of full contact info for some eligible customers in some areas; and 4) continued impact of Covid and supply chain disruption.

6 Experience of Customers, Market Actors, and Collaborators

This section addresses the research questions identified in the third section of Table 2-1, "Experience of Customers, Market Actors, and Collaborators." It is subdivided into five sections, each addressing a single research question or related set of questions.

6.1 Program Outreach

This section addresses the following research question:

> ***What strategies is the Program using to reach out to priority customers and trade allies, and how effective have those strategies been?***

As detailed in Section 5.2, the Program has carried out increased outreach to priority populations through engagement with CBOs and tribal nations and providing culturally responsive communication, including collateral translated into multiple languages. Interviewed CBO contacts indicated that the CBOs act as intermediaries for the Program with their constituencies, conducting the outreach directly on behalf of the Program (see Section 6.3.3). Those contacts supported this approach as they are already heavily involved in customer engagement and "know what's best."

The ADM team included some questions in ATAC and contractor interviews to shed light on the Program's efforts to reach priority populations. As detailed in 6.3.1, ATACs were evenly split regarding awareness of the Program's DEI goals and recollection of any Program guidance on reaching priority populations. Two of the 10 interviewed ATACs said that studies targeting priority communities received a higher priority from the Program than did some other studies. However, the other eight were unaware of any specific Program outreach strategies for those populations.

Trade ally and non-trade ally contractors offered some observations about how the experience of program participants differed based on the participants' size, business type, or location. Only two offered comments that specifically addressed an identified priority population – in this case, customers in more rural locations. Neither comment suggested any particular challenges for those customers. However, one respondent did suggest the need to improve outreach to commercial customers in rural areas.

The program participant interviews included questions about the size and ownership or leadership of the respondents' organization as well as languages spoken with that organization's customers. The ADM team examined whether any of those factors were associated with whether the respondent was a repeat participant, how the respondent (if not a repeat participant) learned about the Program, and whether anyone had visited the respondent's location to identify savings opportunities.

As detailed in Section 6.2, results suggested that both business size and leadership demographics were related to some of these items. Neither business size nor leadership demographics was related to repeat participation or to having learned about the Program from a program representative. However, some evidence suggests that smaller businesses and organizations may be at a disadvantage because they do not receive the same level of direct outreach efforts as larger ones. Specifically, they were less likely than larger ones to say that someone came to their workplace to help identify savings opportunities or to say

they learned about the Program from a market actor and more likely to say they learned about it through their own efforts, by visiting the Energy Trust website. Respondents that represented organizations owned or led by women or persons of color did not differ from others in terms of how they learned about the Program. They were, however, *more* likely than others to report that someone came to their workplace to help identify savings opportunities. Respondents who reported they conducted business in Spanish with some customers did not differ from other respondents on any of the above items.

6.2 Customer Experience

This section addresses the following research questions, identified in Table 2-1:

> ***What are the experiences of different customers (such as individual market segments, business sizes, etc.) when participating in various EB program offerings and services? What do they see as working well and what could be improved?***

As discussed in Section 0, descriptive (i.e., univariate) analyses are shown for each stratum as well as combined across strata. The stratum-level results use unweighted data, while the results combining the strata use weighted data. Since the combined results use weighted data, some respondents count more than others. Therefore, the following discussion generally refers to what *the responses indicate about the percentage of participants* with a given experience rather than the percentage of *respondents* with that experience, since the two may not be the same.

Chi-square analyses of the relationship between two items use weighted data. Readers should recall that stratum-level results have lower precision than the combined result and should exercise caution in interpreting stratum differences unless the report states that the difference was statistically significant.

6.2.1 Participation History

The Direct Install and Standard Tracks draw many first-time participants, while the Custom Track is more dominated by repeat participants. Results indicate that nearly two-thirds of participants were first-time participants. Direct Install participants were the most likely to be first-time participants, followed by Oregon Standard Multifamily and Non-multifamily, Washington, and Custom participants (Table 6-1). The difference between Direct Install participants and the other strata combined was statistically significant (*chi-square* = 4.02, p = 0.04) as was the difference between Custom participants and the other strata combined (*chi-square* = 6.75, p = 0.009).

Table 6-1: First Time Participant

	Valid *n*	%	%, Compared to Other Groups
OR Direct Install	10	80%	Higher than all others combined
OR Standard Multifamily	16	63%	
OR Standard Non-multifamily	18	56%	
WA-All	6	33%	
OR Custom	17	24%	Lower than all others combined
Combined (Weighted)	67	60%	

Repeat participants varied considerably in the number of previous projects, when they occurred, and what they involved. As Table 6-2 shows, repeat participants reported anywhere from one time prior to hundreds of times. Their first year of participation spanned most of the Program's existence. The most common prior measures installed were insulation and windows, followed by heat pumps and lighting. The table shows counts rather than percentages for the individual strata because of the small numbers of respondents in each stratum who reported prior participation; however, the table shows weighted percentages for the combined results. The small counts for this subset of respondents argues against drawing conclusions about stratum differences.

Table 6-2: Prior Participation

Response	OR Standard Multifamily	OR Standard Non-MF	OR Custom	WA-All	OR Direct Install	Combined (Weighted)
Valid *n*	5	7	13	4	2	23
Repeat Participants' Number of Prior Projects						
1 to 2	2	4	3	1	0	42%
3 to 5	1	1	0	2	1	18%
6 to 10	0	0	1	0	0	1%
11 to 20	2	0	2	1	1	30%
21 to 50	0	0	4	0	0	2%
More than 50	0	0	2	0	0	1%
Not specified	0	2	1	0	0	6%
Year of First Project (Repeat Participants)						
2020 to Present	2	0	1	1	1	30%
2015 to 2019	0	4	6	3	1	16%
2010 to 2014	2	0	3	0	0	30%
Before 2010	1	2	2	0	0	21%
Don't know	0	1	1	0	0	3%
Measures Installed (Multiple Responses Allowed)						
Insulation	2	3	0	0	0	37%
Windows	2	1	1	0	0	32%
Heat pump	1	0	1	0	0	15%
Lighting/controls	0	3	7	2	1	13%
HVAC and controls	0	1	9	0	1	8%
Fryer	0	2	0	1	1	6%
Appliances	0	1	1	0	1	4%
Boilers	0	1	2	1	0	4%
Mech. systems[1]	0	0	3	1	0	2%
RCx	0	0	2	0	0	1%
Solar	0	0	1	1	0	1%
Other[2]	0	0	3	0	0	2%

[1]Not otherwise specified. [2]Programmable thermostat, steamers, steam traps (one mention each)

6.2.2 Awareness

First-time participants learned about the Program from a wide range of sources, with the relative prevalence of reported sources varying for large and small organizations. First-time participants were asked how they learned about the Program. Nearly two-thirds learned about it from a market actor, such as a contractor or vendor (Table 6-3). Other frequent sources were program representatives, word of mouth, and the Energy Trust website.

Table 6-3 : Sources of Awareness (Multiple Responses Allowed)

Source	OR Standard Multifamily	OR Standard Non-MF	OR Custom	WA-All	OR Direct Install	Combined (Weighted)
Valid *n*	11	11	4	2	8	44
Market Actor	64%	45%	50%	50%	13%	60%
Contractor	45%	9%	50%	0%	13%	39%
Vendor	18%	27%	0%	0%	0%	19%
Other	0%	9%	0%	50%	0%	2%
Energy Trust Website	27%	9%	25%	0%	13%	24%
Word of Mouth[1]	9%	9%	25%	50%	25%	10%
Program Representative	9%	0%	25%	0%	38%	8%
Advertisement	0%	0%	0%	0%	13%	<1%
Professional affiliation[2]	9%	18%	0%	0%	0%	10%
Don't recall	0%	18%	0%	0%	0%	3%

[1]For the Standard strata, all word of mouth reports were from a coworker. For the other strata, they either were from a property manager or landlord or information learned at an event.

[1]One was an Energy Trust trade ally, one reported having "worked with Energy Trust for 20 years," and one worked the California Public Utilities Commission.

Larger organizations (more than 10 employees) more commonly reported market actors as a source of program awareness than did smaller organizations (72% vs. 23%; *chi-square* = 11.04, p = 0.001). By contrast, smaller organizations more commonly reported learning about the Program from the Energy Trust website (23% vs. 0%; *chi-square* = 3.63, p = 0.06).[8]

A substantive share of participants suggested increasing awareness of the Program through more advertising or direct outreach, making more effective use of contractors, or improving the website. When asked how to make it easier for organizations to learn about Energy Trust assistance, one-quarter of respondents said nothing is needed, and it is easy to find information about the Program, but other respondents offered a range of suggestions (Table 6-4). The most common of these suggestions was to provide more advertising, followed closely by relying on contractors and vendors. Other common suggestions were to conduct more direct outreach to customers (e.g., by calls, visits, and emails) and to improve website accessibility. A less common suggestion was to conduct some form of community outreach.

[8] Since this set of results clearly indicate that organization size was related to source of program awareness (relating to market actors), we relaxed the standard criterion of $p \leq .05$ for the second finding (relating to website).

Table 6-4 : How to Make It Easier to Learn about Energy Trust Assistance (Multiple Responses Allowed)

Suggestion	OR Standard Multifamily	OR Standard Non-MF	OR Custom	WA-All	OR Direct Install	Combined (Weighted)
Valid *n*	16	18	17	6	10	67
Nothing needed	19%	50%	35%	17%	30%	25%
More advertising	25%	11%	12%	17%	40%	22%
Use contractors more	19%	28%	6%	17%	10%	20%
More direct outreach	13%	22%	53%	17%	60%	16%
Improve website	19%	0%	6%	0%	0%	15%
Community outreach[1]	0%	11%	0%	50%	10%	3%

[1]Six responses. Two respondents suggested working with county permit offices to inform permittees about the program. One each suggested working with "hospitality groups" (e.g., the Oregon Restaurant & Lodging Association) and the Community Associations Institute, a homeowners association advocacy group. One suggested doing outreach at farm fairs. One simply referenced doing community outreach, without identifying any specific organizations or event.

The suggestion to conduct more advertising was much more common among respondents who reported learning about the Program from the Energy Trust website than from those who reported another source of awareness (62% vs. 15%; *chi-square* = 11.53, $p = 0.001$). This may suggest that respondents who learned about the Program by visiting the website were unaware of the advertising that Energy Trust conducts.

6.2.3 Motives for Doing Energy Efficient Upgrades

Participants carry out upgrades to save on energy bills and otherwise be more energy efficient. The most common reasons for doing energy efficient upgrades were to save on energy bills and to be more energy efficient generally (Table 6-5).

Table 6-5: Reason for Energy Efficient Upgrades (Multiple Responses Allowed)

Reason for Upgrade	OR Standard Multifamily	OR Standard Non-MF	OR Custom	WA-All	OR Direct Install	Combined (Weighted)
Valid *n*	16	18	17	6	10	67
Save on energy bills	50%	50%	41%	67%	90%	50%
More energy efficient[1]	44%	56%	65%	83%	40%	47%
Building comfort	19%	17%	12%	0%	0%	18%
Environment	19%	11%	12%	0%	20%	17%
Better equipment[2]	13%	6%	12%	17%	10%	11%
Other requirements[3]	13%	6%	18%	0%	0%	11%
Recommendations	0%	6%	12%	0%	0%	1%

[1]Not specified whether to save money or for other reasons.

[2]For example, less noisy or better performing.

[3]The equipment was required because of other identified or unidentified requirements or needs.

The interview did not explicitly ask whether the equipment upgrade represented an early replacement or was at end/near-end of life, but somewhat less than half (43%) of respondents volunteered that they needed to replace their old or broken equipment. All such respondents also identified a reason for upgrading the efficiency of the replaced equipment.

6.2.4 Upgrade Identification

The interviews explored the types of assistance that respondents received, including whether a program representative or some type of market actor visited their site to help identify energy saving opportunities and who, if anyone, they consulted with about equipment selection once opportunities were identified.

Frequency and Sources of Assistance

Most participants had assistance from a program representative or market actor in identifying savings opportunities, and the assistance was nearly equally likely to be initiated by the participant proactivity as by the program representative or market actor. Responses indicate that just over one-quarter of participants received some type of site visit to identify savings opportunities, most commonly a program representative; somewhat less than two-thirds of participants did not receive a site visit but consulted with a contractor or vendor in identifying the equipment to be installed; about one in eight identified the equipment with no assistance (Table 6-6). All Direct Install participants indicated a visit by a program representative – this makes sense in light of how the Direct Install offering works.

Table 6-6: How Participants Identified Energy Saving Opportunities [1]

How Identified	OR Standard Multifamily	OR Standard Non-MF	OR Custom	WA-All	OR Direct Install	Combined (Weighted)
Valid *n*	16	18	17	6	10	67
Someone visited site	25%	17%	88%	67%	100%	27%
Program rep.[2]	25%	6%	65%	17%	100%	24%
Market actor	0%	6%	24%	50%	0%	2%
Someone else[3]	0%	11%	41%	50%	0%	4%
Consulted market actor	63%	67%	0%	17%	0%	60%
No assistance[4]	13%	17%	6%	17%	0%	13%

[1]This table represents responses to two questions. The first question asked, "Did someone come to your workplace and identify ways to save energy? If so, who?" Multiple responses were allowed, but most respondents gave only one response. The second question, displayed to those who said that nobody came to the workplace, was "How did you identify the equipment you decided to install?" That allowed two responses: 1) Consulted with contractor or vendor; and 2) Other (open-ended). All "other" responses indicated no external assistance was received.

[2]Three respondents reported a utility representative, but the context made it clear it was a representative of the Energy Trust program.

[3]Two referenced their SEM participation. Two each identified a utility representative or said they were not sure who it was.

[4]Respondent or internal company source identified the equipment.

In just over half of the cases involving site visits, it was the person who visited the site who contacted the participant to offer that service, but customers were nearly as likely to seek out the visit proactively. ADM examined whether the origin of the site visit idea was related to the type of actor who performed it. For example, is it possible that site visits by program representatives were more likely the result of the

program's outreach efforts while those done by market actors were more likely in response to customer requests – or *vice versa*? As Table 6-7 shows, we found no relationship between the type of site visitor and who arranged for it.

Table 6-7: Who Made Contact for Site Visit

Who Contacted Whom	All Respondents (*n* = 36)	Program Representative Visited Site	
		Yes (*n* = 27)	No (*n* = 9)
Respondent contacted other	48%	47%	60%
Other contacted/don't recall	52%	53%	40%
Significance		*Chis-square* = 0.12, ns.	

Participants most commonly found assistance by conducting online searches or contacting someone they had worked with previously. Respondents that said they contacted the person who visited their site were asked how they identified that person, as were those who said they consulted with a contractor or vendor to select their equipment. Responses indicate that it was usually someone they found online or that they had worked with in the past (Table 6-8).

Table 6-8: How Participants Identified Site Visitor or Consultant

How Identified	OR Standard Multifamily	OR Standard Non-MF	OR Custom	WA-All	OR Direct Install	Combined (Weighted)
Valid *n*	12	13	6	5	5	49
Online	58%	0%	0%	0%	0%	47%
Prior experience	17%	69%	17%	60%	20%	26%
Word of mouth	17%	23%	0%	40%	0%	18%
Energy Trust	0%	8%	50%	0%	20%	7%
Unsure	8%	0%	33%	0%	0%	7%

Types of Assistance Received

Respondents who reported anyone visited their site or provided consultation (whether they contacted that person or that person contacted them) identified the type of assistance received. Descriptions of the type and level of assistance varied by stratum, primarily reflecting differences by program track. This makes sense, given differences in how the program tracks operate. Custom projects often require a technical study; Direct Install projects require an advance visit to qualify the customer and identify needs; Standard projects require neither of the above.

Custom participants most commonly described Program-provided facility audits and/or technical studies but some mentioned consultation from market actors. Sixteen Custom participants (including one in Washington) described whether and what kind of assistance was received in developing their project, 11 of whom indicated a program representative had visited their site. Most comments by those 11 respondents described a detailed facility audit and/or technical study to identify savings opportunities.

These generally indicated the program representative conducted a thorough needs review, assessed the savings potential, and identified available incentives. For example:

> *"Uh, they do like a full technical analysis…. They collect data from the building … and they installed data collectors and or they pull data from the HVAC control system you know and then they come up with the technical analysis report, which projects savings and [capital expense] requirements."*

> *"[TRC] did an audit of the building identified, potential energy savings and programs that actions that we could take, and produced a bid guide, about a 20-page report that had a list of energy efficiency measures … with a summary table of the estimated [energy and dollar] savings … the estimated incentive that might be available from Energy Trust of Oregon and …. the payback period."*

> *"They'll bring engineering type folks and they'll do a study on your buildings … based [on] the equipment you have, the insulation values, all that. Lot of factors go into it and then they give us the options of different avenues of things that we could do to conserve energy and save money. So that basically they just give us the factual information based out of studies on how to make a good decision and spend our money wisely."*

One of these respondents expressed particular satisfaction with the assistance and what it identified:

> *"We didn't have a decent control system and … so the one suggestion was that we do a computer based control system by a third party [that would allow us to] track [savings and] work on our efficiencies through data. … [They] brought us to the 21st century by suggesting a computerized based control system … that went into two buildings, which has been a godsend."*

Another noted the proactivity of a particular program representative in keeping tabs on the respondent's needs:

> *"[The program representative] will cold call me once in a while and say, hey, you have any projects and he's looking out ahead as to what I'm thinking we're going to do. And … because a lot of times I have projects I don't even know I have coming until the next day, somebody gives me a call and we're in business and I call [the program representative] up and say, hey, I need to do this."*

This respondent reported using the results of an Energy Trust study to inform further project decision making, which was primarily done with input from third-party engineers.

Five Custom respondents reported a visit by a program representative but did not describe how that representative helped identify savings opportunities. One of those did note that the site visitor identified program incentives: "I told him what I was going to do and he said here's what your incentive will be."

Five Custom respondents said a market actor or consultant, but not a program representative, visited their site to help identify needs. Of those five, one described anything that sounded like a formal technical study:

> *"…they looked at our boilers and furnace … they did different air quality control [tests and] after they did those tests they went over the best plan and … a lot of the nuances. …they came and did testing first before the system was put in place. …I think [the contractor] gave us information about, you know what Energy Trust is and all that."*

Two described assistance in identifying opportunities and equipment needs that sounded less formal than that provided by the Program:

> *"They listened to what we needed – what our requests were for, how to control the buildings, how much of a tolerance we needed, the trouble spots that we had in our building – and then they came back with an equipment list of what we should use…."*

> *"Oh, I think we looked at they able to look at what would be the optimum savings. You know, how do we get the optimum savings as relates to cost?"*

The other two Custom respondents indicated that the market actor's visit did not influence project decisions.

Direct Install participants reported assistance focusing on equipment options, energy savings, and incentives. Ten Direct Install participants said someone – in each case, a program representative – had visited their site or that they had consulted someone when developing their project. All 10 respondents noted that the site visitor described equipment options, discussed energy savings, discussed incentives, or some combination.

In three cases, all smart thermostat installations, the respondent simply noted that the visitor presented a single option for installation. The three responses, however, presented subtly different shadings in terms of their reactions to the visitor's presentation. One response was fairly matter of fact:

> *"[The program representative] told them what would be the best thermostat for the space."*

A second response reflected a positive reaction:

> *"He suggested to change the thermostat to save energy and that helped a lot. It is more practical and easier to use. It is more up to date."*

The third response, however, suggested a more negative response to the way the option was presented:

> *"When they were talking about upgrades it sounded like there was one option, a smart thermostat. There was no pressure, but it was like 'here is the opportunity take it or leave it. how many do you want to do?'"*

Four respondents said that the program representative talked to them about thermostats as well as lighting, although the context of the conversations varied. Two respondents explicitly indicated that the initial program representative provided thermostats during the visit but also gave them contacts for lighting. Another respondent also indicated that the program representative made lighting suggestions, but that respondent indicated they already were "using least lumens possible [and so it] didn't make sense to switch over." The fourth respondent reported that, when they signed up for power, the utility "mentioned Energy Trust and their incentives and sent [a program representative] around" who "talked about different programs." In this case, the respondent wanted lights and the program representative mentioned the smart thermostat.

Two respondents described more thorough visits, with equipment discussions that touched on equipment options for the current project and for future consideration. One described both lighting and thermostat installation, but noted that they "also talked about HVAC for the future." The other discussed a detailed walk-through:

> *"They … walked through the building. …[The program representative] was given differing opinions about stuff. Reiterated options on water heater. Talked about furnaces and heat pumps – smart thermostat was quick and easy way to start, other things were more expensive. They did offer guidance on cycling fans that was helpful."*

One respondent reported that the site visitor provided information about other available Energy Trust incentives but did not identify the equipment types discussed.

Most of the reported discussions that addressed equipment beyond the direct install project included a discussion of the available incentives.

For three respondents, a salient part of the discussion about smart thermostats was about control features. These three respondents specifically mentioned "the temperature schedule," "ultimately having control remotely," and "being able to control it from the phone."

Standard track participants described varying degrees of assistance, most frequently from a market actor, with about one in five describing a visit from a program representative. Thirty-three Standard participants (15 multifamily and 18 non-multifamily) said someone had visited their site or that they had consulted someone when developing their project. In contrast to the Custom and Direct Install respondents, a minority of Standard respondents (7 of the 33) said a program representative had visited their site.

Of the seven Standard respondents who reported a visit from a program representative, four said the program representative had no input into project decisions. As one put it, "They didn't help to decide because it was already decided."

The other three provided fairly simple descriptions that focused on identifying available equipment:

> *"They provided a list of qualifying equipment that matched with their needs and when the programs were no longer incentivizing some of the equipment."*
>
> *"Suggested upgrades, fairly helpful, but gave a pretty wide range of options."*
>
> *"The [program representative] helped inform my conversations with the contractors."*

The 26 Standard respondents who reported a visit from or consultation with a market actor described varying degrees of assistance. Three were more detailed than the others, indicating that the market actor discussed various equipment options and their advantages:

> *"The contractor selected gave me better information about why they were sizing the equipment the way they did. The one I selected gave me more and better information in which to decide. They gave me one option that they thought would be the best fit for my situation."*
>
> *"[The contractor] gave me a couple of options for fryers but they showed me the one with incentives and that was the one that made the most financial sense. The fact that the upfront cost was lower and the long term energy savings were both attractive to me."*
>
> *"They gave a rundown of opportunities of where they could qualify for incentives. They did the 'pick and choose' of what would be the best from the list and determined what upgrades would be achievable. The consultant gave them a list of what to do, and specifications to make sure the equipment qualifies."*

Another 12 respondents also indicated the market actor presented equipment options or otherwise helped with equipment selection – for example:

> *"The contractor I selected gave me better information about why they were sizing the equipment the way they did. The one I selected gave me more and better information in which to decide. They gave me one option that they thought would be the best fit for my situation."*
>
> *"They gave me a couple of options and in discussions the bat would be a better job and less expensive than spray foam and that ETO would cover more if we did the bat insulation (pink fiberglass)."*
>
> *"They offered three [HVAC] options [including heat pumps]. … They showed us what we needed and offered what they thought was the best one was."*

A subset of these 12 explicitly mentioned that the market actor also mentioned the Energy Trust incentives.

Nine indicated the market actor specified the appropriate equipment for the job – for example:

> *"The contractor recommended the insulation and we chose it. I vaguely recall having a conversation about a couple of items but don't recall specifics. We talked about things like fire suppression and the type of insulation that would be required to accommodate fire suppression."*
>
> *"[The contractor] selected the fryer and pointed out the lower upfront cost and low operating costs compared to other items."*
>
> *"[The competing contractors] each recommended a 95% efficient unit and were able to tie into existing ductwork."*
>
> *"They decided for her which types of windows to use."*

The remaining two Standard respondents indicated the visitor or consultant provided no substantive input into the project decisions.

6.2.5 Assistance with Application

Most respondents received help on their incentive application, which most commonly consisted of completing the application for the participant or providing completion instructions. Almost half received help from a contractor, and a little over one-third got help from a program representative (Table 6-9). In about one in seven cases, the participant was able to complete it without any assistance. In those cases, the participant either found the application online or was sent the application.

Table 6-9: Who Helped Participants with their Incentive Application

Source of Help	OR Standard Multifamily	OR Standard Non-MF	OR Custom	WA-All	OR Direct Install	Combined (Weighted)
Valid *n*	16	18	17	6	10	67
Contractor	50%	28%	24%	17%	20%	45%
Program rep.	38%	28%	65%	50%	40%	37%
Utility representative	0%	6%	12%	33%	10%	2%
No help	13%	33%	0%	0%	10%	15%
Don't Recall	0%	6%	0%	0%	20%	1%

Respondents reported the types of assistance provided. Someone completed the application on behalf of about half of participants. Other common forms of assistance were providing instructions on how to complete the application, and providing general Program information, such as available incentives and requirements. Table 6-10 summarizes the frequency with which various types of assistance were provided. More detailed and qualitative information follows.

Table 6-10: Types of Assistance Provided

Source of Help	OR Standard Multifamily	OR Standard Non-MF	OR Custom	WA-All	OR Direct Install	Combined (Weighted)
Valid *n*	13	5	14	5	3	48
Completed application	46%	80%	43%	100%	67%	49%
Completion instructions	38%	60%	36%	20%	33%	39%
Program information	8%	20%	14%	0%	33%	9%
Provided app./forms	15%	0%	29%	40%	0%	15%
Submitted application	8%	0%	7%	20%	0%	7%
Checked for accuracy	0%	0%	36%	0%	0%	1%

Respondents generally found the application assistance valuable. In nearly all cases, the respondents who reported that someone completed the application for them commented on how valuable that assistance was. Some comments focused on technical understanding of the equipment or the program (or both) that was provided:

> *"Their assistance was super helpful. We don't have expertise and they do. They know the construction nuances and the program awareness and needs."*

> *"I couldn't have done it without them. I mean the documentation was not overly complex but terminology is key and specifics are important … and I have not been through this often enough to have a full grasp of all those items. So yeah, the assistance that was given was necessary."*

> *"Very valuable. They knew how to phrase everything, so equipment-wise … it's always nice to have somebody who knows what exactly did change and how it improved everything for efficiency and usability."*

> *"The specific person was quite invaluable and instrumental in getting rebates. Felt like there was a lot of work and the process was difficult to figure out which program they qualified for, some buildings qualified under some programs but not the others. And the ETO rep helped make this process much easier for them."*

Others still noted that the assistance greatly facilitated the process, even if the focus was not on providing technical knowledge:

> *"This was a big benefit. I am old and not computer savvy. It was very nice to have this done for me."*

> *"I think it is real valuable. Just them taking care of the paperwork end of it for us. All we [have to] do is they send us a DocuSign, we sign off on the DocuSign, and then it gets submitted, and it's all taken care of for me except for a signature."*

> *"Extremely valuable. We wouldn't have gotten the incentives and ensure the incentives were capitalized. [The contractor] was invaluable to that process."*

> *"[Valued] a lot because they are doing this professionally and they know how to do it."*

Two respondents commented that the market actor who completed the application charged a fee, but that the assistance was "very valuable and worth the percentage that was taken" and that it "made the process so easy it was a no-brainer. Well worth the small fee."

Even most of those who did not provide the same level of detail commented that the assistance was "greatly valuable," "invaluable," "highly valued," "extremely valuable because it was seamless." The two least enthusiastic responses were that the assistance was "helpful" and "useful."

Other common forms of assistance were providing instructions on how to complete the application, and providing general Program information, such as available incentives and requirements:

> *"…All sorts of assistance. You know, setting up and evaluating projects, … explaining the how the process works, helping with forms, and introducing us to trade allies."*

> *"Energy trust put us in contact with professional help, would answer the problem and the dollar savings to the with the incentive."*

All those who described this level of assistance, even if they completed the application themselves, indicated the assistance was very valuable – for example:

> *"Was valuable. I usually have to take care of the paperwork, so you know, just knowing what needs to be done and just them shepherding us through the process."*
>
> *"Great, the process was difficult and without him it wouldn't have been completed properly."*
>
> *"Very valuable. These programs are complicated, so it's helpful to have someone to explain how everything works."*

Even those who did not go into detail described the assistance as "extremely valuable, 10 out of 10," "very valuable," or "very helpful."

The perceived value of the assistance was related to the type of individual who provided the assistance as well as to the respondent's sector. We coded each comment based on the degree of value they indicated the assistance provided, to allow a more quantitative comparison of responses across respondent groups. Comments that indicated the application could not have been completed without the assistance were coded as "essential." Those that did not say that but nevertheless described it as "extremely," "greatly" or "very" valuable were coded as "very valuable." Those that indicated the assistance generally made the process easier or indicated it was helpful without qualifying how helpful (e.g., "…it was nice not to have to worry about it," "That assistance made the process easy for me to participate") were coded as "helpful." Finally, two comments that indicated the respondent could have completed the application without assistance were coded as "not needed." Codes were not necessarily mutually exclusive. For example, comment could have indicated the assistance was helpful but not needed. Similarly, a comment that indicated the assistance was very valuable because it was helpful would have been assigned both codes.

The assistance was at least somewhat helpful for a large majority of participants (Table 6-11). For almost three-quarters, the assistance was very valuable or even essential – that is, the participant would not have been able to complete the application without the assistance. About one in seven would have been able to complete the application independently.

Table 6-11: How Valuable the Assistance Was

Value of Assistance	OR Standard Multifamily	OR Standard Non-MF	OR Custom	WA-All	OR Direct Install	Combined (Weighted)
Valid *n*	13	5	14	5	3	48
Essential	8%	0%	21%	0%	0%	8%
Very valuable	62%	60%	86%	60%	100%	62%
Helpful[1]	31%	80%	29%	40%	33%	34%
Not needed	15%	0%	0%	0%	0%	14%

[1]Responses either indicated that the assistance generally made the process easier or indicated it was helpful without qualifying how helpful.

A higher percentage of participants found the assistance very valuable or essential when it was received from a contractor than from other sources (60% vs. 32%; *chi-square* = 5.4, *p* = 0.02).

Similarly, a higher percentage of multifamily than other participants found the assistance very valuable or essential (50% vs. 26%; *chi-square* = 2.5, *p* = 0.11).

The source of program awareness and the source of application assistance were strongly related. As Table 6-12 shows, respondents who said a market actor was a source of program awareness were more likely to say a contractor helped with the application (94% vs. 13%) but much *less* likely to say a program representative helped with the application (3% vs 59%), compared to respondents who *did not* identify a market actor as a source of awareness. By contrast, having the Energy Trust website as a source of Program awareness is associated with a much lower percentage of applications assisted by a contractor (1% vs. 53%) and a much higher percentage of applications assisted by a program representative (69% vs. 31%) compared to respondents who *did not* identify the website as a source of awareness.

Table 6-12: Relationship Between Source of Awareness and Source of Assistance

Type of Actor	Helped with Application	Market Actor a Source of Program Awareness		Energy Trust Website a Source of Program Awareness	
		Yes	No	Yes	No
Contractor	Yes	94%	13%	1%	53%
	No	6%	87%	99%	47%
	Chi-square, p	*Chi-square* = 42.0, *p* < 0.001		*Chi-square* = 9.9, *p* < 0.001	
Program Representative	Yes	3%	59%	69%	31%
	No	97%	41%	31%	69%
	Chi-square, p	*Chi-square* = 21.1, *p* < 0.001		*Chi-square* = 5.4, *p* = 0.02	

In addition to the above, results show that assistance with the application was related to whether someone visited the site to identify savings opportunities. A higher percentage of participants who reported a site visit said they got contractor help on the application, compared to those who did not report a site visit (64% vs. 35%; *chi-square* = 5.0, *p* = .02). The reason for this relationship is not immediately clear, given that the large majority of respondents who reported a site visit identified a program representative rather than a market actor as the one who visited the site (see Table 6-6). Perhaps this relationship suggests that projects initiated by program representative visits may be more complex than other projects and, thus, more likely to involve contractors and to require assistance with the application.

6.2.6 Pre- and Post-Installation Site Visits

We asked respondents whether anyone from the program carried out any "inspections" of their workplace either before the incentives were approved or after the equipment was installed and, if so, what their impressions were of those visits. This was separate from the question about whether someone visited their workplace to help identify savings opportunities (Section 6.2.4). That question addressed assistance with identifying potential projects, while this question focused on activities related to program qualification or preliminary estimation of savings.

Nevertheless, a site visit may mean different things to different respondents, depending on their project type – in particular, whether the project was Custom, Standard, or Direct Install. For example, for Custom

projects, the pre-installation site visit may entail assessment of the pre-existing equipment and conditions to develop a savings estimate, whereas for Direct Install projects, the purpose would be to identify needs and assess eligibility. Similarly, post-installation visits for Custom projects would be more detailed than for other project types, which would be done primarily to verify installation. For this reason, we examined this set of responses separately by program track, disregarding state and sector.

Responses generally met expectations based on program processes (Table 6-13). A large majority of Custom respondents reported site visits both before and after installation. Many fewer Standard participants reported visits, most of which occurred post-installation. Finally, most Direct Install participants reported pre-installation visits, and reports of post-installation visits were on a par with those by Standard participants.

Table 6-13: Pre- and Post Installation Inspections[1]

Comment	Custom	Standard	Direct Install
Valid *n*	18	39	10
Reported pre- or post-installation visit	83%	23%	60%
Pre-installation visit	67%	8%	60%
Post-installation visit	72%	18%	20%
No visit or could not recall	17%	77%	40%

[1]The combined results are not pertinent to this topic and so they are not shown in this table.

Most respondents, regardless of track, offered positive comments about the site visits. A relatively large share of comments were generally positive but nonspecific – e.g.:

> *"It was great. This is not our first time working with ETO and it's always good."*
>
> *"It was good, they confirmed that they were doing what they said they were doing."*

More specific themes were the visit's thoroughness, the good technical understanding displayed, and the feedback and insights provided. The relative frequency of these themes, and the types of detail offered, varied across the respondent types, as detailed below.

Custom participants. Custom participants' specific responses most commonly underscored the thoroughness of and technical understanding shown in the site visits. Eight of the 18 Custom participants commented on the visit thoroughness. Some of these comments provided details to illustrate how thorough the visit was:

> *"The initial audit was thorough and professional. The evaluation inspection, he spent six hours in our building with a range of engineering equipment and personal tools. He did a thorough job. … I think we visited eight units to measure air pressure and airflow and spent time on the roof of the building measuring air pressure and air flow. So I thought that the post installation inspection was very thorough."*
>
> *"…there's an Energy Trust guy that comes out and says, 'Let me let me take pictures of nameplates that you did it.' …The guys come out, they know what they're looking for. And then they take evidence."*

> *"After the equipment was installed we did a controls review to look at all the sequence of operations and ensure that the set points were all per the report of the engineering study that showed the viability of the project. And that was [program representative] that reviewed it with myself. It was thorough and good."*
>
> *"I have photographs of [program representative] … going through the equipment, going through the facility…."*

Some were more general:

> *"It was very thorough. It was very flexible. We were just finishing up part of it. The last little piece and we were going to be up against the 12-month deadline. …It was very thorough, very quick."*
>
> *"It was thorough and there's a lot of potential."*
>
> *"Very thorough."*

About half of those who commented on the visit thoroughness also said something about the technical understanding displayed by the person doing the visit:

> *"I think they knew what they were talking about. They looked at and they understood the equipment."*
>
> *They provide "the technical math for the incentive. …They are spot on."*
>
> *"I thought they went really well. The people that we've had do those are very professional. …and they just come in and look at what they need to look at and take down all the information and notes and stuff and we've never had a bad experience with it."*

One Custom participant commented not so much on the site visit itself but on the information provided afterwards:

> *"So an energy study happened … and my experience with the contractors that did that work was positive. They connected me with utility information. And then we developed a relationship with several vendors. They were flexible and … they would communicate that we need to do this, will be on site for X amount of time of time. …And then they did the work and they provided a professional report."*

Direct Install participants. Direct Install participants' comments most commonly focused on the ease of the process:

> *"They came and … checked how many lights I have and it was easy because my business is small."*
>
> *"Good, they knew what they were doing and did it quick."*
>
> *"Great, no complaints."*
>
> *"It was fine."*

Two comments, however, focused on the visit's thoroughness and the insights received:

> *"Great, fantastic. Gave us insights. Found out we lacked insulation in a wall that was needed. Very helpful, helped us troubleshoot. Came back and fixed stuff."*

"They were very thorough they explained a lot, how things worked and what to expected. They explained the thermostat how it worked and energy saving benefits. Setting schedule from your phone was highlighted as a benefit. A remote way to control it was highlighted."

Standard participants. The Standard participants' comments also were generally undetailed and focused mainly on the ease of the process:

"The inspections were straightforward and speedy - no issues."

"It was very easy and went well."

"Positive, it went well and they were pretty quick."

"It was good, they confirmed that they were doing what they said they were doing."

"No specific impression. They were brief inspections. "

"It was very smooth and efficient."

One respondent further reported that the person doing the visit was "very knowledgeable and knew what to look for."

The above information is summarized in Table 6-14.

Table 6-14: Comments About Inspections

Comment	Custom	Standard	Direct Install
Valid *n*	15	9	6
Any positive comments	11	6	6
Good technical understanding	4	1	2
Visit was thorough	8	0	1
Provided feedback and insights	1	0	2
Easy, quick	1	3	2
Positive, nonspecific comment	5	2	0
Can't recall/Wasn't there	3	3	0

6.2.7 Overall Process

A large majority of respondents offered positive feedback about the overall process for applying for and receiving Program incentives. The most common feedback was that the process was seamless or easy, or at least reasonable, particularly given the incentive amount (Table 6-15):

"I was thrilled. The whole process was positive."

Several respondents provided both "easy" and "reasonable" comments, for example, saying that the application process itself was easy and the time taken to receive the incentive was "reasonable":

"Everything went smoothly. I waited a few weeks for the incentive which seemed reasonable. All pretty smooth."

"Pretty easy to do the application. The incentive came within 30 days so that seemed reasonable.

A few identified "one off" positives that were not strictly related to the process *per se*: one noted that Energy Trust assisted with a challenge the respondent experienced with one of the companies involved with the project:

> *"They had trouble with funding, an independent engineer who was not an employee of one of those companies. Well, it was a challenge and Energy Trust of Oregon was helpful in that regard."*

Table 6-15: Feedback on the Program Overall

Feedback	OR Standard Multifamily	OR Standard Non-MF	OR Custom	WA-All	OR Direct Install	Combined (Weighted)
Valid *n*	16	18	17	6	10	67
Any positive	81%	83%	76%	50%	70%	81%
Easy process	63%	61%	35%	17%	60%	61%
Reasonable process	38%	72%	41%	50%	20%	43%
Any negative	19%	6%	41%	50%	10%	17%
Incentive	6%	6%	24%	0%	0%	7%
Communication	6%	0%	12%	17%	10%	6%
Burdensome	0%	0%	6%	33%	0%	1%
Neutral	6%	0%	0%	0%	20%	5%
Don't recall	0%	11%	0%	0%	10%	2%
Unclear	0%	6%	1%	0%	0%	1%

[1]TABLE NOTE, IF NEEDED

About one in six participants had some negative experiences, primarily associated with communication or incentive issues. Most of the comments seemed to suggest fairly mild criticisms.

Six respondents offered incentive-related comments: two commented on changes over time in incentive amounts and one each on the amount received, lack of incentives for certain parts of Custom projects, inability to capitalize on available incentives, and on the mode of incentive delivery.

Of the two who commented on changes over time in incentive amounts, one noted that the project paper work was not completed until after the year end because of delays in getting the new equipment working properly. Because of incentive changes that took place in the new year, the incentive amount declined. This respondent indicated the decreased incentive was not a major issue as the contractor took care of the difference. A second respondent simply commented that incentives are decreasing over time.

The third incentive-related comment was by someone who had been under the impression that a bigger incentive amount was forthcoming, based on the project that was done, but that respondent nevertheless said, "I can say that we were happy."

A fourth respondent – a Custom participant – commented that some things "are not being appropriately incentivized." That respondent's comment was somewhat difficult to interpret, however. The respondent said that "there is no incentive being offered for the metering or being able to grab that data and bringing it into a spot which you could then kind of like proactively do something about it." This respondent seemed

to be suggesting that incentives were not available to cover equipment that would allow monitoring of energy use in the installed equipment. Incentives are available for building automation systems.

One respondent's comment was not so much an issue with Energy Trust incentives *per se*, but spoke to the fact that it was not always possible to capitalize on this. The reason is that "[internal] funding can become available unexpectedly" but that the funding has a lifespan that may not accommodate the Program processes. As a result, "there have been a few projects I would have liked to have run through Energy Trust, but the timing just didn't work out correctly."

The only other incentive-related comment was not a criticism of incentive amounts, just an observation that it would be better would be to have the incentive taken at the point of purchase.

Five respondents commented on communication issues. One Custom participant's comment suggested the participant was not aware of having received a report documenting the results of the technical study:

> *"It would be nice to know if there's a study … in terms of like, are we saving on the long run and that would be something that would be beneficial to see, maybe to submit to our committee saying, other than we received a small rebate, this is what we're saving. So that would be really helpful to get a report."*

It should be noted that the Program does distribute technical studies to all Custom participants and provides those studies to their main site contact at the time of the project. The above comment might suggest a need to ensure that study reports are distributed to all interested individuals.

Another Custom participant spoke about "an issue getting ahold of [program representative] at times." That respondent noted: "we have had other representatives in the past that have been very responsive. So the more responsive the representative is to our status request, or if the additional information is needed, the better for us."

One respondent reported frustration over a "lack of communication," not about the project that was the subject of the interview (a Direct Install smart thermostat project) but about a prior insulation project. That respondent had relied on the contractor to complete the application, as it required details that "are harder for people not in the energy efficiency business to navigate." The respondent was not sure whether the contractor did the application and contacted Energy Trust to get guidance. A person at Energy Trust gave the respondent a phone number to get help with application and told the respondent that Energy Trust would reach out to the contractor. The respondent indicated, however, the case "slipped through the cracks" and the respondent may have missed the deadline for submitting the application.

The two other communication issues – both from participants with Standard projects – related to receiving ongoing communication about Program incentives. Both comments suggested that the respondents would like to receive periodic information about available incentives. One – a Multifamily participant – reported having received some periodic communication in the past and wanted "someone to reach out explain why" such information has not been coming lately.

Three respondents offered comments relating to the burden level of the application process. One Custom participant referred to the number of forms required. That respondent indicated the process was "reasonable" and "doesn't take a super large amount of time," but indicated some type of guidance would be useful (and may already exist):

> *"Maybe we need some kind of road map and maybe there was one that exists. I haven't looked, but it'd be nice to know based on what program or incentive you're going for, whether it's Custom or Standard. If there's like a simple matrix or chart that just says, here's the forms you're gonna be filling out or the steps."*

On a related note, a second Custom participant simply suggested "any means by which ETO can expedite the process" would make that respondent want to do even more upgrades.

The third comment about process burden was from a Standard Multifamily participant, who said that the process "was pretty onerous for $500." That respondent reported having "many properties" in Oregon and that there are "a lot of nuances between Washington and Oregon that made it confusing." That respondent suggested that the process should be specific to the market area rather than the state level, "since Clark County is often folded into the Portland Metro umbrella."

Finally, one respondent voiced a negative perception, but it did not appear to be directed at the Program per se. Instead it appeared to be directed toward the equipment provider:

> *"…the follow through and the issues that we're having now with trying to operate the system and not knowing how to operate it on-site… we have to call and coordinate with someone who's out of state to adjust our own system, which is extremely, extremely, extremely frustrating."*

6.2.8 Referrals to Renewable Energy or Lighting Program

Most respondents reported no referrals to other programs for renewable energy or lighting equipment. Respondents reported on whether they discussed incentives for renewable energy or lighting equipment with a program representative. Responses indicate that about one in seven participants had such conversations (Table 6-16). The vast majority (95%) of such conversations were about the lighting program, and very few (9%, or three respondents) were about renewable energy.

Table 6-16: Discussion with Program Representative about Renewable or Lighting Incentives

Response	OR Standard Multifamily	OR Standard Non-MF	OR Custom	WA-All	OR Direct Install	Combined (Weighted)
Valid *n*	16	18	17	6	10	67
Yes	6%	28%	71%	83%	90%	14%
No	88%	61%	18%	17%	10%	79%
Don't recall	6%	11%	12%	0%	0%	7%

The referrals that were reported were more common for Custom participants, Multifamily participants, and large organizations than for other participant types. We also examined whether the frequency of such conversations was related to project or participant type. To do this, we re-split the respondents three ways: 1) based on program track (Custom, Standard, or Direct Install), disregarding state; 2) based on sector (Multifamily or Non-multifamily), disregarding track or state; and 3) based on the size of the participant's organization. These analyses showed that such conversations were more common for Custom participants than those in other tracks (66% vs. 14%, *chi-square* = 5.2, $p = 0.02$). They also were

more common for Multifamily than Non-multifamily participants (40% vs. 6%, *chi-square* = 10.6, p = 0.001). Finally, they were more common for participants from larger organizations (those with more than 10 employees) than from smaller companies (44% vs. 4%, (*chi-square* = 14.4, $p < 0.001$).

6.2.9 Equipment Types Unable to Obtain with Incentives

About one-third of respondents identified at least one type of equipment they wanted but were unable to receive incentives for, most commonly HVAC or lighting equipment. The percentage was relatively consistent across strata (Table 6-17).

Table 6-17: Incentives Unavailable for Some Equipment

	OR Standard Multifamily	OR Standard Non-MF	OR Custom	WA-All	OR Direct Install	Combined (Weighted)
Valid *n*	16	18	17	6	10	67
Percent of Participants	31%	28%	35%	33%	30%	31%

Respondents most commonly identified HVAC-related equipment types. Three specifically mentioned large HVAC systems:

> *"We need a totally, totally new HVAC system. …I guess the grant or the assistance doesn't cover things like replacing existing equipment like your HVAC system. Like we have furnaces that are like 30 or 40 years old that needs to be replaced. We have a boiler system that is antiquated. We have a huge building. We have no A/C, so I know it might be outside the scope, but we're kind of hoping you know, it could include things like that."*

> *"A chiller or air handling unit. A big piece of HVAC at the end of its useful life, which kind of disqualifies it, even though replacing it with a new piece of equipment will save a lot of money."*

> *"I wish we could have gotten incentives for my HVAC upgrade. I worked with my HVAC contractor and we could not find the equipment on the market at the time."*

One respondent each said that their ductless heat pumps did not qualify for incentives or that the incentive was not sufficient to offset the high upfront cost. In addition, one respondent each identified electric furnaces (as a "maybe") and "gas furnace water heater."

Four respondents referenced lighting: one referred to the Program's "running out of funds"; one said that the incentives were insufficient to cover the cost of replacing existing lighting; one said that they had already installed lighting and it was too much work to "backtrack" and try to get the incentive after the fact; and one referenced an expectation that all lighting incentives would discontinue soon.

No more than one respondent identified any other equipment type. The types identified by one respondent each were windows, refrigeration, HVAC controls, fryers, and stoves/ovens and three did not identify the equipment they were unable to get incentives for.

6.2.10 Planned Future Upgrades

A substantial minority of participants plan future equipment upgrades, most commonly HVAC, and collaborate with Energy Trust on them. Respondents reported on whether they had plans for more energy-related improvements or facility upgrades in the near future and, if so, whether they planned to work with Energy Trust again on those projects. Responses indicate that just over one-quarter of participants have such plans, a large majority of whom plan to collaborate with Energy Trust on them (Table 6-18). Of the three respondents who did not state they planned to work with Energy Trust, two said they had not yet explored whether incentives were available, while the third explained that the upgrade site was outside Energy Trust's service territory.

Table 6-18: Future Improvement/Upgrade Plans

Response	OR Standard Multifamily	OR Standard Non-MF	OR Custom	WA-All	OR Direct Install	Combined (Weighted)
Plan More Improvements or Upgrades in the Near Future						
Valid *n*	16	17	17	6	10	66[1]
Yes	25%	29%	88%	67%	40%	28%
No	69%	65%	12%	17%	50%	66%
Not sure/not answered	6%	6%	0%	17%	10%	6%
Will Work with Energy Trust[2]						
Valid *n*	4	5	15	4	4	19
Yes	3	5	13	4	4	81%
No	0	0	1	0	0	1%
Not sure/not answered	1	0	1	0	0	18%

[1]One respondent discontinued the interview at this point.

[2]Counts are shown rather than percentages because of the small total number of respondents in each stratum.

The most commonly reported planned equipment types were HVAC (primarily heat pumps and controls), solar panels, and lighting (Table 6-19).

Table 6-19: Planned Types of Equipment Improvement/Upgrade

Response	Count
HVAC, incl. controls	15
Solar	10
Lighting	9
Windows	4
Systems/automation	3
EV charging	3
Refrigeration	3
Insulation	3
Other[1]	6

[1]Battery storage, outdoor heaters, air quality, kitchen ventilation, thermal (not specified).

HVAC and solar equipment were consistently the most and second-most commonly identified equipment type across program tracks and sectors. However, the frequency with which some other items were reported appeared to vary somewhat by program track and sector. For example, only Standard track participants identified EV charging and refrigeration, and they did so more commonly than systems/automation or battery storage (Table 6-20).

Table 6-20: Planned Types of Equipment Improvement/Upgrade – by Track

Response	Count
Custom Track	
HVAC, incl. controls	5
Solar	2
Systems/automation	2
Battery storage	1
Standard Track	
HVAC, incl. controls	8
Solar	7
EV charging	3
Refrigeration	2
Systems/automation	1
Battery storage	1
Direct Install Track	
HVAC, incl. controls	2
Solar	1
Refrigeration	1

When viewed by sector (Table 6-21), the most striking differences were that Non-multifamily participants identified HVAC equipment relatively more frequently (i.e., as a share of all those who planned future improvements/upgrades) than Multifamily participants and were the only ones who identified refrigeration or battery storage.

Table 6-21: Planned Types of Equipment Improvement/Upgrade – by Sector

Response	Count	
	Multifamily	Non-multifamily
HVAC, incl. controls	5	10
Solar	5	5
Systems/automation	2	1
EV charging	2	1
Refrigeration	0	3
Battery Storage	0	2

6.2.11 Demographics

Responses indicate participants were diverse with respect to organization type and size as well as sex and race/ethnicity of ownership or leadership. Participants represented a wide range of organization types and sizes, but a large majority were privately owned organizations and smaller organizations (Table 6-22). Of participants in the nongovernmental sector, almost one-third are owned or led by a woman or person of color. Almost all participants use English in customer interactions.

Table 6-22: General Firmographics

Source	OR Standard Multifamily	OR Standard Non-MF	OR Custom	WA-All	OR Direct Install	Combined (Weighted)
Organization Type						
Valid *n*	16	17	17	6	10	66
Publicly traded	0%	0%	12%	0%	0%	<1%
Privately owned[1]	88%	76%	18%	67%	90%	83%
Non-/not-for-profit	0%	12%	35%	17%	10%	3%
Government	0%	12%	35%	17%	0%	3%
Not a business	13%	0%	0%	0%	0%	10%
Number of Buildings Participant Owns in Energy Trust Territory						
Valid *n*	16	17	16	6	10	66
None	0%	6%	0%	0%	0%	1%
1 to 5	69%	65%	31%	67%	90%	67%
6 to 10	6%	12%	6%	0%	0%	7%
11 to 20	0%	6%	13%	17%	10%	2%
21 to 100	13%	12%	13%	17%	0%	12%
101+	13%	0%	31%	0%	0%	11%
Don’t know	0%	0%	6%	0%	0%	<1%
Number of Employees						
Valid *n*	16	17	17	6	10	66
One to 10	75%	53%	6%	33%	80%	69%
11 to 25	13%	12%	12%	33%	10%	13%
26 to 50	0%	24%	6%	0%	0%	4%
51 to 100	0%	0%	6%	0%	0%	<1%
101 to 500	0%	6%	18%	0%	10%	2%
More than 500	0%	0%	41%	0%	0%	1%
Did not answer	13%	0%	0%	17%	0%	10%

Source	OR Standard Multifamily	OR Standard Non-MF	OR Custom	WA-All	OR Direct Install	Combined (Weighted)
Languages Used with Customers						
Valid *n*	16	12	12	6	10	66
English	94%	100%	100%	100%	100%	95%
Spanish	13%	35%	65%	33%	50%	18%
Chinese[2]	0%	0%	6%	0%	0%	<1%
Vietnamese	0%	0%	6%	0%	0%	<1%
Russian	0%	0%	24%	17%	0%	1%
Indian	0%	0%	6%	0%	0%	<1%
Korean	0%	0%	6%	0%	0%	<1%
Other[3]	0%	12%	12%	0%	0%	2%
Don't know	0%	0%	6%	0%	0%	<1%
Not a business	0%	0%	6%	0%	0%	<1%
Business Owned, or Non/Not-for-Profit Led, by a Woman or Person of Color						
Valid *n*	13	15	9	5	10	54
Woman	23%	40%	44%	20%	40%	27%
Person of color[4]	8%	13%	33%	20%	30%	10%
Neither	69%	60%	56%	60%	50%	67%

[1]Includes individual proprietorships.

[2]Mandarin or Cantonese.

[3]Three reported they would work any customer language, using interpreters if needed; one, representing a school district, simply indicated "we will work with parents speaking other languages too."

[4]Three Asian or Asian American, two Black or African American, three Hispanic, Latino, or Spanish, and one Native American or Alaska Native.

Of the 10 respondents who represented non-profit or not-for-profit organizations, five reported that their organization was established to provide services specifically to women (five), persons of color (five), or people in rural areas (three).

A large majority of participants own the facility where the project occurred, just over half of whom are absent owners while the rest occupy some or all of the facility (Table 6-23). About two-thirds of absent owners are responsible for no energy bills, while the rest are responsible for all or some. By contrast, just over half of tenants are responsible for all such bills, while the rest share responsibility with the facility owner.

Table 6-23: Ownership and Control of Participating Facility/ies

Source	OR Standard Multifamily	OR Standard Non-MF	OR Custom	WA-All	OR Direct Install	Combined (Weighted)
Own or Lease						
Valid *n*	16	18	17	6	10	66
Own	94%	71%	82%	100%	20%	89%
Lease	0%	29%	6%	0%	80%	6%
Other	6%	0%	12%	0%	0%	5%
Facility Owners: Occupy or Lease Out Facility/ies						
Valid *n*	16	12	16	6	2	63
Lease all	63%	17%	6%	50%	0%	55%
Occupy all	19%	75%	50%	50%	0%	27%
Occupy part/lease part	19%	8%	44%	0%	100%	18%
Absent Owner: Responsibility for Gas and Electric Bills						
Valid *n*	12	3	7	3	2	42
None	67%	33%	0%	0%	0%	63%
All	17%	67%	86%	67%	100%	21%
Mixed	17%	0%	14%	33%	0%	16%
Tenant: Responsibility for Gas and Electric Bills						
Valid *n*	1	5	3	0	8	7
All	0%	100%	67%	0%	100%	54%
None	0%	0%	0%	0%	0%	0%
Mixed	100%	0%	33%	0%	0%	46%

6.3 Market Actor Experience

This section addresses the following research question:

> ***What are the current experiences of the various market actors interacting with the Program – trade allies, non-trade ally contractors, distributors, ATACs, community-based organizations, etc. – and how might they be improved?***

In addition, some of the information also addresses several research questions that pertain to Program History and Program Operations. Such information is included in summary form in Sections 4 and 5.

This section is subdivided into three subsections, each detailing pertinent feedback from ATACs, contractors, and CBOs.

6.3.1 ATAC Experience

Energy Trust relies on ATACs to support and guide customers in the commercial building segment. Specifically, ATACs provide engineering analysis through technical studies to assess the costs, benefits,

and payback for energy efficiency investments in existing commercial buildings. These studies focus on assessing the cost-effectiveness of various energy efficiency technologies, including rooftop fans or upgrading a HVAC system. To support these analyses, ATACs may conduct site visits or install and analyze data loggers to assess energy performance during a specific time period.

To shed light on the ATACs' experiences interacting with the Existing Buildings Program, the ADM team interviewed them on a variety of topics, as identified in Section 3.4. These comprised their roles in project development, effect of recent Program changes, referrals to other Energy Trust programs, how their work relates to Energy Trust DEI goals and objectives, their customers' experience, areas for program improvement, and market trends. Through our discussions on these topics, the 10 interviewed ATACs provided valuable insights into the current operations of the Existing Buildings PMC and emerging energy trends within the Existing Buildings market in Oregon and Washington.

Respondents' Background

All of the ATAC respondents were either trained engineers or had a strong engineering and technical background. Two specialized primarily in the multifamily sector, specifically condominiums, while the eight others served a broader range of building types, including healthcare, schools, existing office buildings and municipal buildings. Eight respondents worked in Oregon while two worked in Washington. Two ATACs have reported working with the Program since it began in 2002, while the others have worked with this program for five years or more.

The ATAC respondents all had supported the Existing Buildings Program for at least three years, with most having worked with the Program for the past five years.

Respondents' Role in Project Development

An ATAC may identify a project and bring it to Energy Trust for review, or Energy Trust may assign a project to the ATAC. While some ATACs indicated that Energy Trust selected them to complete a specific project, most reported that they generated their projects on behalf of their clients. Those respondents described their role as a "project developer," finding projects that could benefit their clients and bringing those projects to Energy Trust staff for consideration. One ATAC described his role this way:

> *"I'm almost exclusively looking at the existing built environment. …[I] work alongside our direct or service sales account managers, helping them think about and develop projects… [A] customer might … have a piece of equipment that's at end of life. And we can go in there and look at that. And then maybe there's opportunities to kind of broaden the scope. …. And oftentimes, when you're talking about that looking at that kind of work, usually there's an incentive from Energy Trust" to complete the technical study.*

ATACs varied in their reported workload regarding the number of technical studies completed for Energy Trust. Two reported completing 40 to 70 projects during the past two years. One noted:

> *"In the last three months, I've done two commercial projects. One was with a church, and one was with a county-owned office building… and I've probably done somewhere in the range of a dozen commercial buildings, not including higher education or K through 12."*

Other ATACs completed an average of 10 to 20 projects annually.

Most respondents reported little or no changes in workload since the change of PMC, while three provided varied reports on this subject. One ATAC reported that "it does feel like more projects have come to us from Energy Trust." By contrast, two said their workload had decreased under the new PMC. One indicated that the change in their workload was the result of a change in their own focus. That respondent "used to kind of do analysis studies for its own sake [but is] now focused more on developing projects, implementing energy efficient retrofit projects…." That ATAC will go through Energy Trust "when the client wants to" but is "less tapped into" Energy Trust and getting more work from building owners.

Program Transition and Performance of the New PMC

The ATACs reported generally favorable reactions to the change in PMC from ICF to TRC.

Most respondents had no specific comments about the overall transition process – that is, the hand-off from ICF to TRC. One reported not having been aware that a change had occurred and six others had no specific comment about the transition process. Three respondents commented on the transition process. Of those, two indicated a good transition. One described it as "smooth" and the other reported that "it's been pretty seamless as far as the transition between the two companies." A third reported being aware of the change to TRC, but indicated the change had had little impact on daily operations, as the Energy Advisors they had worked with under the previous PMC continued that role under TRC. Most others either provided no comments on the changeover to TRC or said they had not been aware there was a change. One respondent, however, described the transition as "messy," saying "I don't know if ICF gave TRC all the information" that was needed. Thus, for this respondent, the transition "messiness" was caused by the outgoing PMC, not TRC.

All respondents provided positive comments about TRC, touching on their performance in general or on program operations under TRC. For eight of the 10 respondents, the comments were generally positive or neutral. Two respondents identified specific improvements to program operations under TRC. One of the two noted that working with Energy Trust had been "very difficult" under the previous PMC. There were no good guidelines for doing studies, but the transition to TRC has "actually made that work a little bit better, there are … templates available that we can use [so you don't] just … do something and then later on find out it's not what" you should have done. These comments were echoed by a second respondent, who noted the "additional resources for ATACs, such as templates, guidelines" that provide more "strategic guidance." The context of these respondents' comments suggests that the primary value of these improvements has been to give these ATACs a better understanding of what is expected in a technical study.

Other respondents also noted some changes in templates and forms, but their comments suggested changes were fairly minimal. For example, one noted that "there's a little bit of process change. It's always going to be, you know, [when changing from] one company to another" but that "it stays pretty consistent." Nevertheless, this respondent noted that "TRC has been, on average, better than most of them in the past. They've been great. Things have been super timely in their review and email communications and response."

Although most comments about TRC were favorable, five respondents identified concerns, some of which were more substantive than others.

Three respondents identified concerns about changes in the technical study processes.

One respondent indicated being constrained at times from using "the sound equations that we use to do the analysis" because TRC staff "have their own thoughts about what certain factors should be used." As a result, "it's become onerous to me to be able to meet all of their requirements for the very technical stuff." For this respondent, the concern seemed to be largely one of whether the focus is on serving the client versus being "able to crank out these studies very quickly" to get "low hanging fruit," which has led to "adversarial" conversations about how to go about a project.

The second respondent suggested that, in some cases:

> *"you may get a very vague scope of work and maybe it goes nowhere because it … hasn't been vetted. …It didn't pass the sniff test enough to send it on down the line. …I think that's probably my biggest critique though for Existing Buildings."*

A third respondent noted that, since the new PMC took over, "Energy Trust never brought a project to me, and this has been frustrating." That respondent further reported that there had been "quite a few times" when the respondent's firm had identified a project but TRC "took the project" to do the technical studies in house. As this respondent described it,

> *"I've been on sites where I wrote proposals and [TRC] ended up getting the work. … I just wanted to connect [the customer] with an energy advisor, because the energy advisor is so crucial in this process. … And then when I finally circle back with the energy advisor … they already are working with TRC on a custom study … or they negotiate the contract lower and either I have to accept it at that lower price that sometimes is a loss or they get the work."*

The respondent described the resulting environment as "very stressful." By contrast, the former PMC "never did their own in-house work."

All three of the above respondents also voiced concerns about TRC's staff. In all cases, the concerns about TRC staff were either explicitly or implicitly related to the concerns about the technical study processes.

In two cases, the concerns were about the experience or skill level of TRC's staff. According to the one who mentioned being constrained from using "sound equations," TRC "brought on quite a few younger people," some of whom are not professional engineers. While this respondent did not indicate that the change in staff was the reason for the changes in procedures, the comments suggested that the lower experience levels of the new staff necessitated more work on the ATAC's part. Specifically, according to this respondent, the "younger people" that TRC had brought on…

> *"are very technically intelligent and capable … in terms of doing equations and analytics and all that, but they're pretty out of touch with design concepts and the big picture and so I'm more and more pressed to do very, very technical minutia."*

The respondent who commented on vague scopes of work similarly commented that some of the Energy Advisors are more skilled than others:

> *"Some of them are highly technical. They may even be degreed engineers. Some of them are very experienced and can sniff out a viable project. Others, it's the opposite…."*

In this case, the respondent explicitly suggested that the staff who are less skilled staff are responsible for the vague scopes of work that go "nowhere." This respondent suggested a need for training: "Other programs only hire experienced engineers for this role. TRC does not do that."

The third respondent, reported there had been a turnover in TRC staff in the past year. Although this respondent did not comment specifically on the skill level of the new TRC, the turnover had objectionable implications (according to the respondent), as discussed below.

Similarly, the respondent who commented on how TRC had taken technical studies in house linked that change to the turnover in TRC staff. The respondent who commented on vague scopes of work that go nowhere did not explicitly link that to a change in staff but did relate it to varied staff skill levels.

Comments from other respondents were less substantive although worth noting.

Three respondents commented on long project review times, which can get in the way of getting projects completed. One reported the existence of "a backlog of projects to review," which "can delay incentive offers. And as you know, building owners and contractors have to make purchase orders and contract receipt to order equipment if they're going to meet … due dates." Another expressed a similar view, saying "it takes them a significant amount of time to get us approvals on the proposals and then do the reviews." A third said that it takes time to do a custom study, and the lead time adds to that, and "sometimes we lose projects that way." By contrast, one respondent said that TRC has been "super timely" in its review process.

Notwithstanding the above, nearly all respondents were generally satisfied with TRC. Some emphasized how much they liked working with Energy Trust and the Energy Advisors:

> *"We love working with Energy Trust….and (we) hope to continue working with them."*
>
> *" We like working with Energy Advisors at TRC – [it's] a great experience."*

Further, most of the ATACs indicated that the change in program management did not directly affect their clients. This is because the clients interact primarily with the Energy Advisors, who did not change after TRC took over. One exception was a respondent who indicated that some clients are not clear on how to contact their Energy Advisor, especially if the Energy Advisor has changed. According to this respondent, "the biggest feedback I get is who is their Energy Advisor? How to get a hold of them and the hardest part is the communication with them."

Effect of Adding Multifamily Projects to the Program

The ATACs reported mixed results regarding the inclusion of multifamily projects into the Existing Buildings Program. Six of the ATACs reported doing little to no multifamily projects, so this program enhancement did not affect their projects.

Of the four ATACs who work in the multifamily sector, two reported that this program enhancement led to more multifamily work. One respondent indicated that some changes had been made relating to multifamily projects to make it easier on ATACs, which resulted in more projects. Another simply indicated that having the multifamily sector included in the Existing Buildings Program provided "more opportunity for work."

The other two ATACs who work in the multifamily sector reported that the Program change has not affected the number of multifamily studies. One said:

> *"We are hoping [the change] would bring in multifamily under that same commercial existing building program and we would get opportunities to be doing more business, and we've tried. We've reached out…. That's a tough sector to really engage … it's hard to find the people who are willing to invest (in projects)."*

Two respondents indicated that there are fewer opportunities for custom measures in the multifamily sector. Interestingly, one of those was the one who said that incorporating the multifamily sector into the Program created more opportunities for work, while the other did not indicate it had affected workload in that sector.

Effect of Business Lighting Program Change

None of the ATACS reported concerns about creating a separate program for Building Lighting, as they were not directly involved with lighting projects.

Furthermore, these ATACs historically have not been involved with lighting projects, as other technical experts, such as lighting designers, complete those projects. Therefore, transitioning lighting away from the Existing Buildings Program did not affect the ATAC's projects, customers, or overall workload. As one put it:

> *"There's a lot of customers who figured [that out], and they've got internal staff that can handle it. And so they just they take their incentive dollars, and they just kind of self-direct or do the work themselves."*

Project Referrals

Most interviewed ATACs could not describe any specific instances when Program staff referred the customer to another Energy Trust program to do additional work. Four, however, did provide some discussion about such referrals.

One ATAC brought in a new project and Program staff "helped move the project to New Buildings."

Two respondents talked about bringing clients to Energy Trust as they look for incentives for their customers in other Energy Trust Programs. As one respondent noted:

> *"We'll do renewable projects. We'll do lighting projects, and if there's serious interest [from the client], we'll stay involved" in the project.*

Another provided a similar description, albeit more generally:

> *"We find clients, and then Energy Trust staff may take them over for other projects … based on project specifics. …The client comes to me and then I make the introduction to Energy Trust."*

A fourth respondent described how a customer was referred to that respondent's firm for a small business project.

All four of these ATACs reported that the referral process was smooth. Three in particular reported the process "works well," with a "clear handoff" or "no issues." One reported not being aware of any specific

coordination between Existing Buildings and other program staff, but another reported that the interaction between the client and the different projects was "seamless":

> *"The Energy Advisors do a good job in navigating that [referral process] and making sure that the customer understands [the process]."*

Four ATACS said they had "no role" in the referral process.

When asked whether they had received any training or guidance from Energy Trust or the PMC about project referrals, all 10 respondents recalled attending workshops every year sponsored by Energy Trust but that those workshops focused on specific topics like retro-commissioning or changes in program offerings and measures. None recalled receiving specific training related to project referrals.

DEI Goals/Objectives

Although Energy Trust has increased its efforts to reach priority populations, five of the 10 ATACs were unaware of any specific program goals. These five respondents did not recall receiving specific guidance about identifying minority-owned businesses, and indicated it was their understanding that was handled primarily by the Energy Advisors.

Four ATACs recalled specific conversations with Energy Trust staff about expanding the Program's reach but they varied in terms of the nature and content of the conversations. Two of them recalled having specific program training from Energy Trust as to how best to serve these customer groups. Another recalled several meetings in which Energy Trust staff discussed "their desire to serve underserved communities." The fourth ATAC provided no details about the conversations.

Two ATACs also noted that studies targeting priority communities received a higher priority from the Program than did some other studies. One of these ATACs spoke of priority communities in general, while the other specifically mentioned more rural communities.

Eight ATAC respondents were unaware of any specific outreach strategies Energy Trust has used to increase program participation among priority populations. With respect to rural areas in particular, most ATACs do not work in such areas and so could not provide any insights regarding efforts there.

Two ATACs working outside of the major population centers in Oregon have connected with Energy Trust staff to identify projects. One of those spoke specifically about rural areas. The other reported having an account manager assigned to Southern Oregon, which has led to some project studies but those occurred in some of the larger communities in the area rather than specifically in rural areas. This latter respondent observed that the goal of this program is to save energy, so this organization focuses on where energy is being consumed—and that is largely in the urban areas. The respondent noted that a few industries, such as timber and agriculture, are located in rural areas, but that is not a primary focus for this ATAC. This respondent reported having made efforts to reach priority groups but that they have not been successful:

> *"We honestly have tried to make concerted, focused efforts. I don't think we've been very successful, but we are trying to make efforts to try and serve … underserved communities or more rural communities."*

Several ATACs provided suggestions on ways that Energy Trust could increase or enhance its outreach to these priority populations including:

For non-rural areas:

- Reach out to organizations in the Portland area that serve priority communities to offer classes and workshops about the Program.
- Link with affordable housing programs and provide support for those projects using ATACs.
- Reach out to condominium associations and present at their monthly luncheons about potential savings opportunities.

For rural areas:

- Reach out directly to engineering firms in more rural areas to identify beneficial projects.
- Target the local schools, hospitals, and municipal buildings in rural communities, as these will be the largest energy users.

Customer Experience

All interviewed ATACs reported client satisfaction with the Program in general or technical studies in particular. Several comments indicated general satisfaction with the Program:

> *"[Customers] do tend to enjoy the process."*
>
> *"Generally very positive. …haven't seen anyone upset, disappointed."*
>
> *"Overall I'd say it's been positive … clients have been grateful."*
>
> *"Most of the time, I'd say we have heard a high level of satisfaction about the projects and how they've gone. "*
>
> *"I think people are pretty happy, pretty stoked."*

Four respondents in particular commented on their clients' satisfaction with the incentives that result from the studies:

> *"Customers are always super happy when they get the incentive money."*
>
> *"[Customers] like the incentive money and they like studies that we do that quantifies the savings and costs."*
>
> *"[Customers] seem to like it especially with the bigger incentives."*
>
> *"I think people are pretty happy…especially in in recent years…There's been some really big dollars available."*

One respondent noted that the energy incentives "actually led to projects being completed that were 'on the cusp' but the owner went ahead because of the incentives."

Customers also are satisfied with the energy savings. According to one respondent, "we just did a walk-through of another project that was completed and they were gushing" that they could tell their energy bills had gone down.

Five interviewed ATACS reported issues that may create challenges for customers.

As noted in *Program Transition and Performance of the New PMC*

, above, three respondents commented on long project review times, which can get in the way of getting projects completed. In particular, a backlog of projects to review can delay incentive offers, which can be a concern for building owners and contractors who have to make purchase orders to meet due dates. The long lead times can cause ATACs to lose projects.

Two comments pointed to communication issues. As also noted above, one respondent noted that some clients are not sure how to contact their Energy Advisor, especially if the Energy Advisor has changed.

Other challenges relate to factors outside the PMC's control:

- Customer budgets: "Budget is almost always the first problem."
- Technical challenges in requesting incentives for electrification projects: "…We haven't come up with an EZ button [for electrification projects]."
- Delays in the supply chain, which makes it difficult to get the equipment: "… in the Post-COVID environment, there are not enough contractors, and everybody needs work done…sometimes there is a long lead time in the supply chain."

Areas for Program Improvement

The ATACs also identified several ways in which the Existing Buildings Program could improve:

- Continue to offer the higher incentives, as that directly led to more project studies.
- Complete project reviews more quickly as "it takes significant time to get approvals" from Energy Trust" which leads to customer frustration.
- Proactively reach out to vendors to secure price quotes on highly efficient equipment, which would also help to alleviate the supply chain issues.

6.3.2 Trade Ally and Non-Trade Ally Contractor Experience

The ADM team interviewed contractors on a variety of topics relating to their program experience. These covered their program background and their experiences and perspectives relating to program changes, cross-program referrals, program processes, contractor satisfaction and benefits of program involvement, participant satisfaction, and future trends and program opportunities.

Contractor Descriptions

Contractor respondents varied by business type, services provided, and areas served (Table 6-24). More than half reported more than one million dollars in annual revenue per year. They reported offering a range of services, most commonly HVAC or building shell services, and covering the range of Energy Trust service areas.

Table 6-24: Contractor Respondent Characteristics

	EB Trade Ally (*n* = 25)	Non-EB Trade Ally (*n* = 5)[1]	Non-Trade Ally (*n* = 18)	Total (*n* = 48)
Annual Revenue				
Up to $500,000	1	2	4	7
$500,001 to $1M	4	0	2	6
More than $1M	19	3	12	34
Firm Services				
HVAC	19	2	7	28
Building Shell	6	3	8	17
Plumbing	4	0	2	6
Refrigeration	3	0	3	6
Motors & Drives	1	0	2	3
Controls	1	0	2	3
Other[2]	2	0	7	9
Locations by State				
Oregon	24	4	18	46
Washington	2	1	3	6
Service Areas				
Portland Metro	18	3	14	35
SW Washington	10	2	9	21
Mid-Willamette	7	1	8	16
North Coast	3	1	9	13
Eastern Oregon	3	0	8	11
Southern Oregon	1	0	9	10
Central Oregon	2	0	8	10

[1] As noted in Section 3.5.3, five contractor interviewees initially identified as non-TAs were actually TAs for Energy Trust programs other than Existing Buildings, mainly the Existing Homes Program.

[2] Lighting, steam traps, water/wastewater, solar, appliances (one or two respondents each).

Respondents varied in terms of their Program background (Table 6-25). Existing Buildings TAs tended to report more projects with the Program than did the other respondent types, who largely reported 10 or fewer Existing Buildings projects in 2022 and 2023. More than three-quarters said they had worked with the Program since before 2021. Most respondents described their role in working with Energy Trust projects as largely administrative and in a somewhat transactional role – that is they completed incentive applications on behalf of customers or they gathered information that the customer could then use to submit their application. Many of these administrative respondents were familiar with the equipment that qualified for incentives but were not installers working at customer sites. Somewhat fewer than half indicated they were their customers' key liaison with Energy Trust, while somewhat fewer than one-third said they installed equipment or performed some other technical role.

Table 6-25: Contractor Respondent History with Existing Buildings Program

	EB Trade Ally (*n* = 25)	Non-EB Trade Ally (*n* = 5)	Non-Trade Ally (*n* = 18)	Total (*n* = 48)
Energy Trust Projects Completed in 2022 and 2023				
1 to 5	6	4	14	24
6 to 10	5	1	3	9
11 to 15	7	0	0	7
16 to 20	3	0	0	3
More than 20	4	0	1	5
Time Working with Energy Trust				
Before 2021	18	5	15	38
2021 or later	3	0	2	5
Not sure	4	0	1	5
Role of Respondent (Multiple Responses Permitted)				
Administrative/paperwork	22	3	14	39
Technical/Installer	7	2	6	15
Key liaison with Energy Trust	18	1	2	21

Contractors' Perspectives on Program Changes

Few contractors reported even noticing the 2021 change in program implementers. Trade allies and non-trade allies had very little to report about the change in program implementers and the change in program design instituted in 2021. Of the 48 respondents, only five (three non-trade allies, one non-EB trade ally and one EB trade ally) expressed an awareness of the change in program implementers. Two trade allies had only begun work with the Program after the implementer change. Four trade allies reported a change in communication frequency with Energy Trust since the change: two mentioned an increase in frequency, and the other two mentioned a decrease. Three trade allies reported that it takes less time to complete the application process and to receive payment from Energy Trust now than it did prior to 2021. A non-trade ally reported a "drastic reduction in contact with Energy Trust" to the extent that they have not received any information at all since the change. While this contractor was listed in Energy Trust's database as being a current ally, they believed that they had been "kicked out" of the Program and not informed of the need to reapply. This respondent preferred to have more contact and interactions with Energy Trust representatives.

Contractors reported no effect on their business or their customers when Energy Trust split the lighting component of the Program into a stand-alone lighting program in 2021. No contractor respondent could report about how the creation of a separate Business Lighting Program affected their business or their customers. This is likely because these allies do not do lighting nor do most interact with lighting contractors directly. We heard comments such as "We just do HVAC and stick to that" when we asked contractors to report about any changes that may have occurred when Energy Trust split lighting into its own program.

Most contractors reported no or little effect on their business or their customers when Energy Trust added multifamily properties to the Existing Buildings program in 2021. Six of the 48 contractor respondents (three non-trade allies, two non-EB trade allies, and one EB trade ally) reported noticing this program change. One respondent generally said the change benefited his business and his customers but did not specify how the change benefited him. Another respondent reported that the forms for multifamily properties changed and the new ones were confusing. However, this respondent reported their program representative helped them to complete the forms. A third respondent recalled having to reapply to be a multifamily trade ally "but that [it] was not a big deal." A non-EB TA respondent mentioned having some difficulty distinguishing between residential and commercial properties reporting that they "came across situations where say a family lives in a townhome considered a residential building but the fine print would qualify it as a commercial building." A non-trade ally respondent commented that now "multifamily projects are a much slower process."

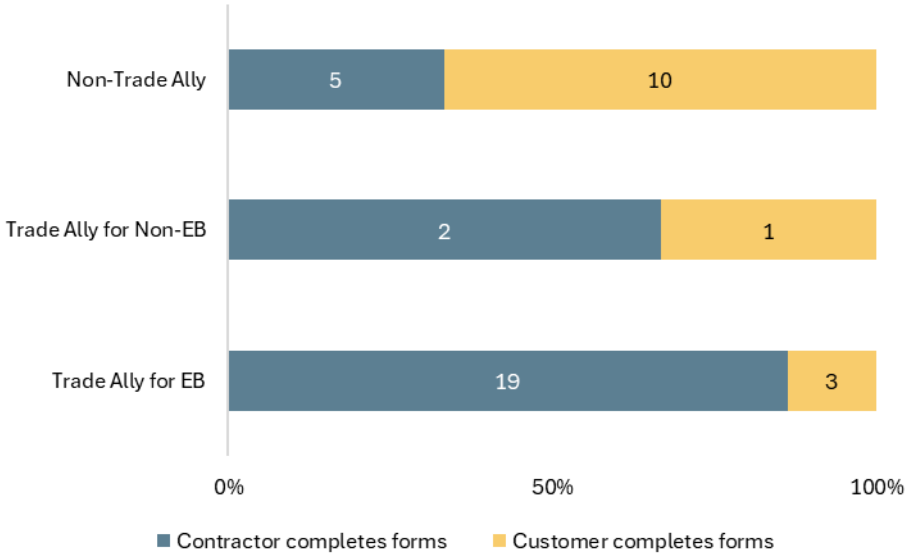
Cross-Program Referrals

Contractors provided almost no evidence of referring customers to other Energy Trust programs or contractors that could help them save energy. Contractors reported little awareness that Energy Trust split lighting measures into a separate program in 2021 – only five of the 48 interview respondents expressed an awareness of the change in the PMC – an indication that the interviewed contractors have little insight into measures and programs outside of their trade. Additionally, during discussions about interactions with other Energy Trust programs, contractors did not indicate that they received many (or any) referrals from other contractors for Energy Trust projects. Instead, most contractors reported sticking to their trade and not being involved in referrals. The one exception to this was a trade ally that specialized in controls, energy management, and refrigeration. This contractor reported getting involved in lighting projects as part of their controls work which could sometimes lead to them referring a customer to a lighting contractor.

Program Processes

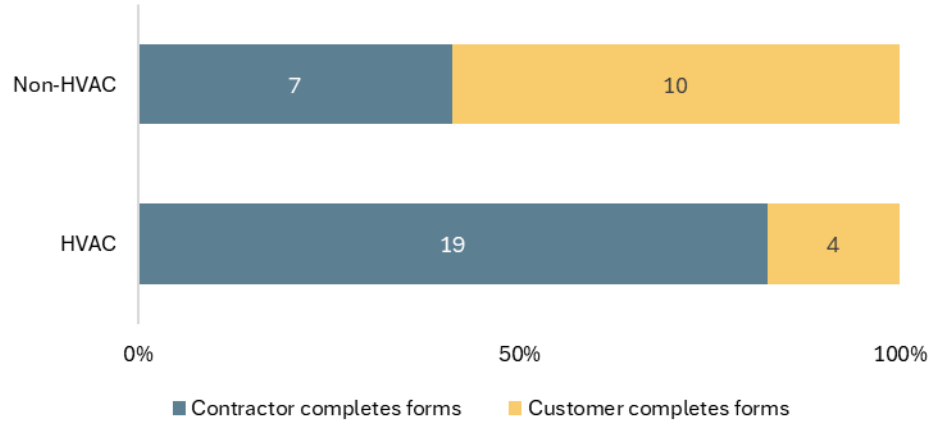
On average, trade allies report they typically complete incentive paperwork on behalf of their customers whereas non-trade allies typically have the participant complete the application for the incentive. Figure 6-1 shows that of the contractors that reported who completes program incentive paperwork, 19 of 22 EB trade allies and 2 of 3 trade allies for other Energy Trust programs prepare program applications on behalf of the customer whereas five of 15 non-trade allies prepare the incentive applications. Non-trade allies typically reported directing customers to the Energy Trust website or providing a program application to the customer, but it was up to the customer to submit program paperwork and receive the incentive. In contrast, trade allies typically submitted the Program paperwork for the customer and used the incentive money to lower the upfront cost of the project for the customer.

Figure 6-1: Who Completes Program Forms, by Trade Ally Status (n = 40)



Most HVAC contractors complete the Energy Trust application for their customers whereas about two-fifths of other contractors do so. Figure 6-2 shows that 83% (19 of 23) of HVAC respondents reported they, as the contractor, completed program forms for their customers. Non-HVAC contractors varied more in their responses to who completes the Program forms with 41% (7 of 20) completing the forms.

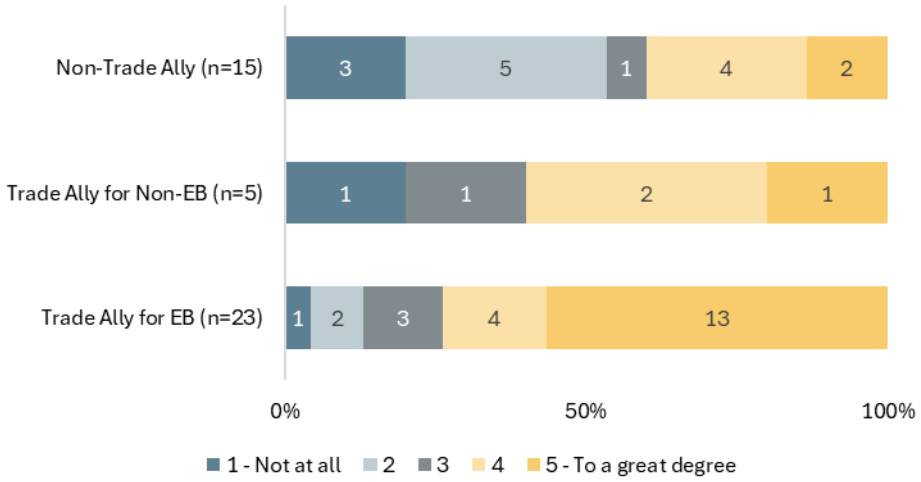
Figure 6-2: Who Completes Program Forms, by Contractor Type (n = 48)



Contractor Satisfaction and Benefits of Program Involvement

Trade allies reported that working with Energy Trust had helped their business opportunities whereas non-trade allies and trade allies not associated with EB were more mixed in their response. When asked on a scale of 1 to 5, where 1 means "not at all" and 5 means "to a great degree," how much has working with Energy Trust helped your business opportunities, 71% (17 of 24) of trade allies reported a score of four or five compared with 60% (3 of 5) of non-EB trade allies and 40% (6 of 15) of non-trade allies (Figure 6-3).

Figure 6-3: Degree to Which Working with Energy Trust Helped Contractor's Business Opportunities



Just over one-third of contractors (20 of 48) specified some aspects of the Energy Trust program that are working well for them and most of these highlighted their interactions with program staff. Of these contractors, most (14) specified they appreciated their interactions with Energy Trust, with one respondent describing the Program representatives as "helpful kind contacts" and others reporting that staff address their questions in a timely fashion. Other aspects of the Program that are working well according to contractor respondents included:

- Five HVAC respondents appreciated incentives that are high enough to entice customers to choose the more efficient option.
- One building shell contractor reported liking the process that allows them to submit applications online.

Over half of all contractors (27 of 48) highlighted some areas of the Energy Trust program as not working well. Eight respondents reported incentives as being insufficient. Seven of these eight respondents were building shell contractors, of whom four specifically identified window incentives as too low – one characterized the incentives for windows as "insignificant." Another one of these seven shell contractors respondents did not specify a measure type but said that "lump sum (per unit) incentives provide far less of a return than proportionate (%) ones did before."

Another seven respondents found applications too difficult and/or lengthy, most of whom expressed a dislike for the lack of an online portal to file applications and check up on their status.

Other areas of the Program identified by contractors as not working well included:

- Six respondents, three of whom were HVAC contractors, reported an insufficient amount of productive correspondence with Energy Trust, one citing significant "delays in communication" with another "not being provided information directly" and one other claiming that "trying to find the right person at [Energy Trust] can sometimes be difficult."
- Three respondents mentioned issues with the accuracy and clarity of incentive qualification criteria and availability. One respondent highlighted that "TRC and ICF [are] guilty of mis-

categorizing customers" and should, for example, "be more discerning as to what is an HVAC study or an industrial study." Another reported a "need to know what the Energy Trust money is meant for and to be educated about what it can be used for."

- Three respondents, including two HVAC contractors, mentioned a need for improved approval time. Two mentioned that it can take over six weeks to receive the incentive resulting in cash flow problems for their business. "Floating the money before we get the incentive can be hard."
- Two non-HVAC contractors expressed frustration with the frequency of Energy Trust staff turnover, one observing a "lack of stability and consistency in terms of Energy Trust contacts" and the other stating that "it seems we're always talking to a new rep who replaced the old one"
- One building shell contractor stated that Energy Trust does too much "micromanaging of our work, demanding extra work beyond scope" which results in "wasting our time having to revisit sites"[9]
- A refrigeration contractor mentioned a need for an improved measure list.

Perspectives on Participant Satisfaction

Just under half of all contractors could not report about participants satisfaction with the Energy Trust program. Twenty-one contractors (12 trade allies, one non-EB trade ally, and eight non-trade allies) had no insights into participant satisfaction. Some of this inability to discuss participant satisfaction was because the contractors made the Program almost invisible to their customers. One trade ally stated, "we take care of everything for the customer so [the Program] is largely invisible to them." In these instances, customers' knowledge of participating in the Energy Trust program and level of engagement with the Program may be limited to a line item on their contractor invoice showing the incentive to lower the cost of the project.

Of those that could report about participants' satisfaction with the Energy Trust program, most (25) reported receiving comments from participants that viewed the Program positively. These contractors reported that most participants were satisfied because the Program lowered the overall cost of projects. Some contractors shared both positive and negative feedback they had received from customers. Below are some notable comments from respondents that reported participant dissatisfaction:

- Six respondents (three exclusively building shell, and one exclusively appliance contractor) reported participants were dissatisfied with the lower incentive amounts provided by the Program in recent years and indicated that the lower incentives made it less likely that a customer would participate in the Program.
- One controls and refrigeration contractor reported participants were frustrated with the time it took to get approval from Energy Trust to start a project.
- One building shell contractor that often works with multifamily properties reported that the Program is very beneficial to property owners but not tenants. This contractor reported that the Program

[9] This respondent indicated that Energy Trust wanted this firm to install attic and roof vents, work this respondent thought was beyond the necessary scope of work for the project.

supports installation of new windows which in turn gives the landlord a reason to increase rent for the tenants. Therefore, the energy bill savings the tenant should see from an improved building shell are offset by the increase in rent.

More than half (28 of 48) of the contractors mentioned opportunities to improve program participants' satisfaction with the Program.

- Increase incentives (10 mentions). Six of the ten represented building shell contractors and several of these respondents specified they would like to see better incentives for windows. According to these contractors, the incentives for windows are not sufficient to encourage a customer to bother participating in the Program. The other four were HVAC contractors who suggested higher incentives for boilers and better incentives for items that have "good" efficiency, not just those that have the best efficiency.
- Developing an online system that would enable submitting and tracking applications would make it easier for contractors to keep participants aware of their incentive status (5 mentions).
- Increasing communication and interactions between contractors and Energy Trust (5 mentions). These respondents reported that more frequent communication and information sharing between contractors and Energy Trust would result in contractors being better informed and able to help participants to receive their checks sooner and, in some cases, start their projects sooner.
- Developing a more customized approach to incentives (2 mentions). Two trade ally HVAC respondents reported that they would like to see more ways to qualify some participant projects. One of these respondents would like to move away from incentives based on SEER and HSPF and more towards a custom approach that looks at the overall HVAC system instead of just the unit. The other respondent wanted more Wi-Fi enabled thermostat options covered by the Program, specifically citing the Cielo Breeze thermostat for inclusion in the Program.
- Improving outreach to commercial customers (6 mentions) especially in those in rural areas (1 mention).

Differences in Participant Experience by Size, Business Type, or Location (Urban/Rural)

Five contractors provided feedback on how the experience of program participants differed based on the participants' size, business type, or location, none of which provided much insight into DEI goals and achievements.

- Four provided feedback on customer size. Three indicated that larger customers were more likely to apply for incentives than smaller customers. However, one indicated that smaller customers get more satisfaction from participation because they see a larger relative return and that incentives are *not* as much of a selling point for larger customers.
- Two provided feedback on rural versus urban location. One noted that customers in urban locations face more red tape to get permits for work, which deters installation of energy efficient upgrades. The other commented on receiving more feedback from urban customers after projects – particularly, feedback on water and electricity consumption reductions after switching from water- to air-cooled systems. No respondents suggested greater challenges or different satisfaction for rural customers.

- One contractor respondent offered feedback on business type. That respondent reported that apartment complexes realize greater savings than traditional large commercial customers.

6.3.3 Community-Based Organization (CBO) Experience

Two representatives from CBOs participated in interviews about their organizations' relationship and collaboration with Energy Trust of Oregon for the Existing Building programs. Respondents interviewed serve as energy efficiency program coordinators for CBOs that predominantly serve the Portland Metro and mid-Willamette Valley areas, with clientele that is typically of Hispanic descent.

The interviews covered the nature of the collaboration between the CBOs and Energy Trust, their experience with and perspectives on engaging with priority populations, and the quality of their collaboration with Energy Trust.

It should be noted that during the interviews with the CBO representatives there was some confusion regarding which Energy Trust program was the focus of the interview. One of the respondents seemed to conflate their organizations' partnership with Energy Trust for residential programs with the mostly commercial focused Existing Buildings program. When this occurred, the interviewer reminded the respondent that the interview focused on the Programs serving commercial customers, which included multifamily housing, and attempted to redirect the conversation accordingly.

Nature of Collaboration

Both respondents indicated Energy Trust's partnership with their organization for the Existing Buildings program was about one to two years old, and therefore still new. Both explained that the partnership for Existing Buildings involves hands-on engagement and day-to-day program delivery and direct communication with program participants. CBO respondents meet with Energy Trust staff one to two times per month to discuss program updates and the status of various projects. These meetings include CBO staff as well as staff from Energy Trust, TRC, and CLEAResult (the PMC for residential programs). Respondents also reported communication via email or phone when needed.

Engaging Priority Populations

Due to the nature of the CBOs and the role they play in the community, much of the Program outreach and customer engagement for the Existing Buildings program comes directly from the CBOs, rather than from Energy Trust or TRC representatives; both respondents agreed this is the preferred outreach approach. The CBO respondents explained that they have strong relationships with community members and that they are trusted source of information and services, and therefore community members are more likely to engage in offerings provided by them than directly from Energy Trust or utilities:

> *"Good that they let us handle it. We're in touch and know what's best. They give us resources we need. They invite me to table events, provide funding for food."*

The two CBO representatives explained that they and their colleagues are heavily involved in customer engagement and will often walk their clients through the entire program process.

The above observations are apt in view of reports by program staff of field staff's challenges in conducting outreach with some priority populations that may be served by CBOs (Section 5).

Quality of Collaboration

In general, both respondents characterized their organization's partnership with Energy Trust and the Existing Building's program positively. Although respondents identified some issues and provided recommendations for improvement, respondents overall indicated the partnership was strong and had good communication. They also applauded Energy Trust for partnering with CBOs to help build trust and relationships with residents.

Both respondents provided suggestions for partnership and program improvement. Two respondents suggested that Energy Trust provide application materials in multiple languages. Reflecting common suggestions among market actors, two suggested that incentives be increased for priority groups. Finally, one suggested that Energy Trust should share more promotional materials with CBOs.

Additionally, both respondents cited Energy Trust staff turnover as a pain point with the Program and partnership. According to one:

> *"Our main contact has changed two, maybe three times, which has really fractured the process. Every time there's a new person, they have to get up to speed and it just creates some delays."*

6.4 Coordination with Utilities

This section addresses the following research questions, identified in Table 2-1:

> ***How is the Existing Buildings program working with utilities to promote offerings? What do they see as working well and what could be improved?***

Seven representatives from five investor-owned utilities participated in interviews about their utilities' relationship and collaboration with Energy Trust of Oregon for the Existing Buildings program (Table 6-26). Individuals interviewed served as their utilities' communications specialist (n = 5) or energy efficiency program managers (n = 2). Respondents had worked at their utility for two to eight years (n = 3) to over twenty years (n = 2), and all respondents indicated that Energy Trust had been partnering with their utility for the Existing Buildings Program for four or more years.

Table 6-26: Represented Utilities

UTILITY	STATES SERVED	FUEL TYPE PROVIDED	CUSTOMERS (APPROX.)
Utility 1	OR	Electricity	900,000
Utility 2	OR, WA, CA (northern)	Electricity	800,000
Utility 3	OR, WA (southwestern)	Natural Gas	800,000
Utility 4	ID, WA, OR	Electricity	418,000
		Natural Gas	382,000
Utility 5	WA, OR	Natural Gas	314,500

6.4.1 Nature of Collaboration

Across all five utilities, respondents indicated that the collaboration with Energy Trust of Oregon for the Existing Buildings program is focused on marketing and communication. They explained that Energy Trust

of Oregon implements and delivers the Program to customers and thus the utilities themselves are fairly hands-off and uninvolved in the day-to-day program coordination. Relatedly, none of the respondents identified any issues or challenges with the transition between program implementers, as they primarily interact with Energy Trust staff, not TRC staff.

Utility respondents formally meet with Energy Trust staff monthly (two respondents) or quarterly (three respondents) to discuss marketing and outreach initiatives and to coordinate these efforts for maximal impact, with additional communication occurring more regularly via email. They noted that Energy Trust staff often provide specific outreach language and marketing materials for the utilities to use that explain the Program and direct customers to Energy Trust contacts for more assistance.

Respondents did not experience any major challenges or pain points when Energy Trust transitioned its Existing Building lighting offerings to the Business Lighting Program nor when multifamily services were incorporated into Existing Buildings. Respondents again noted that their collaboration with Energy Trust is mostly marketing and communications related in nature and they are not involved in daily implementation of the Programs. During the regular check-in meetings, both utility and Energy Trust representatives plan their marketing schedules and campaigns, ensuring their communications to existing buildings eligible customers are coordinated, and customers are not being inundated with too much information at once.

One utility representative explained that their customers likely do not understand the nuance between Energy Trust's various offerings and the transition between programs, but that this nuance is not important to a customers' experience of and engagement in the Program. Another respondent echoed this sentiment but also indicated that the delineation between Energy Trust and the utility itself is confusing for some customers and they (the utility representative) worry that that their partnership with Energy Trust might dilute their connection with customers:

> *"We were removed from customer process. Energy efficiency is a positive thing for customers, so it is nice to be associated with positive offerings."*

Some of the respondents representing utilities that work in both Oregon and other States indicated it can sometimes be difficult to run the non-Oregon energy efficiency programs in house, while those in Oregon are run by Energy Trust (n = 2). Despite these difficulties, these respondents noted the partnership is beneficial, as Energy Trust has a large infrastructure and strong support system.

6.4.2 Priority Populations

Utility representatives had varying opinions regarding Energy Trust's efforts to engage low-income, small business, and rural customers. Representatives from three utilities said that Energy Trust is doing a good job targeting these priority communities, citing community-based campaigns and partnerships with other local organizations. Representatives from the remaining two utilities said that Energy Trust could increase promotion and outreach in low-income communities. One respondent explained that the Program seems more targeted towards moderate income businesses, since the Program requires some degree of customer contribution, which can minimize engagement for some customers. Additionally, another respondent noted that engaging small businesses and low-income customers is challenging, and although

opportunities for growth for exist, Energy Trust seems to prioritize these activities and is trying to engage all types of customers.

6.4.3 Quality of Collaboration

Representatives from all five responding utilities characterized their relationship with Energy Trust of Oregon and the Existing Buildings program positively. They noted that their Energy Trust contacts are professional and communicative and clearly care about the work. One utility representative reflected on the changes they have observed with Energy Trust over time, explaining that the current team is far more engaged and proactive than previous teams. As this representative put it:

> *"Our editorial calendar … was kind of on the back burner. It was kind of like, 'Oh yeah, we have an article that could apply to [your] customers. Maybe you're interested in that.' …It felt like it wasn't very prioritized and planned so solidly."*

6.4.4 Suggestions for Improvement

Despite an overwhelming sense of program and partnership satisfaction, utility representatives provided some suggestions for program and partnership improvement:

- Changes to the nature of communication (two mentions).
- Continued focus on innovations for electric and gas fueled businesses (two mentions).
- Provide more non-lighting options and opportunities for businesses (one mention).

The respondents who suggested changes to the nature of communication indicated that they do not always know when programmatic changes are happening and/or why these changes occur. One of those attributed this, at least in part, to a decreased frequency of formal check-ins (from monthly to quarterly). While indicating general satisfaction with the frequency of communication, this respondent noted that less frequent communication…

> *"means we're not always aware of the status of goals. We're getting notification about policy changes as FYI rather than 'how do we collaborate, how does this apply to us.' We need more discussion and leeway so we can respond. Policy changes can impact the way the programs run and we don't always feel like we have a say in how things are going."*

The other contact who commented on the nature of communication suggested the meetings with utility and Energy Trust staff should also include program staff, in case utility staff have any specific program-related questions or concerns. According to this contact:

> *"Sometime … I could have a question that may be best answered by someone in the program, but my contacts in our regular meetings are with marketing folks, and they don't necessarily always have the answers."*

For example, this second contact noted having had some questions when the small business offering was evolving over time. This respondent indicated it is not a "huge problem" and has the contact information for program staff to address any "burning issue" but that it would be valuable to have more regular

contact with program staff to get "some visibility into development into programs and details about what future might hold."

Additionally, two of the contacts for utilities that provide natural gas to Oregon customers underscored the importance of focusing on innovative technologies for both electric and gas. These respondents acknowledged that Energy Trust is fuel neutral, however they said they felt as though the energy efficiency industry as a whole is electricity focused, which can be frustrating for natural gas providers.

6.5 Collaboration with Oregon Department of Energy (ODOE) and Oregon Multifamily Energy Program (OR-MEP)

This section addresses the following research questions, identified in Table 2-1:

> ***How is Energy Trust working with the Oregon Department of Energy (ODOE) to support energy efficiency upgrades in K-12 public schools? Is the collaboration enabling more measures to be completed?***
>
> ***How is Energy Trust working with Oregon Housing and Community Services' (OHCS) Oregon Multifamily Energy Program (OR-MEP) to support and promote energy efficiency upgrades for income qualified electric multifamily customers? Is the collaboration enabling more measures to be completed?***

Four representatives from two Oregon government agencies participated in interviews about their agency's relationship and collaboration with Energy Trust of Oregon for the Existing Building programs. One respondent worked for the Oregon Department of Energy while the other three respondents worked for the Oregon Housing and Community Services – Multifamily Energy Program.

The Oregon Department of Energy respondent explained that Energy Trust's collaboration with their agency began in the early 2000s, however the partnership strengthened and intensified around 2016. Housing and Community Services representatives noted that the co-funding opportunities between Energy Trust and Housing and Community Services began in 2018.

6.5.1 Nature of Collaboration

The contacts for government agencies characterized the relationship between Energy Trust and Department of Energy and Housing and Community Services as a financial partnership, indicating that Energy Trust and the two agencies co-fund energy efficiency programs for schools (Department of Energy) and multifamily housing (Housing and Community Services). Agency representatives noted that they meet with Energy Trust staff once a month, with regular email communication in between.

Respondents explained that prior to the formal partnership with Energy Trust, their agencies and Energy Trust offered similar but separate incentive programs to customers. This similar but separate incentive program structure caused a lot of confusion amongst program applicants, which was the impetus for the formal partnerships. For example, in the past, school districts interested in receiving energy efficiency incentives had to apply for Energy Trust Existing Buildings and Department of Energy funding separately; frequently, schools did not understand the differences between the two programs and rarely maximized their incentive potential because they did not realize they might be eligible for both funding sources. Now,

because of the partnership, school districts submit one application which is reviewed by both Energy Trust and the Department of Energy, and program staff work together to maximize school districts' incentive offerings, rather than putting the onus on the schools.

6.5.2 Quality of Collaboration

Representatives from both agencies underscored how much simpler and easier programs have become because of their formal partnerships with Energy Trust. Not only is there more clarity for the customers (school districts and housing managers), but the collaboration has also streamlined the application process as well as maximized benefits to the communities served. Agency representatives explained that their agencies and Energy Trust have the same goals and working together toward those goals has allowed them to not only serve more customers, but also provide more comprehensive and robust offerings.

6.5.3 Suggestions for Improvement

Despite an overall positive opinion of their relationship with Energy Trust and the Existing Buildings program, agency representatives identified partnership challenges and provided suggestions for improvement. Representatives from both agencies noted that their agencies' and Energy Trust's funding cycles vary, which can cause confusion and difficulties regarding project timelines. Additionally, Energy Trust sometime changes incentive amounts mid-project, due to funding cycle schedules, which can result in changes in the amount of money a project gets; agency representatives suggested Energy Trust lock in incentive amounts for each project rather change incentive amounts mid-project, to avoid confusion and unexpected costs for customers.

7 Future Opportunities

This section addresses the research questions identified in the fourth section of Table 2-1, "Future Opportunities." The responses to these research questions are informed by feedback from staff, ATACs, contractors, funding utilities, collaborating agencies, and CBOs

7.1 Primary Drivers of Energy Efficiency

The following research question is informed by ATAC and contractor feedback:

> ***What are the largest forces on energy efficiency projects in the commercial and multifamily market segments right now? What additional drivers are anticipated over the next few years?***

The interviewed ATACs identified the following key drivers of efficiency:

- Energy Savings. Customers will continue to want to save money on their energy bills and reduce their overall energy costs. Clients are also interested in reducing overall building expenses: *"Customers want to see a simple payback on their energy-efficient investments."*
- Stronger Building Codes. Several ATACs indicated that the stringent building codes in Oregon and Washington will require significant building upgrades: *"The Oregon energy code continues to push forward, too. So, as that code pushes forward, customers are going to be driven to … make investments. They're being forced…. I think those are probably some of the biggest drivers."*
- Climate change and social impacts of having high-energy buildings. One ATAC suggested the healthcare institutions and major state universities will be looking for ways to make meaningful impacts in reducing energy use, which will result in more energy-efficient buildings within these sectors.

Interviewed contractors reported that cost continues to be the primary consideration driving customers' decisions. Almost all respondents (44/48) provided insight into what considerations currently have the greatest weight in driving their customers' decisions about energy efficiency in the commercial and multifamily market segments (Table 7-1). Most frequently, trade allies reported both upfront cost and energy cost, non-EB trade allies reported general economic motivations, and non-trade allies reported both energy cost and general economic factors as the main considerations motivating their customers' choices about energy efficiency. Four responses, from two trade allies, and two non-trade allies, reported carbon reduction and environmental concerns as key considerations; another two responses mentioned improved comfort.

Table 7-1: Considerations Driving Customers' Energy Efficiency Decisions (Multiple Responses Allowed)

	Trade Ally (*n* = 22)	Non-EB Trade Ally (n = 5)	Non-Trade Ally (n = 17)	Total (n = 44)
Energy cost	14	0	8	22
Upfront cost	13	0	2	15
General economic	1	4	8	13
Carbon reduction/environmental	2	0	2	4
Improved comfort	1	1	0	2

7.2 Greatest Opportunities for Energy Efficiency in the Near Future

The following research question is informed by ATAC and contractor feedback:

> ***Where are the biggest opportunities – in terms of market segments, geographic, areas, and measures – for the Program over the next five years?***

ATACs identified some specific areas of opportunity as well as general trends that may affect programs. The ATACs identified the following more specific areas that could lead to significant opportunities for Energy Trust and their customers:

- Retro-commissioning, which one observed could be a "gold mine" for current clients.
- Targeting K-12 schools as their existing facilities need to be upgraded, especially to meet new building performance standards.
- Reaching high energy users, such as data centers and server farms.
- Serving the multifamily segment, which will continue to grow as more people move to the urban areas.

Four ATAC respondents offered some more general observations.

One discussed the potential impacts of ongoing trend toward greater building electrification. According to this ATAC, there is a growing move to switch to all-electric buildings. Achieving this, however, will require some improvements in the efficiency of electric HVAC equipment, as "right now gas is just so much cheaper that customers [cannot afford to switch] even though they want to."

Two ATACs suggested that the Energy Trust should continue to fund studies that analyze the effects that the new Oregon Building Energy Performance Standards will have on existing buildings.[10]

Finally, one ATAC anticipated that there will be "significant dollars" available from the Inflation Reduction Act for companies to invest in building upgrades.

A fraction of all contractor respondents reported that customers' interest in savings, efficiency, or specific measures would increase in coming years. Twenty-three percent of contractors (11 of 48) expressed at least one prediction about how their customers' energy efficiency considerations may change in the coming years. Eight respondents mentioned that customers would show an increased

[10] See: https://www.oregon.gov/energy/save-energy/Pages/BPS.aspx

interest in some aspect of efficiency with four saying customers would be more motivated to save money on energy bills, two expressing a general interest in efficiency, one predicting a specific customer interest in heat pumps, and one indicating customers would show a greater interest in sustainability generally.

In contrast to those forecasting a greater interest in some aspect of efficiency, three reported customers would exhibit general concerns about energy mandates (one mention), increased interest in natural gas measures due to the lower cost of gas compared to electricity (one mention), and less interest in energy efficiency generally (one mention) because incentives for efficiency are getting too low.

7.3 Energy Saving Measures or Services

The following research question is informed by feedback from staff, ATACs, contractors, and participants:

> ***What energy saving measures or services is the Program developing? Does the Program have the right mix of measures or offerings to achieve its goals?***

Program staff identified several energy savings measures or services that are in development or being considered, some of which are discussed in greater detail elsewhere (such as Section 4.4):

- Continuing support for the recently implemented Multifamily SEM effort.
- Developing a no-cost pilot program for commercial heat pumps in rural areas.
- Using utility usage data to identify energy saving opportunities and targeting customers with marketing to realize those opportunities.
- Carrying out lighting and smart thermostat direct-install efforts in rural areas.
- Working with schools and other institutions that are pursuing electrification projects.
- Working to understand how the Program can be leveraged to support Energy Trust's work on Solar For All .

A few ATACS also identified some new technologies that Energy Trust should consider:

- Improving overall indoor air quality with better ventilation equipment such as air handlers
- Installing Solar PV chargers with a canopy.
- More sophisticated building management systems:

  > *"I think there's a lot of existing buildings out there that have antiquated control systems…the ease of use for their operators will start driving more controlled upgrades in buildings, heat pumps/electrification, and adhering to building code requirements."*

- Advances and improvements in refrigerants used for building cooling, including variable refrigerant flow systems.
- Continued emphasis on heat pumps as owners shift to all-electric buildings.
- Reducing noise in buildings.

Contractor respondents reported heat pumps as the best measure-specific opportunity for energy savings going forward and several identified opportunities to address different audiences with information about

efficiency. Almost three quarters of all respondents (34 of 48) reported opportunities for energy savings in the coming years. Of those 34, 28 reported a specific measure as a key opportunity, and ten mentioned opportunities to improve awareness or outreach among owners of certain building types or certain market actors:

- Measure opportunities (28 mentions).
  - Increase adoption of heat pumps and associated technologies like smart thermostats (20 mentions).
  - Increase adoption of build shell measures such as spray foam insulation, efficient windows, and insulation generally (6 mentions). Respondents specified that existing windows incentives are not sufficient to drive adoption and that working to lower the cost of spray foam insulation and increase its adoption can make things like solar installation more palatable to some customers.
  - Increase use of solar technologies such as installing more solar panels and using solar for water heating (4 mentions)
  - Replace rooftop HVAC units (RTU) with more efficient options, especially those on small buildings that currently do not qualify for incentives (1 mention).
  - Continue to replace old inefficient lighting in buildings (1 mention).
  - Increase adoption of measures that track and monitor energy usage that can help identify savings opportunities (1 mention).
- Awareness opportunities (10 mentions).
  - Work with contractors to increase their awareness of Energy Trust offerings (3 mentions).
  - Increase Energy Trust staff awareness of the latest efficient technologies (2 mentions).
  - Work with multifamily property owners and tenants to improve the efficiency of laundry facilities by having centralized instead of in-unit facilities (1 mention) and by offering more tenant focused-incentives (1 mention).
  - Work with owners of large old buildings to get them closer to current energy code (2 mentions).
  - Work with multifamily properties to install modern ductless heat pumps instead of older technology found in package heat pump (PHP) units (1 mention).
  - Work with warehouses more to identify energy savings opportunities (1 mention).
  - Increase awareness of program offerings in rural areas.

Some interviewed participants indicated they were unable to receive incentives for some equipment that was near end of useful life or that the available incentives did not sufficiently offset the cost. The few comments that suggested lack of available incentives referenced electric furnace, gas furnace water heater, fryers, stoves and ovens, windows, and refrigeration.

8 Conclusions and Recommendations

The information collected from our research points to a generally successful program despite some challenges with the transition to a new PMC and with some of the program changes that occurred in 2021. In particular, we identified the following high-level findings relating to the key research questions:

- Some challenges occurred with the transition to the new PMC, including bottlenecks in serving customers and challenges with managing the multiple implementation subcontracts, but such issues were largely invisible to the Program's collaborators, ATACs, contractors, and participants.
- Although staff found the removal of lighting measures from, and the incorporation of multifamily buildings measures into, the Program to be challenging, feedback from the interviewed ATACs and contractors identified few or no downsides to that change.
- Feedback from program and implementer staff, CBOs, collaborating agencies, and customers all point to success with efforts to reach priority populations.
- CBOs and collaborating agencies characterized their relationship with Energy Trust and the Existing Buildings program positively.
- Market-side informants (ATACs, contractors, and participants) generally were satisfied with the Program, despite some ATACs' concerns with the new PMC and some contractors' identification of slowness in incentive processing.
- The Program supports referrals to other Energy Trust programs reasonably well, although opportunities for improvement exist.

The above, and other findings detailed in the body of this report, produced the following conclusions and recommendations.

Conclusion 1: The Program has made achievements towards addressing Energy Trust's DEI goals. Energy Trust and the implementer have supported DEI work by doing things like hiring bilingual energy advisors, expanding their work with CBOs, providing marketing collateral in multiple languages, offering food and childcare services along with the multifamily SEM offering, and establishing relationships with affordable housing agencies. Furthermore, the PMC sought to work with a range of diverse suppliers to implement the program and worked with CBLs to inform program development. These efforts began a process that can be built on in the future. However, some of the many efforts taken did not go as smoothly as hoped, in particular: 1) the use of CBLs to help develop culturally appropriate outreach material; and 2) field staff's interactions with tribal communities. The decision to pause the CBL network in 2024 allows Energy Trust and TRC to assess whether and how CBLs can be used more effectively or whether a different approach may be appropriate. While several staff contacts suggested the Program has had success in developing culturally appropriate collateral (which the CBLs were meant to assist with), it may still be possible to use outside assistance to improve on them as well as to help with training field staff to work with tribal groups.

> **Recommendation 1a:** Energy Trust and TRC should assess whether it may still be valuable to use the CBL network for the purpose of helping develop cultural appropriate outreach material or should examine alternative approaches to doing so; if it is concluded that the CBL network is still

valuable, Energy Trust and TRC should ensure that the scope of work and expected deliverables are clearly understood.

Recommendation 1b: Energy Trust and TRC also should assess the training needs of field staff in how to work with tribal communities and identify the most appropriate training sources, including whether the CBLs may be among those sources.

Conclusion 2: The addition of multifamily measures and exclusion of lighting measures – which started in 2021 at the same time as the transition to the new PMC – resulted in many challenges for program staff. Although the changes in the program implementation did not appear to affect how trade allies and non-trade ally contractors worked with Energy Trust, the challenges that program staff experienced could have been exacerbated by the simultaneous change in implementers. Recent staff efforts, including working with the residential program on outreach efforts, appear to have decreased the challenges relating to the multifamily component of the Program in the latter half of 2023 and early 2024 compared to the 2021-22 timeframe. Further, feedback from the interviewed ATACs and contractors identified few or no downsides to the incorporation of multifamily projects into the Existing Buildings Program.[11]

Recommendation 2: Energy Trust should consider limiting the number of program changes that are implemented at any given time, to allow program staff to absorb and adapt to the changes. Program staff should prioritize planned changes and roll them out over a period of time – perhaps a minimum of 6 months and as much as a year for each change. If feasible, it may be advisable to engage a change management consultant to ensure that proposed program changes are thoroughly discussed internally, with all potentially involved program staff, to identify and plan to mitigate potential internal challenges.

Conclusion 3: Incorporating multifamily measures and properties into Existing Buildings has mostly worked well. There were some initial challenges to incorporating multifamily work into Existing Buildings, such as a lack of marketing resources directed at multifamily, but the Program is addressing those challenges. Additionally, the Program is working on identifying measures and services that work for multifamily, including the SEM for multifamily services, and continuing to work with state agencies to find co-funding opportunities for measures that do not meet cost-effectiveness tests when funded solely by one organization.

Recommendation 3: Continue to look for co-funding opportunities and processes that will support adoption of efficiency measures in multifamily properties. Energy Trust and state agencies have started the process to work together towards this end, however, the state agencies funding cycles differ from Energy Trust's funding cycle which has resulted in changes in incentives mid-project which can cause confusion and frustration among participants. Continue to look for ways to overcome these funding cycle challenges such as locking in an incentive amount early in the process and not changing that incentive amount mid-project.

[11] We also note that the COVID pandemic also could have exacerbated the situation, as it affected how work was done (more remote working and meeting). This possibly contributed to the shortened transition timeframe or the turnover in PMC staff. However, we are not certain how this would affect our recommendations, other than to avoid significant program changes when major external events are occurring.

Conclusion 4: Contractors and ATACs are generally satisfied with their participation with Energy Trust, but Energy Trust may be able to improve contractors' program experience. Most trade allies noted that their involvement with Energy Trust has helped their business opportunities, and many contractors appreciated the helpful interactions they had with Energy Trust representatives. However, a subset of contractors (both trade allies and non-trade allies) offered some suggestions for improvement, the most common of which were to increase incentives (especially for windows), improve communication with Energy Trust, and improve the application process in various ways (e.g., offering online applications and improving explanations of what qualifies).

Recommendation 4a: With the understanding that Energy Trust and TRC attempt to establish incentive levels that are high enough to induce the adoption of energy efficient technologies in a cost-effective manner, we encourage Energy Trust and TRC to review incentives for windows and possibly other shell measures.

Recommendation 4b: Energy Trust and TRC should review outreach to non-trade allies to identify opportunities for improvement. In particular, the program may consider sending periodic e-blasts to *all* known non-trade ally contractors – or, at least, all those that have done any Energy Trust projects – with current program information. The e-blasts should include an option to unsubscribe from further contact.

Recommendation 4c: Energy Trust and TRC should review the information included on outreach materials (e.g., *The Insider* e-newsletter) sent to trade allies to ensure that they identify all key program contacts for various project types, if they do not already do so.

Recommendation 4d: Energy Trust and TRC should continue to review the application forms and processes to ensure they are clear and as easy to complete as possible. This may particularly help with obtaining more applications through non-trade ally contractors, as they were more likely to comment on this concern. This may also argue for more proactive communication with this group (see Recommendation 4b) to provide clear information on the application process.

Recommendation 4e: Energy Trust and TRC should consider the feasibility and benefits of creating an online portal to allow contractors to check the status of submitted applications.

Conclusion 5: Non-HVAC contractors, especially building shell contractors, are not as likely to complete incentive applications for customers, something almost all HVAC contractors do. In some cases, this may reflect important differences in the contractor-client relationship between HVAC and other contractors. HVAC contractors may be willing to invest the time to assist with application because doing so represents a small proportion of the project cost and may help ensure continued work with the client (e.g., to maintain the equipment). By contrast, the commodity-like nature of some other measure types may mean that additional time and effort beyond installation may cut into a contractor's margin.

Recommendation 5: Energy Trust may want to investigate reasons why non-HVAC contractors are less likely to help complete incentive applications. What is it about building shell projects or contractors that make them resistant to completing incentive paperwork, or why do HVAC contractors see it as important to complete the incentive paperwork? Learning this may help Energy Trust and the PMC devise approaches to incent such contractors to assist with

applications, increasing customer satisfaction and possibly increasing the number of projects completed.

Conclusion 6: Energy Trust decided to apply the SDP to the EB contract in 2021, requiring the implementer to use at least 20% of its contract award with diverse suppliers. To satisfy that requirement, the new implementer engaged 17 different firms, many which had not worked with Energy Trust before and may not have had a full understanding of Energy Trust and their programs. The implementer showed commitment to complying with the SDP by finding so many suppliers. However, in that process, they may have selected more supplier subcontractors than they could reasonably manage. Furthermore, some of these subcontractors may have needed more guidance or support, especially in the early phases of the implementer's overseeing of the Program. Progress has been made in improving some of the challenges with subcontractors for the current contract, but the potential remains for similar challenges to arise in future contracts.

Recommendation 6: Energy Trust should require that proposals to provide implementation services include plans to provide adequate orientation, training, and support to subcontractors that may be unfamiliar with Energy Trust programs and requirements. The proposal should further demonstrate that the primary contractor and any proposed subcontractors have the capacity to provide the required orientation, training, and support.

APPENDIX

This appendix includes the following:

- Staff Interview Guide
- Utility Interview Guide
- Community Based Organization (CBO) Interview Guide
- ODOE/OHCS Interview Guide
- ATAC Interview Guide
- Trade Ally/Non-Trade Ally Contractor Interview Guide
- Program Participant Interview Guide

Energy Trust Existing Buildings Staff Guide

Recruitment Scripts

Email

Hello,

My name is [ADM STAFF NAME] and I work for ADM and am working on the Energy Trust Existing Buildings process evaluation. We would like to speak with you and your colleagues (cc'd on this email) involved with [STAFF GROUP NAME]. We want to conduct this interview to help us understand the varying elements that go into the program, recent program achievements, and any challenges the program may face working with the program.

Can one of you suggest a time when we could all speak via a Microsoft Teams call in the next week or so? I anticipate this interview will last about 60 minutes.

The interview will start with some background questions and then get into questions about the recent history of the program, operations, customer experience, and future opportunities for the program.

I look forward to hearing from you and learning more about the program when we talk.

Sincerely,

[ADM TEAM CONTACT]

Phone

Hello,

My name is [ADM STAFF NAME] and I work for ADM and am working on the Energy Trust Existing Buildings process evaluation. We would like to speak with you and your colleagues involved with [STAFF GROUP NAME]. We want to conduct this interview to help us understand the varying elements that go into the program, recent program achievements, and any challenges the program may face working with the program.

Can one of you suggest a time when we could speak with you and [STAFF GROUP COLLEAGUE NAMES] via a Microsoft Teams call in the next week or so? I anticipate this interview will last about 60 minutes.

[SCHEDULE INTERVIEW TIME]

Interview Script

Introduction

Hello,

My name is [ADM STAFF NAME] and I work for ADM and am working on the Energy Trust Existing Buildings process evaluation. We are conducting this interview today to help us understand the recent achievements of the program and any challenges the program may face with implementing the program.

I anticipate this interview will last about 60 minutes. I'll start with some background questions and then get into questions about the recent history of the program, operations, customer experience, and future opportunities for the program.

As we go through the questions, please let me know if there are questions or topics you are not able to address. This is a conversation so please don't hesitate to ask questions or clarify things as we go through the questions.

I will be taking notes throughout the call, but I would also like to record our conversation to make sure I capture what you are telling me accurately. The recording is confidential. Is it ok that I record the call?

[IF YES] Start recording

[IF NO] Take notes as best as possible

Background

Who Gets Question	Questions
All	1. To start, please describe your role working with the Energy Trust Existing Buildings (EB) Program? [PROBE: What are your key tasks and objectives?]
	2. Who do you typically work with regarding the EB Program and what are their roles?
	3. How long have you been in your role? And how long have you worked with the EB Program?

Program History

ETO Staff	4. [ASK IF 3 indicates program familiarity is > 2 years] I understand the new implementer (TRC) started working with the EB Program in early 2021. So far, how has working with TRC been for you and your team?
TRC Staff	5. [ASK IF 3 indicates program familiarity is > 2 years] How did the transition from the old implementer (ICF) work? What challenges, if any, did you experience during that transition?
All but ETO New Initiatives	6. [ASK IF 3 indicates program familiarity is > 2 years] I understand that in 2021, the lighting component of the EB program became the independent Business Lighting program. What effect has the removal of lighting had on the EB program? [PROBES: Has it been difficult to use lighting as a gateway to get participants to do other projects like HVAC? How if at all, did it affect trade allies? Something else?]
ETO Ops, EB Coordination, CCS/Outreach, Customer Acquisition, Coordination, and New Initiatives	7. [ASK IF 3 indicates program familiarity is > 2 years] I understand that in 2021, the EB program incorporated Multifamily measures. What effect has incorporating that had on the EB program? [PROBES: Has it positively or negatively impacted multifamily participation? Has it made it more or less difficult for multifamily properties to install efficient measures? How, if at all, did it affect trade allies? Something else?]
ETO Ops & New Initiatives, TRC Prgm Mgmt	8. What changes have been made to the program in the last year or so? [PROBES: These changes could be changes in measures, incentive caps, marketing or outreach efforts, or anything else?]
	9. What changes would you like the program to make in the next year or so? [PROBES: These changes could be changes in measures, incentive caps, marketing or outreach efforts, or anything else?]

	10. Why do you want to make these changes? [PROBES: Is it to increase or expand participation, make rules clearer to participants, something else?]
	11. How likely is it that these changes will happen? Why?

Program Operations

All	12. [ASK IF NOT ADDRESSED ABOVE] Since TRC has been implementing the program (2021), what do you see as the biggest successes of the EB Program?
	13. [ASK IF NOT ADDRESSED ABOVE] Since TRC has been implementing the program (2021), what have been the biggest challenges the program has faced?
	14. [ASK IF CHALLENGES NOTED IN Q12] How have you and the team addressed those challenges?
	15. How does your team/group communicate with your counterparts at TRC/Energy Trust?
	16. What aspects of communication between Energy Trust and TRC are working well?
	17. How, if at all, could communication between Energy Trust and TRC be improved?
TRC Program Managers	18. Who does TRC subcontract with and what are each subcontractors primary roles?
ETO Ops	19. How has the TRC's use of subcontractors differed from how the previous implementer used subcontractors?
ETO Ops	20. [ASK IF 19 DENOTES DIFFERENCES] Which use of subcontractors has served the program better and why?
ETO PMs and New Initiatives	21. What has worked well with the community-based liaisons (CBLs) and what, if anything, could be improved? [PROBE: If CBL work is stopping, ask why?]
All TRC	22. Which subcontractors, if any, does your team work with regularly, and in what capacity?
	23. How has working with these subcontractors helped your team or the program as a whole achieve your goals?
	24. What challenges, if any, have you encountered in working with these subcontractors to achieve your goals or program goals?

ETO Ops, New Initiatives, TRC Prgm Mgmt	25. The next few questions are about how the EB program supports Energy Trust's DEI Operations Plan. The most recent plan (2021) and the updates issued in August 2023 indicate that Energy Trust would address four key areas: ..supporting CBOs? …offering culturally responsive communication and outreach? …addressing needs in rural communities? ….using data to effectively reach communities? How is the EB program addressing these areas?
	26. What metrics are you using to know when you or the program have achieved these goals?
	27. What activities, if any are you doing to address DEI goals in addition to what is in the operations plan? What, if anything, has been a barrier to the program engaging priority customers and what could be done to overcome those barriers?
	28. What activities, if any are you doing to address DEI goals in addition to what is in the operations plan?
	29. What else, if anything, could the program do to better engage priority customers and advance Energy Trust's DEI objectives
	30. What has been working well in terms of the EB program addressing Energy Trusts DEI goals?
All but New Initiatives, Marketing and Initiatives + Operations	31. How, if at all, does the EB program coordinate with other Energy Trust programs to refer customers or receive referrals? [PROBES] How, if at all, does the program identify participants that may be candidates for other Energy Trust programs? How, if at all, does the program refer (or hand off) an EB participant to participate in another program?
	32. How is any coordination with other Energy Trust programs going as it pertains to launching and conducting pilots?
	33. What training, if any, do trade allies receive in identifying other possible projects a participant may want to pursue? For example, will HVAC trade allies notice that a customer could benefit from upgraded lighting and refer that customer to Energy Trust?
Ask All	34. What opportunities, if any, do you see to improve program processes?
	35. What opportunities, if any, do you see to increase participation among priority customers? [IF NEEDED: We understand that Energy Trust now uses "priority customers" to mean groups that historically have been underserved, such as rural, POC, etc.]

ETO PMs and TRC Prog. Mgt. New Initiatives	36. How, if at all, has and is the EB program working with community-based organizations (CBO)?

Experience of Customers, Market Actors, and Collaborators

Operations, CCS/Outreach, Customer Acquisition, Program mgt. Marketing + Market Actors, Outreach Staff	37. How is the EB program marketing and conducting outreach to customers generally and priority customers specifically? [IF NEEDED: We understand that Energy Trust now uses "priority customers" to mean groups that historically have been underserved, such as rural, POC, etc.]
	38. How effective have those strategies been?
	39. How, if at all, could marketing and outreach to customers generally and priority customers specifically be improved?
	40. How is the EB program marketing and conducting outreach to trade allies?
	41. How effective have those strategies been?
	42. How, if at all, could marketing and outreach to trade allies be improved?
	43. What do you hear from participants about their satisfaction with the program? What do they like and dislike about participation?
	44. How, if at all, has the experiences and satisfaction of program participants differed when you think about participants by… Size Business type Location (rural/urban)
	45. What do you hear from trade allies, contractors, and ATACs about their satisfaction with the program? What do they like and dislike about being a trade ally?
	46. What, if anything, do you hear from contractors (non-trade allies) about why they are not trade allies?
Operations, Program Mgt.	47. How does EB program coordinate with utilities to promote efficiency offerings?
	48. How, if at all, could coordination with utilities be improved?
Operations, Program Mgt, New Initiatives.	49. How does EB program work with ODOE to support efficiency in k-12 public schools?
	50. How, if at all, could this work be improved

	51. How does EB program work with OHCS to support efficiency for multifamily customers?
	52. How, if at all, could this work be improved?
	53. How, if at all, have the collaborations with ODOE and/or OHCS assisted the program in better serving priority customers?

Future Opportunities

Operations, Program Mgt., Initiatives + operations, New Initiatives	54. What pilot efforts has the program undertaken in the last year or so and why is the program conducting these pilots?
	55. What non-lighting direct install opportunities, if any, is the program considering implementing and why?
	56. How, if at all, does your team coordinate with other teams at Energy Trust or TRC to plan and implement measure changes?
	57. How, if at all, does your team coordinate with other teams at Energy Trust or TRC to plan and implement pilot programs?
	58. What trends in energy efficiency - technologies, market adoption, changes in price, electrification, something else - do you see impacting the EB program in a notable way in the next three to five years?
	59. How, if at all, does the EB program plan to address these trends?
	60. What do you see as the largest opportunity for the EB program to drive energy efficiency in the Oregon market? Is it pushing a specific technology, improving outreach to a region or business type, something else?
	61. If not already mentioned above, what energy efficiency measures do you see as being the primary contribution to savings for the EB program over the next three to five years?
	62. What measures, if any, does the program need to consider adding to the program to help it achieve its long-term savings goals?
	63. What measures, if any, does the program need to consider removing from the program because it is no longer enough above baseline to bother with incentives or it is not cost effective?
ALL	64. Finally, what would you like to learn from this evaluation of the EB program? [PROBES: Is there anything that would especially help you with your job?]

Utility Interview Guide

Recruitment Scripts

The team will contact all potential respondents using both email and phone. The interviewers will attempt contact up to five times. We anticipate that the utility and state agency staff will not allow them to accept a gift for completing the interview.

Email

Dear [NAME],

As part of its commitment to continuous improvement, Energy Trust of Oregon regularly evaluates its energy efficiency programs for business customers.

Energy Trust has hired ADM Associates to contact individuals like yourself for a brief discussion about your utility's experiences collaborating with Energy Trust programs to reach your business customers. The conversation should take about 20 minutes. Your responses are confidential. We will report only the overall findings to Energy Trust, not any individual responses.

If you have questions about how we treat collected data, please see ADM's privacy policy at https://www.admenergy.com/privacy

Please let us know a few times over the next few weeks when you can chat about your experiences. If we don't hear from you, we'll follow up with a call.

Of course, if you would rather not hear from us again, just let me know by return email. But I hope you can spare a few minutes to give me your feedback.

If you have any questions about this research, please feel free to contact me by return email or at [ADM CONTACT INFORMATION] or [ENERGY TRUST CONTACT INFORMATION].

Sincerely,

[ADM TEAM CONTACT]

ADM conducts research to support research and evaluation in the energy sector. Survey data are not shared with third parties for marketing purposes. Our full privacy statement is linked here: www.admenergy.com/privacy

Phone (If No Response to Email)

Hello,

This is _____ with ADM Associates. I am trying to reach [NAME].

IF NEEDED:

We emailed [NAME] about a week ago on behalf of Energy Trust of Oregon to try to set up a time to get feedback on your utility's experience collaborating with the Energy Trust programs for business customers. I'm just following up on that email.

IF NOT AVAILABLE: Try to get callback time.

IF REACHED RIGHT CONTACT:

Hello,

This is _____ with ADM Associates. We emailed you about a week or so ago about your utility's collaboration with the Energy Trust programs for business customers. Do you remember that email?

IF DOES NOT REMEMBER EMAIL:

> The purpose was to try to set up a time to chat about your experience working with the Energy Trust programs for business customers. This is part of Energy Trust's commitment to continuous improvement. Your feedback will help Energy Trust improve its services to your business customers.
>
> Do you have some time to talk now?
>
> IF NO TIME TO TALK:
>
> Can we schedule a time in the next week or so?
>
> IF YES:
>
> That's great. I'll go ahead and start. I will be taking notes throughout the call, but I would also like to record our conversation to make sure I capture what you are telling me accurately. The recording is confidential. Is it ok that I record the call?
>
> [IF YES] Start recording
> [IF NO] Take notes as best as possible
>
> USE AS NEEDED:
>
> Our chat will cover your experience with the program as well as how well it serves your business customers.
>
> Our chat should take about 20 minutes, although we want you to feel free to share as much information as you want. All your responses will be treated as confidential. We will report only the overall findings to Energy Trust, not any individual responses.

IF REMEMBERS EMAIL:

> I'm just following up on that email.

As you'll recall, the purpose was to try to set up a time to chat about your experiences with the program.

Do you have some time to talk now?

IF NO TIME TO TALK:

Can we schedule a time in the next week or so?

IF YES:

That's great. I'll go ahead and start. I will be taking notes throughout the call, but I would also like to record our conversation to make sure I capture what you are telling me accurately. The recording is confidential. Is it ok that I record the call?

1. [IF YES] Start recording
2. [IF NO] Take notes as best as possible

USE AS NEEDED:

Our chat will cover your experience with the program as well as how well it serves your business customers.

Our chat should take about 20 minutes, although we want you to feel free to share as much information as you want. All your responses will be treated as confidential. We will report only the overall findings to Energy Trust, not any individual responses.

Phone (If Scheduled Interview Via Email)

AFTER REACHING CORRECT PERSON:

Hello,

This is _____ with ADM Associates, calling as scheduled to talk about your utility's work with the Energy Trust programs for business customers. Is this still a good time to talk?

IF NO TIME TO TALK:

Can we schedule a time in the next week or so?

IF YES:

That's great. I'll go ahead and start. I will be taking notes throughout the call, but I would also like to record our conversation to make sure I capture what you are telling me accurately. The recording is confidential. Is it ok that I record the call?

[IF YES] Start recording
[IF NO] Take notes as best as possible

USE AS NEEDED:

Our chat will cover your utility's services, your experience working with the Energy Trust programs for business customers, the effectiveness of the partnership, and your observations, if any, about market trends that could affect how the program serves your business customers.

> Our chat should take about 20 minutes, although we want you to feel free to share as much information as you want. All your responses will be treated as confidential. We will report only the overall findings to Energy Trust, not any individual responses.

Interview Script

Introduction

This interview is really designed to be a conversation so please don't hesitate to ask questions or clarify things as we go through the questions.

I will be taking notes throughout the call, but I would also like to record our conversation to make sure I capture what you are telling me accurately. The recording is confidential. Is it ok that I record the call?

[IF YES] Start recording

[IF NO] Take notes

Background

The next few questions ask some basic questions about your involvement in the Energy Trust programs.

1. To start, please describe your role working with Energy Trust programs.
2. What are your key tasks and objectives?
3. Who do you work with, both within your company/organization and at Energy Trust, regarding the Energy Trust programs? What are their roles?
4. How long have you been in this role? Was there someone else in this role before you?

Program Engagement & Participation

The next few questions are to help us understand how your organization has worked with the Energy Trust programs and its reasons for doing so.

5. Do you also work with anyone at the program implementers – TRC for Existing Buildings and Energy 350 for Production Efficiency? If so, who ?
6. Do you mostly work with staff at Energy Trust or the implementers?
7. How do you work with Energy Trust and/or the implementers to support the Energy Trust energy efficiency programs?
8. [IF NEEDED] How do you work with Energy Trust to promote its energy efficiency programs to your customers?
9. How do you work with the Energy Trust programs to engage lower-income customers and small or rural businesses?
10. What additional actions might be taken to further promote the program across the communities you serve?

Program Changes

Energy Trust recently has made some changes to its energy efficiency programs for business customers, which you may be aware of. I'd like to ask about whether those changes have affected the collaboration between [UTILITY] and Energy Trust relating to these programs.

11. First, lighting measures were removed from the Existing Buildings Program and put into a separate program, called Business Lighting. How, if at all, has that affected the collaboration between [UTILITY] and the Energy Trust programs?
12. Second, Multifamily services were incorporated into the Existing Buildings Program. How, if at all, has that affected the collaboration between [UTILITY] and the Energy Trust programs?
13. In addition, in 2021, Energy Trust changed implementers for the Existing Buildings Program, from ICF to TRC. How, if at all, has that affected the collaboration between [UTILITY] and the Energy Trust programs?

Effectiveness of Partnership

The next set of questions are about your experience working with Energy Trust energy efficiency programs.

14. How often, and how, do you communicate with Energy Trust staff regarding these programs?
15. How would you characterize the effectiveness of the collaboration between your organization and Energy Trust relating to its programs for business customers?
16. What might be done, if anything, to improve that collaboration?
17. What have been some of the biggest successes of your partnership with the Energy Trust programs?
18. What have been some of the largest challenges for this partnership?
19. What changes, if any, do you think Energy Trust can make to improve this program?

Trends

Your responses to this next set of questions will help us provide input to Energy Trust on how its programs for business customers should evolve in the coming years.

20. What trends in energy efficiency—technologies, market adoption, changes in price, electrification, something else—do you see affecting the Energy Trust programs in a notable way in the next three to five years?
21. Do you have any thoughts on what the Energy Trust business programs might do to better drive energy efficiency in Oregon? Why do you say that?
22. [PROBE ABOUT: specific technology, targeted outreach by region or business type, etc.]
23. What changes do you think Energy Trust should make to its programs for business customers to reflect market changes and trends? (adding measures? removing measures?)

Those are all the questions I have. Thanks for your time.

Community-Based Organization (CBO) Interview Guide

Phone Recruitment Script

Hello,

This is _____ with ADM Associates. I am trying to reach [NAME].

IF NEEDED:

We emailed [NAME] about a week ago on behalf of Energy Trust of Oregon to try to set up a time to get feedback on your organization's experience with the Energy Trust Existing Buildings program. I'm just following up on that email.

IF NOT AVAILABLE: Try to get callback time.

IF REACHED RIGHT CONTACT:

Hello,

This is _____ with ADM Associates. We emailed you about a week or so ago about your organization's work with the Energy Trust Existing Buildings Program. Do you remember that email?

IF DOES NOT REMEMBER EMAIL:

> The purpose was to try to set up a time to chat about your experience working with the Existing Buildings Program. This is part of Energy Trust's commitment to continuous improvement. Your feedback will help Energy Trust improve its services to businesses and organizations like the ones [CBO_NAME] serves.
>
> Do you have some time to talk now?
>
> As a thank you, ADM is providing a $100 electronic gift card to all those that complete interviews with us.
>
> IF NO TIME TO TALK:
>
> Can we schedule a time in the next week or so?
>
> IF YES:
>
> That's great. I'll go ahead and start. I will be taking notes throughout the call, but I would also like to record our conversation to make sure I capture what you are telling me accurately. The recording is confidential. Is it ok that I record the call?
>
> 1. [IF YES] Start recording
> 2. [IF NO] Take notes as best as possible
>
> USE AS NEEDED:
>
> Our chat will cover your experience with the program as well as how well it serves the businesses and organizations that [CBO_NAME] serves.

Our chat should take about 20 minutes, although we want you to feel free to share as much information as you want. All your responses will be treated as confidential. We will report only the overall findings to Energy Trust, not any individual responses.

IF REMEMBERS EMAIL:

I'm just following up on that email.

As you'll recall, the purpose was to try to set up a time to chat about your experiences with the program.

Do you have some time to talk now?

IF NO TIME TO TALK:

Can we schedule a time in the next week or so?

IF YES:

That's great. I'll go ahead and start. I will be taking notes throughout the call, but I would also like to record our conversation to make sure I capture what you are telling me accurately. The recording is confidential. Is it ok that I record the call?

[IF YES] Start recording
[IF NO] Take notes as best as possible

USE AS NEEDED:

Our chat will cover your experience with the program as well as how well it serves the businesses and organizations that [CBO_NAME] serves.

Our chat should take about 20 minutes, although we want you to feel free to share as much information as you want. All your responses will be treated as confidential. We will report only the overall findings to Energy Trust, not any individual responses. As a thank you, we are providing a $100 electronic gift card to all those who complete interviews with us.

Interview Script

Introduction

This interview is really designed to be a conversation so please don't hesitate to ask questions or clarify things as we go through the questions.

I will be taking notes throughout the call, but I would also like to record our conversation to make sure I capture what you are telling me accurately. The recording is confidential. Is it ok that I record the call?

[IF YES] Start recording

[IF NO] Take notes

Background

The next few questions ask some basic questions about your involvement in the Energy Trust programs.

1. To start, please describe your role working with Energy Trust programs.
   IF NEEDED: What are your key tasks and objectives?
2. Who do you work with, both within your company/organization and at Energy Trust, regarding the Energy Trust programs? What are their roles?
3. How long have you been in this role? Was there someone else in this role before you?

Program Engagement & Participation

The next few questions are to help us understand how your organization has worked with the Energy Trust programs and its reasons for doing so.

4. First, what types of services do you provide?
5. Please describe the communities you serve. What geographic region of the state do you serve? Do your services focus on specific demographic groups?
6. Who do you work with at Energy Trust?
7. Do you also work with anyone at the company that Energy Trust hired to implement the program – that company is called TRC? If so, who?
8. Do you mostly work with staff at Energy Trust or TRC?
9. How would you describe your organization's collaboration with the Energy Trust programs?
10. [PROBE] How do you see your role in the programs?
11. [PROBE] How do your activities help the people you serve get Energy Trust incentives?
12. How does your organization carry out this collaboration?
13. [IF NEEDED] How do you work with the Energy Trust programs to engage lower-income customers?

14. What additional actions should be taken to further support access to the program across the communities you serve?
15. How can Energy Trust better engage the communities you serve?

Effectiveness of Collaboration

The next set of questions are about your experience working with Energy Trust energy efficiency programs.

16. How often, and how, do you communicate with Energy Trust staff regarding its energy efficiency programs?
17. How would you characterize the effectiveness of the collaboration between your organization and Energy Trust?
18. What might be done, if anything, to improve that collaboration?
19. What have been some of the biggest successes of your collaboration with the Energy Trust programs?
20. What have been some of the largest challenges for this collaboration?
21. What changes, if any, do you think Energy Trust can make to make this program more accessible to the people you serve?

Trends

This final question will help us provide input to Energy Trust on how its energy efficiency program should evolve in the coming years.

22. Have you heard about any changes that might occur in the next few years that might affect how the Energy Trust programs is able to serve the groups you serve?

Those are all the questions I have. Thanks for your time.

ODOE/OHCS Interview Guide

Recruitment Scripts

The team will contact all potential respondents using both email and phone. The interviewers will attempt contact up to five times. We anticipate that the utility and state agency staff will not allow them to accept a gift for completing the interview.

Email

Dear [NAME],

As part of its commitment to continuous improvement, Energy Trust of Oregon is evaluating its Existing Buildings Program, which has been working with [ORG_NAME] to support energy efficiency upgrades to [ORG_AUDIENCE].

Energy Trust has hired ADM Associates to contact individuals like yourself for a brief discussion about your experiences collaborating with the Existing Buildings Program. Our goal is to understand how you and your organization work with the Energy Trust program as well as program related program achievements and challenges. The conversation should take about 30 minutes. Your responses are confidential. We will report only the overall findings to Energy Trust, not any individual responses.

If you have questions about how we treat collected data, please see ADM's privacy policy at https://www.admenergy.com/privacy

Please let us know a few times over the next few weeks when you can chat about your experiences. If we don't hear from you, we'll follow up with a call.

Of course, if you would rather not hear from us again, just let me know by return email. But I hope you can spare a few minutes to give me your feedback.

If you have any questions about this research, please feel free to contact me by return email or at [ADM CONTACT INFORMATION] or [ENERGY TRUST CONTACT INFORMATION].

Sincerely,

[ADM TEAM CONTACT]

ADM conducts research to support research and evaluation in the energy sector. Survey data are not shared with third parties for marketing purposes. Our full privacy statement is linked here: www.admenergy.com/privacy

Phone (If No Response to Email)

Hello,

This is _____ with ADM Associates. I am trying to reach [NAME].

IF NEEDED:

We emailed [NAME] about a week ago on behalf of Energy Trust of Oregon to try to set up a time to get feedback on your organization's experience with the Energy Trust Existing Buildings program. I'm just following up on that email.

IF NOT AVAILABLE: Try to get callback time.

IF REACHED RIGHT CONTACT:

Hello,

This is _____ with ADM Associates. We emailed you about a week or so ago about your organization's work with the Energy Trust Existing Buildings Program. Do you remember that email?

IF DOES NOT REMEMBER EMAIL:

> The purpose was to try to set up a time to chat about your experience working with the Existing Buildings Program. This is part of Energy Trust's commitment to continuous improvement. Your feedback will help Energy Trust improve its services to [ORG_AUDIENCE].
>
> Do you have some time to talk now?
>
> IF NO TIME TO TALK:
>
> Can we schedule a time in the next week or so?
>
> IF YES:
>
> That's great. I'll go ahead and start. I will be taking notes throughout the call, but I would also like to record our conversation to make sure I capture what you are telling me accurately. The recording is confidential. Is it ok that I record the call?
>
> [IF YES] Start recording
> [IF NO] Take notes as best as possible
>
> USE AS NEEDED:
>
> Our chat will cover your experience with the program as well as how well it serves [ORG_AUDIENCE].
>
> Our chat should take about 30 minutes, although we want you to feel free to share as much information as you want. All your responses will be treated as confidential. We will report only the overall findings to Energy Trust, not any individual responses.

IF REMEMBERS EMAIL:

> I'm just following up on that email.

As you'll recall, the purpose was to try to set up a time to chat about your experiences with the program.

Do you have some time to talk now?

IF NO TIME TO TALK:

Can we schedule a time in the next week or so?

IF YES:

That's great. I'll go ahead and start. I will be taking notes throughout the call, but I would also like to record our conversation to make sure I capture what you are telling me accurately. The recording is confidential. Is it ok that I record the call?

[IF YES] Start recording
[IF NO] Take notes as best as possible

USE AS NEEDED:

Our chat will cover your experience with the program as well as how well it serves [ORG_AUDIENCE].

Our chat should take about 30 minutes, although we want you to feel free to share as much information as you want. All your responses will be treated as confidential. We will report only the overall findings to Energy Trust, not any individual responses.

Phone (If Scheduled Interview Via Email)

AFTER REACHING CORRECT PERSON:

Hello,

This is _____ with ADM Associates, calling as scheduled to talk about your organization's work with the Energy Trust Existing Buildings Program. Is this still a good time to talk?

IF NO TIME TO TALK:

Can we schedule a time in the next week or so?

IF YES:

That's great. I'll go ahead and start. I will be taking notes throughout the call, but I would also like to record our conversation to make sure I capture what you are telling me accurately. The recording is confidential. Is it ok that I record the call?

[IF YES] Start recording
[IF NO] Take notes as best as possible

USE AS NEEDED:

Our chat will cover your organization's services, your experience working with the Existing Buildings Program, the effectiveness of the partnership, and your observations, if any, about market trends that could affect how the program serves [ORG_AUDIENCE].

> Our chat should take about 30 minutes, although we want you to feel free to share as much information as you want. All your responses will be treated as confidential. We will report only the overall findings to Energy Trust, not any individual responses.

Interview Script

Introduction

This interview is really designed to be a conversation so please don't hesitate to ask questions or clarify things as we go through the questions.

I will be taking notes throughout the call, but I would also like to record our conversation to make sure I capture what you are telling me accurately. The recording is confidential. Is it ok that I record the call?

[IF YES] Start recording

[IF NO] Take notes

Background

The next few questions ask some basic questions about your involvement in the Energy Trust programs.

1. To start, please describe your role working with Energy Trust programs.
2. What are your key tasks and objectives?
3. Who do you work with, both within your company/organization and at Energy Trust, regarding the Energy Trust programs? What are their roles?
4. How long have you been in this role? Was there someone else in this role before you?

Program Engagement & Participation

The next few questions are to help us understand how your organization has worked with the Energy Trust programs and its reasons for doing so.

5. Who do you work with at Energy Trust?
6. Do you also work with anyone at the program implementer, TRC? If so, who ?
7. Do you mostly work with staff at Energy Trust or TRC?
8. How do you work with Energy Trust or TRC in providing energy-related assistance to [ODOE: SCHOOLS / OHCS: INCOME-QUALIFIED MULTIFAMILY CUSTOMERS]?
9. Do you rely on Energy Trust and/or TRC to provide the equipment-related expertise or does your office bring its own expertise?
10. [IF NEEDED] How, if at all, do you encourage participation in the Energy Trust programs or the installation of more covered equipment types through the program?
11. In what ways, if any, has your collaboration with the Program improved the energy efficiency of the buildings you serve?
12. Do you focus your efforts on buildings in specific communities? If so, how do you determine which communities to focus on?

13. [ODOE ONLY] How, if at all, do you work with the Energy Trust programs to engage lower-income schools? Are there specific accommodations that facilitate program participation?

Effectiveness of Partnership

The next set of questions are about your experience working with Energy Trust energy efficiency programs.

14. How often, and how, do you communicate with Energy Trust staff regarding these programs?
15. How would you characterize the effectiveness of the collaboration between your organization and Energy Trust relating to its programs that serve [ODOE: schools / OHCS: income-qualified multifamily customers]?
16. What might be done, if anything, to improve that collaboration?
17. What have been some of the biggest successes of your partnership with the Energy Trust programs?
18. What have been some of the largest challenges for this partnership?
19. [IF NOT ADDRESSED ABOVE] What would you say are the biggest challenges to serving [ODOE: schools / OHCS: income-qualified multifamily customers]?

    [PROBE about reaching decision-makers, financial constraints, planning constraints, understanding of the value of energy efficiency, etc.]
20. What changes, if any, might be made to either the Energy Trust programs or to your collaboration with it to benefit the buildings you serve?

Trends

Your responses to this next set of questions will help us provide input to Energy Trust on how its programs for business customers should evolve in the coming years.

21. Are you aware of energy-related market trends that could affect the kind of work you do with Energy Trust in the next three to five years?

    [PROBE ABOUT: technologies, market adoption, changes in price, electrification]
22. What do you see as the largest opportunity to drive energy efficiency in the types of buildings you serve? Why?

    [PROBE ABOUT: specific technology, targeted outreach by region or business type, etc.]
23. What changes, if any, might Energy Trust make to its energy efficiency programs to reflect market changes and trends?

    [PROBES: Adding measures? Removing measures?]

Those are all the questions I have. Thanks for your time.

Trade Ally/Non-Trade Ally Contractors Interview Guide

Recruitment Scripts

The team will contact all potential respondents using mail, email, and phone, as with TAs and other contractors. We will make up to five call attempts. To encourage participation and thank respondents for their time, we will offer a $50 gift card to all who complete an interview with us.

Advance Letter

Dear Contractor,

Energy Trust of Oregon has identified your firm as one of those helping make their commercial program successful over the past few years. As part of its commitment to continuous improvement, Energy Trust would like your feedback about your experience working with that program.

Energy Trust has hired ADM Associates to contact individuals like yourself to discuss your experiences briefly. Our goal is to understand how you and your organization work with the Energy Trust program and program-related achievements and challenges.

We are sending you this letter to alert you and your organization that representatives from ADM will be reaching out to you in the coming weeks to talk about your work with the Energy Trust commercial program. We estimate the conversation should take about 20 minutes and any responses you provide are confidential. We will report only the overall findings to Energy Trust, not any individual responses. You will receive a $50 gift card from ADM as a thank-you for your time.

If you have questions about how we treat collected data, please see ADM's privacy policy at https://www.admenergy.com/privacy.

Of course, if you would rather not hear from us again, just let me know by return email. But I hope you can spare a few minutes to give me your feedback.

If you have any questions about this research, please feel free to contact me by return email or [ADM CONTACT INFORMATION] or [ENERGY TRUST CONTACT INFORMATION].

Sincerely,

[ADM TEAM CONTACT]

ADM conducts research to support research and evaluation in the energy sector. Survey data are not shared with third parties for marketing purposes. Our full privacy statement is linked here: www.admenergy.com/privacy

Email

Dear [NAME],

Energy Trust of Oregon has identified your firm as one of those helping make the commercial program successful over the past few years. As part of its commitment to continuous improvement, Energy Trust would like your feedback about your experience working with that program.

Energy Trust has hired ADM Associates to contact individuals like yourself to discuss your experiences briefly. Our goal is to understand how you and your organization work with the Energy Trust program and program-related achievements and challenges. The conversation should take about 20 minutes. Your responses are confidential. We will report only the overall findings to Energy Trust, not any individual responses. You will receive a $50 gift card from ADM as a thank-you for your time.

If you have questions about how we treat collected data, please see ADM's privacy policy at https://www.admenergy.com/privacy

Please let us know a few times over the next few weeks when you can chat about your experiences. If we don't hear from you, we'll follow up with a call.

Of course, if you would rather not hear from us again, just let me know by return email. But I hope you can spare a few minutes to give me your feedback.

If you have any questions about this research, please feel free to contact me by return email or at [ADM CONTACT INFORMATION] or [ENERGY TRUST CONTACT INFORMATION].

Sincerely,

[ADM TEAM CONTACT]

ADM conducts research to support research and evaluation in the energy sector. Survey data are not shared with third parties for marketing purposes. Our full privacy statement is linked here: www.admenergy.com/privacy

Phone (If No Response to Email)

Hello,

This is _____ with ADM Associates. I am trying to reach [NAME].

IF NEEDED:

We emailed [NAME] about a week ago on behalf of Energy Trust of Oregon to try to set up a time to get feedback on your organization's experience with the Energy Trust Commercial Buildings program. I'm just following up on that email.

IF NOT AVAILABLE: Try to get a callback time.

IF REACHED RIGHT CONTACT:

Hello,

This is _____ with ADM Associates. We emailed you about a week or so ago about your organization's work with the Energy Trust Commercial Buildings Program. Do you remember that email?

IF DOES NOT REMEMBER EMAIL:

> The purpose was to try to set up a time to chat about your experience working with the commercial program. This is part of Energy Trust's commitment to continuous improvement. Your feedback will help Energy Trust improve its services to businesses and other organizations you work with.
>
> Do you have some time to talk now?
>
> We are offering a $50 electronic gift card to all who complete interviews with us as a thank you.
>
> IF NO TIME TO TALK:
>
> Can we schedule a time next week or so?
>
> IF YES:
>
> That's great. I'll go ahead and start. I will be taking notes throughout the call, but I would also like to record our conversation to ensure I accurately capture what you are telling me. The recording is confidential. Is it ok that I record the call?
>
> [IF YES] Start recording
> [IF NO] Take notes as best as possible
>
> USE AS NEEDED:
>
> Our chat will cover your experience with the program and how well it serves businesses and other organizations you work with.
>
> Our chat should take about 20 minutes, although we want you to feel free to share as much information as you want. All your responses will be treated as confidential. We will report only the overall findings to Energy Trust, not any individual responses.

IF YOU REMEMBERS, EMAIL:

I'm just following up on that email.

As you'll recall, the purpose was to schedule a chat about your experiences with the program.

Do you have some time to talk now?

IF NO TIME TO TALK:

Can we schedule a time in the next week or so?

IF YES:

That's great. I'll go ahead and start. I will be taking notes throughout the call, but I would also like to record our conversation to ensure I accurately capture what you are telling me. The recording is confidential. Is it ok that I record the call?

[IF YES] Start recording
[IF NO] Take notes as best as possible

USE AS NEEDED:

Our chat will cover your experience with the program and how well it serves businesses and other organizations you work with.

Our chat should take about 20 minutes, although we want you to feel free to share as much information as you want. All your responses will be treated as confidential. We will report only the overall findings to Energy Trust, not any individual responses. As a thank you, we provide a $50 electronic gift card to all who complete interviews.

Phone (If Scheduled Interview Via Email)

AFTER REACHING CORRECT PERSON:

Hello,

This is _____ with ADM Associates, calling as scheduled to talk about your organization's work with the Energy Trust commercial program. Is this still a good time to talk?

IF NO TIME TO TALK:

Can we schedule a time in the next week or so?

IF YES:

That's great. I'll go ahead and start. I will be taking notes throughout the call, but I would also like to record our conversation to ensure I accurately capture what you are telling me. The recording is confidential. Is it ok that I record the call?

[IF YES] Start recording
[IF NO] Take notes as best as possible

USE AS NEEDED:

Our chat will cover your organization's services, your experience working with the commercial program, the effectiveness of the partnership, and your observations, if any, about market trends that could affect how the program serves businesses and other organizations you work with.

> Our chat should take about 20 minutes, although we want you to feel free to share as much information as you want. All your responses will be treated as confidential. We will report only the overall findings to Energy Trust, not any individual responses. As a thank you, we provide a $50 electronic gift card to all who complete interviews.

Interview Script

Introduction

This interview is designed to be a conversation, so please don't hesitate to ask questions or clarify things as we go through the questions.

I will be taking notes throughout the call, but I would also like to record our conversation to ensure I accurately capture what you are telling me. The recording is confidential. Is it ok that I record the call?

[IF YES] Start recording
[IF NO] Take notes

Background

Thanks so much for talking with me today. I'd like to start off by asking a few questions about your business.

[ASK IF ENERGY TRUST REGISTERED TRADE ALLY]

1. According to my records, are a registered Energy Trust trade ally. Is that correct?

   Yes (confirmed status)
   No (did not confirm status)

[ASK IF NOT ENERGY TRUST REGISTERED TRADE ALLY]

2. According to my records, you are NOT a registered Energy Trust trade ally. Is that correct?

   Yes (confirmed status)
   No (did not confirm status)

3. What types of project services do you offer to commercial customers? (Mark all that apply)

   Compressed Air
   Heating and Cooling
   Industrial Battery Chargers
   Insulation
   Lighting + Lighting Controls
   Motors and Drives (including VFDs, pumps and fans)
   Refrigeration
   Steam Traps
   Water and Wastewater
   Welding
   Custom
   Other (Specify: _____)

4. How many locations does your company have? _____

5. How many of these locations are in:

   Oregon: _____
   Washington: _____

6. What particular areas of Oregon and Washington does your company serve?
   [PROBE about: entire state, Portland, Willamette Valley, Southern and Central Oregon, Eastern Oregon, Coastal Oregon, SW Washington.]

Program Operations

Now, I want to ask you some questions about your work with Energy Trust's commercial program.

7. When did you first start working with the commercial program?

   Before 2021
   Since 2022
   Since 2023
   Since 2024
   Not Sure

8. What types of project services do you offer as part of the commercial program? (Mark all that apply)

   Compressed Air
   Heating and Cooling
   Industrial Battery Chargers
   Insulation
   Lighting + Lighting Controls
   Motors and Drives (including VFDs, pumps and fans)
   Refrigeration
   Steam Traps
   Water and Wastewater
   Welding
   Custom
   Other (Specify: _____)

9. Our project tracking data show that your firm has completed [#PROJECTS] with the Energy Trust Buildings Program in 2022 and 2023. Does that seem about right?

   Yes
   No

[ASK 10 IF 9=NO]

10. What is the correct number? ____

11. Please describe your role working with the Energy Trust commercial program:
    [PROBE] What are your key roles or responsibilities working with this program?

[ASK 12 and 14 IF 7=BEFORE 2021]

12. How has that process changed, if at all, since the transition to a new implementation team in 2021?

13. [IF NEEDED] In 2021, the program implementer changed from ICF to TRC.

14. How has the transition to a new implementation team affected your projects and customers, if at all?

15. How has the creation of a separate program for Business Lighting affected your projects and customers, if at all?

16. How has the incorporation of multifamily projects into Commercial Buildings affected your projects and customers, if at all?

Customer Experience

17. What do you hear from participants about their satisfaction with the program?
[IF NEEDED: What do they like and dislike about participation?]

18. To your knowledge, how, if at all, have the experiences and satisfaction of program participants differed when you think about participants by…

    Size
    Business Type
    Location (rural/urban)

19. What opportunities, if any, do you see to improve participants' experiences?

Experience with Energy Trust

20. On a scale of 1 to 5, where 1 means "not at all" and 5 means "to a great degree," how much has working with Energy Trust helped your business opportunities?

[ASK 21 IF 20=1]

21. Why do you say that? [OPEN ENDED]

22. Based on your experience, what areas are working with Energy Trust's commercial program? [OPEN ENDED]

23. Based on your experience, what areas are not working as well with Energy Trust's commercial building program? [OPEN ENDED]

[ASK 24 IF NOT ENERGY TRUST REGISTERED TRADE ALLY]

24. Have you considered becoming a registered trade ally with Energy Trust?

    Yes
    No
    Not sure

[DISPLAY 25 IF 24=0]

25. Why did you decide not to become a registered trade ally with Energy Trust? [OPEN ENDED]

[ASK 26 and 27 ENERGY TRUST REGISTERED TRADE ALLY]

26. As a registered trade ally, does Energy Trust provide you with information about changes to the commercial building program?

    Yes
    No

27. Are you given sufficient information about program changes that may affect your business?

    Yes
    No

[ask 28 if 27=NO]

28. What type of information do you need from Energy Trust about its commercial program?

[DISPLAY 29 and 30 IF ENERGY TRUST REGISTERED TRADE ALLY]

29. Do you recall receiving communications about upcoming Energy Trust's programs and events (for example, trade ally forums, training, others)?

    Yes
    No

30. Which of the following types of communication, if any, do you recall receiving from Energy Trust?
    [MULTISELECT, EXCEPT THAT NONE OF THE ABOVE IS EXCLUSIVE]

    Energy Trust Newsletters
    Training Information
    Program Updates About Changing Program Incentives
    Other-Specify: [OPEN-ENDED]
    None of the above

[display 31 if 30<>NONE OF THE ABOVE]

31. Which of those types of communication is most useful to you, and why?

32. How do you receive information about Energy Trust incentives that are available to commercial customers?

33. How would you like to receive information about program offerings?

Trends

Your responses will help us provide Energy Trust with input on how its energy efficiency program should evolve in the coming years.

34. What considerations have the greatest weight in driving your customers' decisions about energy efficiency in the commercial and multifamily market segments right now?
    [PROBE] Is it economic factors, carbon reduction, or something else?

35. How, if at all, do you think those considerations will change over the next few years?

36. Where are the biggest opportunities for energy savings in the commercial and multifamily market segments over the next five years?
    [PROBE] Are there particular geographic areas, types of businesses, or technologies that you think could be big opportunities for energy savings?

37. Does Energy Trust's program have the right mix of technologies and offerings to meet your customers' needs in the commercial and multifamily market segments?

[PROBES]

Are your customers showing increased interest in certain types of projects or equipment that Energy Trust should be aware of? [OPEN ENDED]

Are there any project or equipment types that Energy Trust is not sufficiently supporting? [OPEN ENDED]

[ASK FOLLOWING IF NOT ALREADY ADDRESSED IN PREVIOUS QUESTION]

38. Are there any Direct Install Measures that should be added to the program? If so, what should be added? [OPEN ENDED]
39. Are there any Direct Install Measures that should be removed from the program? If so, what should be removed? [OPEN ENDED]

Firmographics

Now, I'd like to ask you just a few questions about your business. All responses will be kept confidential.

40. Which range best represents your firm's annual revenue in 2023:

    Up to $100,000
    Between $100,000 and $500,000
    $500,001 to $1 million
    Above $1 million

41. Approximately what percentage of your work is directly related to energy efficiency improvements?
42. Do you have anything else you would like to add to our conversation today about the commercial program?

Those are all the questions I have. Thanks for your time.

Participant Interview Guide

Recruitment

Email recruitment to sampled contacts to: explain the purpose, duration, and importance of participation; offer a $50 gift card for completing the interview; request available interview times; provide a phone number and ADM contact for information or to schedule or complete the interview; identify an Energy Trust contact to provide bona fides; and state that we will follow up with a phone call. As needed, make phone calls to schedule and complete interviews. The phone calls will follow a script similar to the recruitment email.

Email

Dear [NAME],

Your business or organization recently received a monetary incentive from the Energy Trust of Oregon Existing Buildings Program for completing an energy efficient equipment replacement or upgrade. As part of its commitment to continuous improvement, Energy Trust would like to get your feedback about your experience with that incentive program.

Energy Trust has hired ADM Associates to contact individuals like yourself for a brief discussion about your experiences. We have a goal of talking to about 70 individuals – can you be one of those who help us reach that goal?

As a thank you, ADM is providing a $50 electronic gift card to all those who complete interviews with us.

Our chat should take about 20 minutes. All your responses will be treated as confidential. We will report only the overall findings to Energy Trust, not any individual responses. If you have questions about how we treat collected data, please see ADM's privacy policy at https://www.admenergy.com/privacy

Please let us know a few times when you can chat about your experiences. If we don't hear from you, we'll follow up with a call.

Of course, if you would rather not hear from us again, just let me know by return email. But I hope you can spare a few minutes to give me your feedback.

If you have any questions about this research, please feel free to contact me by return email or at [ADM CONTACT INFORMATION] or [ENERGY TRUST CONTACT INFORMATION].

Sincerely,

[ADM TEAM CONTACT]

ADM conducts research to support research and evaluation in the energy sector. Survey data are not shared with third parties for marketing purposes. Our full privacy statement is linked here: www.admenergy.com/privacy

Email Follow-up

Dear [NAME],

I'm following up on an email I sent a few days ago on behalf of Energy Trust of Oregon.

As part of its commitment to continuous improvement, Energy Trust would like to get your feedback about your experience with its Existing Buildings Program – specifically, about [PROJECT] that [COMPANY] did on or around [DATE] and received a discounted price or a monetary rebate from Energy Trust.

Energy Trust has hired ADM Associates to talk to people like you about your experiences. I have been making calls the past week and have not yet been able to reach you. Can you be one of the people who help me reach our goal of talking to about 70 individuals?

As a thank you, ADM is providing a $50 electronic gift card to all those who complete the approximately 20-minute interviews with us.

If you are available for a call sometime this week or next, you can let me know your available times or even schedule a time here [CALENDLY LINK] or by return email. If I don't hear from you, I'll try again to reach you by phone.

All your responses will be treated as confidential.

Of course, if you would rather not hear from me again, just let me know by return email. But I hope you can spare a few minutes to give me your feedback.

If you have any questions about this research, please feel free to contact me by email or at [ADM CONTACT INFORMATION] or [ENERGY TRUST CONTACT INFORMATION].

Sincerely,

[ADM TEAM CONTACT]

ADM conducts research to support research and evaluation in the energy sector. Survey data are not shared with third parties for marketing purposes. Our full privacy statement is linked here: www.admenergy.com/privacy

Phone (If No Response to Email)

Hello,

This is _____ with ADM Associates. I am trying to reach [NAME].

IF NEEDED:

We emailed [NAME] about a week ago on behalf of Energy Trust of Oregon to try to set up a time to get feedback on your organization's experience with the Energy Trust program that provided a monetary incentive for an energy efficient equipment replacement or upgrade your organization completed. I'm just following up on that email.

IF NOT AVAILABLE: Try to get callback time.

IF REACHED RIGHT CONTACT:

Hello,

This is _____ with ADM Associates. We emailed you about a week or so ago about the monetary incentive your organization received from Energy Trust for an energy efficient equipment replacement or upgrade. Do you remember that email?

IF DOES NOT REMEMBER EMAIL:

> The purpose was to try to set up a time to chat about your experience with that assistance. This is part of Energy Trust's commitment to continuous improvement. Your feedback will help Energy Trust improve its services to organizations like yours.
>
> Do you have some time to talk now?
>
> As a thank you, ADM is providing a $50 electronic gift card to all those that complete interviews with us.
>
> IF NO TIME TO TALK:
>
> Can we schedule a time in the next week or so?
>
> IF YES:
>
> That's great. I'll go ahead and start. I will be taking notes throughout the call, but I would also like to record our conversation to make sure I capture what you are telling me accurately. The recording is confidential. Is it ok that I record the call?
>
> [IF YES] Start recording
> [IF NO] Take notes as best as possible
>
> USE AS NEEDED:
>
> Our chat will cover your experience with the program as well as how well it serves your market segment.
>
> Our chat should take about 20 minutes, although we want you to feel free to share as much information as you want. All your responses will be treated as confidential. We will report only the overall findings to Energy Trust, not any individual responses.

IF REMEMBERS EMAIL:

I'm just following up on that email.

As you'll recall, the purpose was to try to set up a time to chat about your experiences with the assistance you received.

Do you have some time to talk now?

IF NO TIME TO TALK:

Can we schedule a time in the next week or so?

IF YES:

That's great. I'll go ahead and start. I will be taking notes throughout the call, but I would also like to record our conversation to make sure I capture what you are telling me accurately. The recording is confidential. Is it ok that I record the call?

[IF YES] Start recording
[IF NO] Take notes as best as possible

USE AS NEEDED:

Our chat will cover your experience with the program as well as how well it serves your market segment.

Our chat should take about 20 minutes, although we want you to feel free to share as much information as you want. All your responses will be treated as confidential. We will report only the overall findings to Energy Trust, not any individual responses. As a thank you, ADM is providing a $50 electronic gift card to all those who complete interviews with us.

Phone (If Scheduled Interview Via Email)

AFTER REACHING CORRECT PERSON:

Hello,

This is _____ with ADM Associates, calling as scheduled to talk about the assistance your business or organization received from Energy Trust. Is this still a good time to talk?

IF NO TIME TO TALK:

Can we schedule a time in the next week or so?

IF YES:

That's great. I'll go ahead and start. I will be taking notes throughout the call, but I would also like to record our conversation to make sure I capture what you are telling me accurately. The recording is confidential. Is it ok that I record the call?

[IF YES] Start recording
[IF NO] Take best notes possible

USE AS NEEDED:

Our chat will cover your experience, including how the program outreach staff contacted you, what information they provided you, and how you made decisions about what kind of equipment upgrade to do.

> Our chat should take less than 20 minutes, although we want you to feel free to share as much information as you want. All your responses will be treated as confidential. We will report only the overall findings to Energy Trust, not any individual responses. As a thank you, ADM is providing a $50 electronic gift card to all those that complete interviews with us.

Interview Script

Confirmation of Participation

1. First, I'd like to confirm that information I have, which is that your organization received a monetary incentive from Energy Trust to complete [PROJECT] on or about [DATE] at one or more of your organization's work places. Is that correct?
   IF NO: What is incorrect? _____

Program Marketing and Awareness

The next couple of questions are about how you learned about the Energy Trust incentive program.

2. Was this the first time your organization received a monetary incentive or other assistance from Energy Trust to buy or upgrade energy-using equipment?

   Yes
   No
   Not sure

[ASK 3 TO 5 IF 2=NO]

3. About how many times has your organization received assistance from Energy Trust to buy or upgrade energy-using equipment? Your best guess is fine.

4. When was the first time your organization received assistance from Energy Trust to buy or upgrade energy-using equipment? Your best guess is fine.

5. When your organization previously received assistance from Energy Trust, what type or types of equipment was that for? Your best guess is fine.

[ASK 6 IF 2=YES OR NOT SURE]

6. How did you learn about the Energy Trust incentive program?

   [PROBE for details. For example, if respondent indicates seeing an ad, ask where that ad was.]
   [MULTISELECT]

   Advertisement – Specify: [OPEN-ENDED]
   Bill insert
   Program representative
   Market actor – Specify: [OPEN-ENDED]
   [For example, contractor, vendor, architect, consultant]
   Word of mouth – Specify: [OPEN-ENDED]
   Energy Trust website
   Other – Specify: [OPEN-ENDED]
   Don't recall/didn't say

[ASK ALL]

7. What suggestions do you have, if any, for making it easier for organizations like yours to learn about Energy Trust assistance?

Identification of Project

The next couple of questions are about how the equipment needs for your recent installation or upgrade were determined.

8. Please tell me why and how you decided to install equipment that would qualify for Energy Trust incentives.

   [PROBES:
   What benefits did you hope to achieve with the program-qualifying equipment?
   IF SAVE ENERGY:
   Did you want to save energy for environmental, cost, or other reasons?
   IF TO GET INCENTIVE:
   I understand the incentive reduced the cost of the program-qualifying equipment, but what was your reason for wanting that equipment in the first place?]

9. Did someone come to your workplace and identify ways to save energy? If so, who?
   [PROBE about contractor, vendor, program representative]
   [MULTISELECT EXCEPT #3]

   Program representative
   Someone else: Specify: [OPEN-ENDED]
   [For example, contractor, vendor, architect, consultant]
   Nobody came to workplace

[ASK 10 IF 9<>NOBODY]

10. Did you contact that person or did they contact you?

    Respondent contacted
    Program rep., contractor, or vendor contacted

[ASK 11 IF 9=NOBODY]

11. How did you identify the equipment you decided to install?

    Consulted with a contractor or vendor
    Other – Specify: [OPEN-ENDED]
    [PROBE about sources, features]

[ASK 12 IF 10=RESPONDENT CONTACTED OR 11=CONSULTED WITH A CONTRACTOR/VENDOR]

12. How did you find that person?

[ASK 13 IF 9<>NOBODY OR IF 11= CONSULTED WITH A CONTRACTOR/VENDOR]

13. How did that person help you decide what equipment to install?

    [IF NEEDED] Did that person suggest upgrades that you had not thought of before and, if so, were those helpful suggestions?

    [IF NEEDED] What did that person tell you that convinced you to get equipment that qualified for Energy Trust incentives?
    [PROBE ABOUT: equipment benefits, payback/ROI/cost savings]

[IF NEEDED] Did that person give you information about Energy Trust incentives that were available?

[DISPLAY 14 IF (6=PROGRAM REP. AND 9=PROGRAM REP.) OR (6=MARKET ACTOR AND 9=SOMEONE ELSE)]

14. Was the person who helped you identify the savings opportunities the same person that you learned about the incentive program from?

    Yes
    No
    Don't recall/not answered

Program Processes

15. Did anyone help you with your application for incentives? If so, who?

    Yes – specify: [OPEN-ENDED]
    No
    Don't recall/not answered

[DISPLAY 16 AND 17 IF 15=YES]

16. What assistance did they provide?

17. How valuable was that assistance?

    [PROBES, IF NEEDED:
    Would you have been able to complete the application without the assistance?
    How challenging would it have been to complete the application without the assistance?]

[ASK 18 IF 15=NO OR DON'T RECALL]

18. How did you go about completing the application process to get the Energy Trust incentives?

    [PROBES, IF NEEDED:
    How did you get the incentive application?]

19. Did anyone from the program carry out any inspections of your workplace either before the incentives were approved or after the equipment was installed?
    [PROBE for whether inspection was before or after] [MULTISELECT]

    Yes-before incentive approval
    Yes-after installation
    No
    Don't recall/not answered

[DISPLAY 20 IF 19=EITHER YES RESPONSE]

20. What was your impression of that/those inspection(s)?

21. What feedback do you have for me, if any, about the process for applying for and receiving the program incentives?
    [PROBE: Was the process reasonable given what you received?]

22. Were there any types of equipment that you wanted but weren't able to get Energy Trust incentives for? If so, what?

23. At any point, did you talk with anyone from the program about incentives for renewable energy or lighting equipment?

    Yes
    No
    Don't recall/not answered

[ASK 24 AND 25 IF 23=YES]

24. What did you talk about?

25. What assistance did they offer, if any, in getting those incentives?

Future Opportunities

26. Do you have more energy-related improvements or facility upgrades planned in the near future?

    Yes
    No
    Not sure/not answered

[ASK 27 IF 26=YES]

27. Do you plan to work with Energy Trust again on those?

    Yes
    No
    Not sure/not answered

[ASK 28 IF 27<>YES]

28. Why would you decide not to work with Energy Trust on future improvements or upgrades?

29. Are there any particular technologies that you think may provide big opportunities for your organization to save energy in the future?

    Yes
    No
    Not sure/not answered

[ASK 30 IF 29=YES]

30. What are they?

Firmographics

The last few questions are about your organization.

31. Does your organization own or lease the facility or facilities where you did the energy efficiency equipment upgrade we've been talking about?

    Own

Lease
Not sure
Refuse to answer
Other – specify: [OPEN-ENDED]

[ASK 32 IF 31=OWN]

32. Does your organization occupy the facility or facilities, lease them to someone else, or occupy part and lease part?

Occupy entire facility/facilities
Lease entire facility/facilities
Occupy part/lease part
Not sure
Not answered
Other – specify: [OPEN-ENDED]

[ASK 33 IF (31=OWN OR OTHER AND 32<>OCCUPY ENTIRE) OR 31<>OWN]

33. Are you or your organization responsible for paying for gas and/or electricity in the facility?

Yes
No
Not sure
Not answered
Other – specify: [OPEN-ENDED]

34. How many buildings does your organization own or lease in Oregon? Your best guess is fine.

35. How many employees does your organization have in Oregon? Your best guess is fine.

One to 10
11 to 25
26 to 50
51 to 100
101 to 500
More than 500
Not sure
Not answered

36. Which of the following best describes your organization's ownership structure? [READ LIST]

Publicly traded company
Privately owned company, including an individual proprietorship
Non-profit or not-for-profit
Government
Other – specify: [OTHER]

Energy Trust is interested in knowing whether its services are reaching all segments of the business community.

37. What are the languages your organization uses when interacting with customers? [IDENTIFY ALL THAT APPLY]
[MULTISELECT]

English
Spanish
Mandarin or Cantonese (Chinese)
Vietnamese
Russian
Other – Specify: [OPEN-ENDED]

[ASK 38 IF 36=PRIVATELY OWNED COMPANY]

38. Is the principal owner of this business a woman or a person of color?
[IDENTIFY ALL THAT APPLY]
[MULTISELECT]

Woman
Person of color
Neither
Not answered

[ASK 39 AND 40 IF 36=NON-PROFIT OR NOT-FOR-PROFIT]

39. Was this organization established to provide services specifically to women, persons of color, low-income individuals, or people in rural areas?
[IDENTIFY ALL THAT APPLY]
[MULTISELECT]

Women
Persons of color
People in rural areas
None of above
Not answered

40. Is this organization led by a woman or a person of color?
[IDENTIFY ALL THAT APPLY]
[MULTISELECT]

Woman
Person of color
Neither
Not answered

[DISPLAY 41 IF 38 OR 40=PERSON OF COLOR]

41. What is that person's race or ethnic background?
[IDENTIFY ALL THAT APPLY]
[MULTISELECT]

Asian or Asian Indian
Black or African American

Hispanic, Latino, or Spanish
Middle Eastern or North African
Native American or Alaska Native
Native Hawaiian or Pacific Islander
Other – Specify: [OPEN-ENDED]
Not answered

[DISPLAY 42 IF 38=PERSON OF COLOR]

42. Is your organization a COBID certified business or is eligible to be COBID certified?
[IF NEEDED: COBID is short for Certification Office for Business Inclusion and Diversity. Generally, COBID businesses are small businesses, business owned by women, minorities, veterans, or other small/emerging businesses.]

Yes – COBID certified
Yes – COBID eligible
No
I don't know
Refuse to answer

Those are all the questions I have.

Appendix E

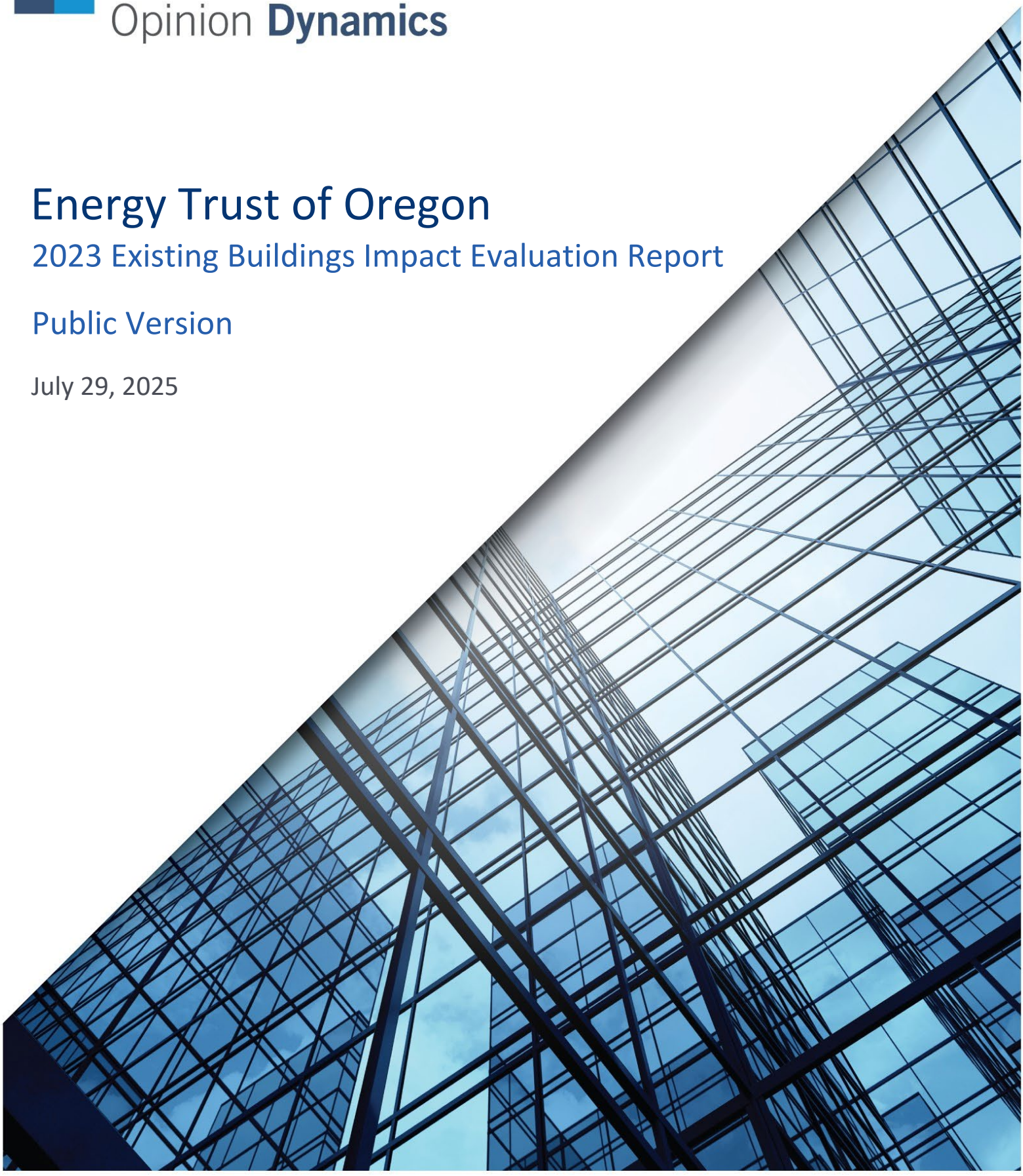
Opinion Dynamics

Energy Trust of Oregon

2023 Existing Buildings Impact Evaluation Report

Public Version

July 29, 2025



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List of Abbreviations

ATAC	Allied Technical Assistance Contractor
BAS	Building Automation System
CAV	Constant Air Volume
CRAC	Computer Room Air Conditioner
DDC	Direct Digital Control
EB	Existing Buildings
EEM	Energy Efficiency Measure
EUL	Effective Useful Life
MAD	Measure Approval Document
M&V	Measurement and Verification
PID	Proportional-Integrative-Derivative
PIV	Post-Installation Verification
PMC	Program Management Contractor
PTTP	Performance Tracking Tool Platform
SEM	Strategic Energy Management
SRT	Savings Rate Tables
TAS	Technical Analysis Study
TMY	Typical Meteorological Year
SSEP	Site-Specific Evaluation Plan
UCI	Utility Consumption Information
UPS	Uninterruptible Power Supply
VAV	Variable Air Volume
VRF	Variable Refrigerant Flow
VFD	Variable Frequency Drive

1. Executive Summary

This report outlines our findings and methodology for evaluating the gross savings achieved in 2023 by Energy Trust of Oregon's Existing Buildings (EB) program. We cover the following major tracks that make up the EB program: Standard, Lighting, Custom, and Strategic Energy Management (SEM). Findings and recommendations for improving the robustness of future energy-saving claims by the program are summarized below and discussed in more detail in subsequent sections.

1.1 Evaluation Objectives

The objectives of this evaluation were to complete the following:

- Develop reliable estimates of EB program gas and electric savings for 2023 to establish realization rates, including realization rates provided separately for SEM and non-SEM measures.
- Develop estimates of electric and gas demand savings at the measure category level and for the program overall, excluding SEM.
- Report observations from the evaluation and make recommendations to help Energy Trust understand substantial deviations from claimed savings, improve ex ante savings estimates, and increase the effectiveness of future engineering studies and impact evaluations of EB projects.

1.2 Methodology Overview

We employed the methodology illustrated in Figure 1 for this evaluation. Each activity is described in more detail below.

Figure 1. Evaluation Methodology

Sampling Plan. Our sampling plan relied on six domains: Custom-Electric, Custom-Gas, Lighting, Standard-Electric, Standard-Gas, and SEM. The SEM domain included both electric and gas savings. Using assumed error ratios based on our experience evaluating similar programs, we selected sample sizes in each domain designed to achieve 10% relative precision at 90% confidence (i.e., "90/10") for Custom-Electric, Lighting, Standard-Electric, and SEM; and 15% relative precision at 90% confidence (i.e., "90/15") for Custom-Gas and Standard-Gas. The resulting sample design is summarized in Table 1.

Table 1. Sample Design and Population Comparison

Sampling Domain	Projects/Sites			Savings		
	Population	Sample	%	Population[1]	Sample	%
Custom-Electric	113	43	38%	12,864,818	8,766,427	68%
Standard-Electric	1,799	42	2%	15,132,518	5,507,942	36%
Lighting	1,548	25	2%	73,669,806	5,953,859	8%
Direct Install	741	5	1%	10,624,934	171,271	2%
Downstream	466	5	1%	14,002,559	170,090	1%
Midstream/Buydown	337	13	4%	46,815,057	4,378,596	9%
Street Lighting	4	2	50%	2,227,256	1,233,902	55%
Total Electric	**3,460**	**110**	**3%**	**101,667,142**	**20,228,228**	**20%**
Custom-Gas	84	21	25%	661,080	351,325	53%
Standard-Gas	468	20	4%	836,940	306,988	37%
Total Gas	**552**	**41**	**7%**	**1,498,020**	**658,313**	**44%**
SEM (Gas)	405	60	15%	1,022,984	665,254	65%
SEM (Electric)				22,167,828	12,500,747	56%

Documentation Review and Data Collection Planning. Energy Trust provided documentation for each sampled project or site. Based on our review of the types of documentation and level of detail usually included under each track, we developed an Overarching Data Collection Guide. For the Custom and SEM Tracks, we developed individual Site-Specific Evaluation Plans (SSEPs) summarizing key details from the project documentation and outlining measurement and verification approaches for the project. Draft SSEPs were shared with the Program Management Contractor (PMC) and Energy Trust for review prior to the initiation of customer recruitment.

Customer Recruitment. Following the approval of draft SSEPs, we engaged customers with projects or sites that required additional data to evaluate the claimed savings. Only Custom and SEM Track customers were recruited; no supplemental information was needed for the Lighting or Standard Track evaluations. To encourage participation, we offered gift card incentives ranging from $25 for supplemental information requests to $125 for physical site visits.

Data Collection and Operator Interviews. Data collection for each project or site proceeded through one or more of the following methods:

- **Desk Reviews.** We used desk reviews for sampled projects with lower complexity, smaller savings, and straightforward data collection needs. This included all reviewed Standard and Lighting projects. Desk reviews generally involve validating ex ante savings calculations or models, verifying key parameters from project documentation and/or data collection, and developing ex post savings by applying verified inputs to validated savings calculations or models.
- **Virtual Site Visits**. For this data collection strategy, we used a video call with the facility operator to view and discuss affected systems. This method was particularly effective for controls-related projects, which accounted for 39 out of 51 unique Custom Track projects reviewed.
- **In-Person Site Visits.** For this data collection strategy, we arranged to go on-site, accompanied by customer personnel, to verify measure installation and operation. Because this is the highest-cost option, it was reserved for the largest, most complex projects. We used in-person site visits for three of the Custom Track projects evaluated.

[1] The population savings for Custom-Electric and Custom-Gas are greater than the total ex ante kWh and therm savings because projects with negative savings were excluded for sampling purposes.

- **Facility Operator Interviews.** In addition to the above data collection strategies, we frequently employed interviews with facility operators or other personnel knowledgeable about the project under review, either in tandem with a virtual or in-person site visit or as an individual exercise for projects that did not receive these methods but still required direct customer interface. The team used interviews to clarify information about facility and system operations or probe for exogenous factors that could account for discrepancies between predicted and observed energy use.

Impact Analysis. We used the following methodologies to evaluate savings at the project or site level and determine track-level energy savings and demand savings.

- **Standard and Lighting Desk Reviews.** We reviewed project documentation to validate that the correct measure approval document (MAD) version and associated per-unit savings were applied for each measure. We further reviewed the project documentation to verify the eligibility of the installed equipment and to validate the number of units installed. Where discrepancies were found, we applied the verified inputs to the Lighting Tool or verified MAD to produce ex post savings. (We did not evaluate the Lighting Tool or MAD savings assumptions.)

  Since EB program tracking data does not explicitly include demand savings, we first calculated the ex ante demand savings for each measure by cross-referencing its assigned load profile to the 2023 load factors provided by Energy Trust, using the utility-average figures. For the ex post demand savings, we used the utility-specific load figures but did not evaluate or change the assigned load factors (per Energy Trust instructions). We then calculated demand realization rates based on the ratio of ex post demand savings to ex ante demand savings. The measure-level demand realization rates were used for the measure category and track level roll-ups.

- **Custom Desk Reviews.** For custom projects, desk reviews consisted of reviewing and validating the ex ante savings calculations or models, reviewing the key inputs from project documentation or collected data, and updating the calculations or models with verified inputs to produce ex post savings. We frequently used whole-building utility data consumption analyses (billing analyses) to inform our reviews.

  We calculated demand savings and realization rates for Custom projects similarly to the process for Standard and Lighting desk reviews, but added an extra step to select the best-fit load profile based on measure characteristics, in addition to using the utility-specific load factor values.

- **SEM Desk Reviews**
  - **Spring Cohort.** For these sites, which claimed savings based on the prescriptive Savings Rate Tables (SRT) methodology due to COVID-19 circumstances, we reviewed the ex ante savings to verify that the historical savings trends were correctly applied by activity level and building type.
  - **Winter Cohort.** For these sites, we used meter-based regression analysis to evaluate savings, working from model specifications and input data exported from the Performance Tracking Tool Platform (PTTP). The analyses generally consisted of billing and weather data validation, checking that baseline period energy use is representative of energy use during the reporting period, reviewing model specifications and diagnostics, reviewing capital projects and non-routine adjustments, and adjusting ex ante models as needed to produce ex post savings.

- **Track-Level Savings.** To produce track-level ex post energy savings, we first determined the population-level realization rate for each sampling domain by extrapolating project- or site-level realization rates to the sample frame from which they were drawn, weighting by the project or site's ex ante savings as a proportion of total sample frame savings. Next, we multiplied the total ex ante savings for each sample domain by its realization rate to produce track-level ex post savings by fuel.

- **Measure Category-Level Savings.** To determine measure category-level savings, we first aggregated ex ante savings from the program tracking data by measure-level and track. Next, we cross-referenced each measure

category/track combination to the realization rate determined for the associated sample domain and calculated the ex post savings by multiplying the ex ante savings by the realization rate.

1.3 Evaluation Results

Table 2 and Table 3 present the gross electric and gas energy savings, respectively, by track. In total, the Existing Buildings program achieved ex post savings of over 124 million kWh and 2.4 million therms in 2023. On the electric side, the Lighting Track produced the most savings, accounting for 60% of program ex post electric savings. On the gas side, SEM produced the most savings, accounting for 42% of program ex post gas savings.

Table 2 and Table 3 present evaluation results and gross realization rates for electric and gas energy savings, respectively, by Track. Electric energy realization rates ranged from 92% (Custom) to 107% (Standard), while gas energy realization rates ranged from 89% (Custom) to 100% (SEM and Standard). Overall, a realization rate of 100% was achieved for electric savings and 97% for gas savings.

Each track achieved at least 90/10 confidence and relative precision on the electric side. On the gas side, the Custom Track did not achieve the 90/15 target, while SEM and Standard exceeded the 90/10 level.

Table 2. Electric Energy Savings and Realization Rates by Track

Track	Ex Ante Population Savings (kWh)	Ex Post Population Savings (kWh)	Realization Rate	Relative Precision (90% Confidence)
SEM	22,167,828	22,167,828	100%	0.0%
Custom	12,863,661	11,892,355	92%	10.1%
Lighting	73,669,806	74,011,564	100%	0.7%
Standard	15,132,518	16,218,558	107%	7.8%
Program Total	**123,833,813**	**124,290,305**	**100%**	**1.5%**

Table 3. Gas Energy Savings and Realization Rates by Track

Track	Ex Ante Population Savings (therms)	Ex Post Population Savings (therms)	Realization Rate	Relative Precision (90% Confidence)
SEM	1,022,984	1,024,800	100%	0.3%
Custom	660,419	588,855	89%	22.6%
Standard	836,940	837,084	100%	0.0%
Program Total	**2,520,343**	**2,450,738**	**97%**	**5.4%**

Electric and gas demand savings are presented in Table 4 and Table 5. Approximately 17,000 kW in summer demand savings and 18,000 kW in winter demand savings were saved, with the Lighting Track accounting for over 60% of savings in both cases. On the gas side, approximately 1,800 therms in winter peak hour savings and 23,000 therms in winter peak day savings were achieved, with the Standard Track accounting for just over half of the total winter peak day and winter peak hour savings.

Table 4. Electric Demand Savings and Realization Rates by Track

Track	Ex Ante Population Summer kW	Ex Ante Population Winter kW	Ex Post Population Summer kW	Ex Post Population Winter kW	Realization Rate, Summer kW	Realization Rate, Winter kW
Custom	2,989	1,597	2,835	1,998	95%	125%
Lighting	10,087	12,368	10,287	11,849	102%	96%
Standard	3,429	4,045	3,796	4,263	111%	105%
Program Total	**16,505**	**18,010**	**16,918**	**18,109**	**103%**	**101%**

Table 5. Gas Demand Savings and Realization Rates by Track

Track	Ex Ante Population Winter Therms/Hour	Ex Ante Population Winter Therms/Day	Ex post Population Winter Therms/Hour	Ex post Population Winter Therms/Day	Realization Rate, Winter Therms/ Hour	Realization Rate, Winter Therms/Day
Custom	786	9,947	843	10,768	107%	108%
Standard	999	12,766	960	12,264	96%	96%
Program Total	**1,785**	**22,713**	**1,804**	**23,032**	**101%**	**101%**

As indicated in Figure 2 and Figure 3, energy savings realization rates stayed about the same or improved from the previous evaluation for 2021 impacts, except the Custom gas realization rate.[2]

[2] The 2021 evaluation report presented the SEM realization rates as determined through two different methods: the SRT method (used by the Spring Cohort in the present evaluation) and the PTTP method (used by the Winter Cohort in the present evaluation). For simplicity, we present only the PTTP results for 2021 here.

Figure 2. 2021/2023 Evaluation Results Comparison: Electric Energy Savings Realization Rates

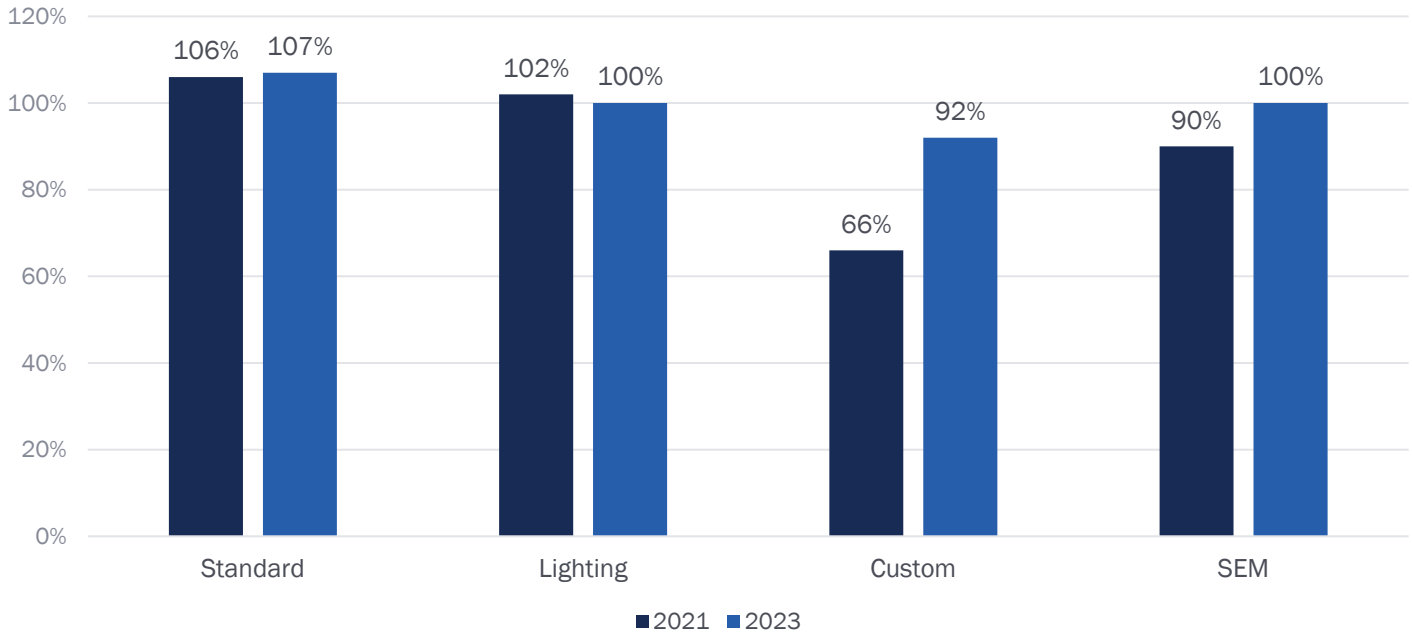
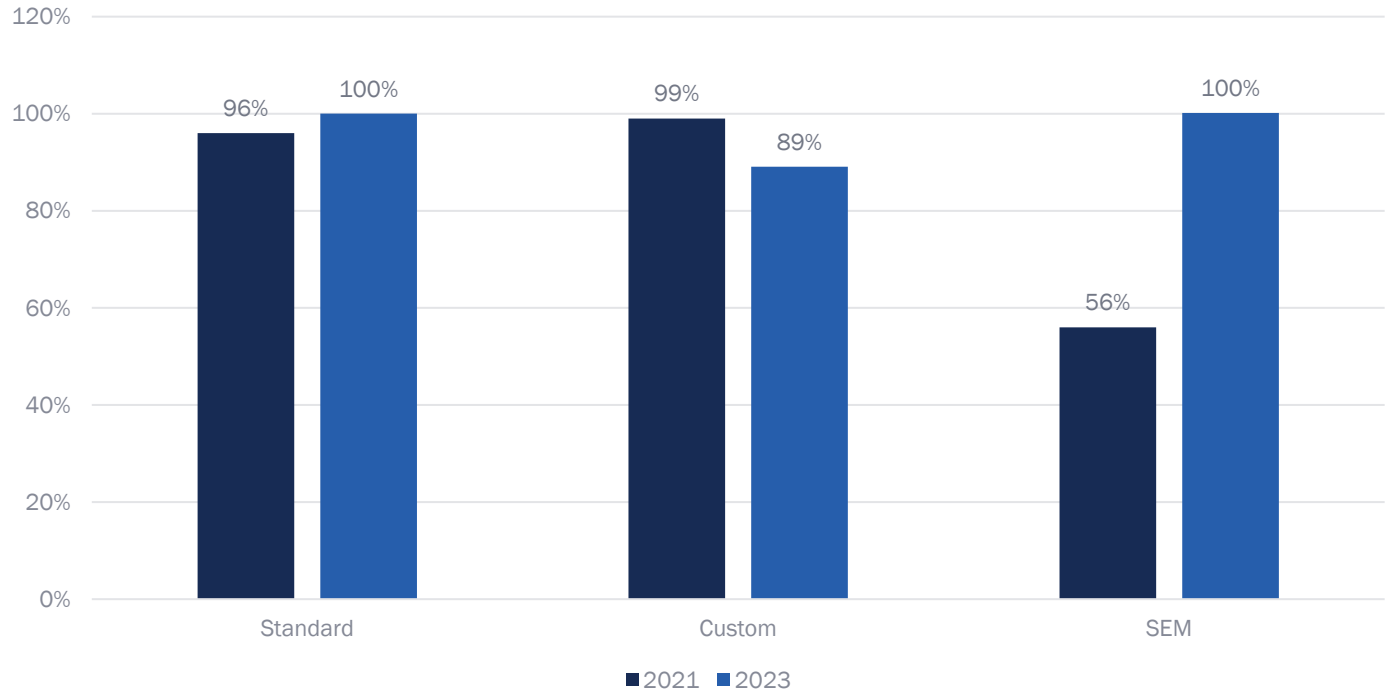


Figure 3. 2021/2023 Evaluation Results Comparison: Gas Energy Savings Realization Rates



1.4 Observations and Recommendations

We summarize key observations and recommendations below.

1.4.1 Quality and Completeness of Documentation

Overall, project folders contained the minimum information necessary to process incentives and validate energy savings claims, such as incentive applications, invoices, savings calculations/models, and post-inspection reports. However, we offer specific recommendations for the Custom and SEM Tracks to increase transparency and improve the accuracy of savings estimates.

- Custom Track
  - **Construction drawings and commissioning reports** were rarely included in project documentation but are important for verifying key savings assumptions. **We recommend that the implementation team routinely collect these documents going forward.**
  - Many Excel calculations included minimum fan speed assumptions below 20%–40%. Most fans are not rated to operate at speeds that low due to adverse harmonic effects, which leads to overestimated savings. **We recommend the implementation team review minimum fan speed assumptions as part of their technical reviews.**
  - Custom spreadsheet calculations that were hard to follow or were not set up to be easily understood tended to have lower realization rates. Issues included undocumented assumptions, overly complex formulas, and poor documentation and organization. **We recommend updating the Program Guidelines to provide clear expectations for custom calculations, developing example templates to promote standardization, and providing regular training to ATACs on templates and guidelines.**
  - Current guidelines do not require post-inspection verifications (PIVs) for Savings-Only projects. Evaluated projects with no PIVs tended to have lower realization rates. **We recommend amending Program Guidelines to require PIV reports for Savings-Only projects with calculated incentives greater than $5,000**—meaning projects that would have qualified for incentives over $5,000 had they not failed cost-effectiveness screening.
  - PIV quality and thoroughness varied. In some cases, key parameters that accounted for the majority of claimed savings were not verified. **We recommend that the implementation team itemize and document key parameters and consider additional steps to improve PIV quality.**
- **SEM Track.** Although realization rates of 100% were achieved for electricity and gas SEM savings, documentation quality can be improved to increase transparency and streamline future evaluations.
  - **We recommend avoiding hard-coded values to the extent possible.** We found many instances with unclear computations and hard-coded values. While it is understandable that some hard-coding is necessary upfront (e.g., for meter data or temperature data), any further calculated values, including capital savings estimations and energy corrections, should be clearly linked in the workbooks so that the evaluators or other stakeholders are able to replicate the results of the program easily.
  - **Explain when statistical criteria for model fitness do not meet the thresholds set forth by the M&V Methodology Guideline.** Per the Guideline[3]: "Individual models may not meet all of these criteria; in those cases, the modeler should document the result of statistical tests and describe whether any of these missed criteria are significant or not and why." **We recommend that modelers provide more clarifying information and context when the**

[3] Energy Trust of Oregon. *Commercial O&M Measurement and Verification Guideline.* Version 2.6, 2023.

statistical criteria are not met or acknowledge the associated model uncertainty when no explanation is available by flagging the unmet criteria.

1.4.2 Savings Quantification and Persistence

In this section, we summarize key observations and recommendations pertaining to savings quantification and persistence for the Custom Track, where the lowest realization rates and most variance were found relative to other tracks.

- **Projects involving HVAC controls were prevalent and had the greatest realization rate variance.** Of the 51 unique Custom projects reviewed, 39 involved installing new direct digital control (DDC) systems or recommissioning existing controls. These projects had lower average realization rates than other project types, but also more variance in realization rates, as shown in Table 6 and Table 7. In some cases, the evaluated savings were significantly lower than the reported savings.

Table 6. Electric Realization Rate Comparison, Custom Projects With and Without Controls

Project Type	Average Realization Rate	Standard Deviation
No Controls (n=10)	108%	31%
Controls (n=33)	88%	38%

Table 7. Gas Realization Rate Comparison, Custom Projects With and Without Controls

Project Type	Average Realization Rate	Standard Deviation
No Controls (n=2)	100%	0%
Controls (n=19)	88%	59%

- Given these challenges, we offer the following recommendations for improving the average realization rates of HVAC controls projects going forward:
  - **Trend data logs should be collected for key parameters.** For recommissioning projects or new DDC installations, understanding the existing system and its control logic is key. While these data are not available through an existing BAS in some instances, an effort should be made to install temporary data loggers to collect this information, which can then inform the facility energy modeling or savings calculations. Accurately and thoroughly characterizing existing conditions will help ensure that models accurately predict energy savings.
  - **Ensure key parameters are thoroughly documented and reviewed in PIVs to verify post-conditions.** As we discuss in Section 5.6, PIV report quality varied in the sample of Custom projects reviewed. For HVAC controls-related projects, it is important to document control logic and key parameters in PIVs to demonstrate that the proposed changes were implemented. Thorough documentation of control settings at the time of project completion will reduce evaluation risk if evaluators find that settings have changed at the time of evaluation.
  - **Time PIV implementation to verify key control changes.** In one project, an overnight setback during the winter months was a major energy savings driver for the project. During evaluation the customer reported that the

setback was ultimately removed because the system was not able to recover sufficiently in the mornings. Unfortunately, the PIV was performed during the summer, so implementation of this measure was not confirmed. We recommend the implementation team consider the ability to verify key parameter changes when scheduling PIVs, even if it means delaying close-out for some projects. The implementation team should also confirm with the facility manager that commissioning is fully complete and no further changes are planned prior to scheduling a PIV. The key parameter settings documented in the PIV should reflect stable conditions.

- **Many baseline models were calibrated to historical billing data.** In the grocery store heat reclaim projects and multiple custom controls projects, the baseline energy usage referenced in the Technical Analysis Study (TAS) report and used to calibrate the models went back several years before the project was implemented. It was common for pre-2020 baselines to be used, with some going back as far as 2012. In some cases, energy usage patterns clearly changed in recent years, making it challenging to understand how the energy savings projects impacted site energy usage.
  - While we recognize that construction delays between initial project scoping and implementation frequently occur for a variety of reasons outside of the implementation team's control, **guidelines should require recalibration when baseline data reaches a certain age.** We recommend that Energy Trust work with stakeholders to develop a policy that balances practical considerations of program delivery with the need for representative baseline modeling.
- **Switch optimization projects generally resulted in higher evaluated savings than reported.** The realization rates for the three switch optimization projects reviewed were greater than 100%. This is likely due partly to underestimating the impacts the switch optimization project has on the cooling system across the entire year.

  We recommend developing a more accurate method for capturing savings customized to the specific cooling equipment at each site. Some data points or methods to consider include:

  - **Collect general IT equipment information** – Collecting some general site information, like total site IT capacity (non-redundant), UPS unit inventory and rectifier inventory could be useful to understand the percentage of savings achieved and support a better understanding of cooling requirements and related savings.
  - **Collect cooling equipment data** - Collecting a cooling equipment inventory as part of the project, including cooling system type (e.g. DX CRAC units, water-cooled chillers, dry coolers, etc.), manufacturer, model number, cooling capacity, redundancy in the system (e.g., N+1), supply and return cooling air or water temperatures, free cooling mode, etc. These data could be potentially used to more accurately estimate the cooling savings associated with a decrease in IT load using engineering formulas. Currently, cooling savings are estimated using a factor of unknown source applied to the IT savings.

    Sub-meter cooling equipment – If there is a large project or a large volume of switch optimization projects are anticipated, it may be worthwhile to sub-meter the cooling system pre- and post-implementation. Ideally, this should be done for a 3-6 month window or longer in order to capture similar weather conditions pre-/post-implementation. This could be done using an existing BAS system (low/no cost) or temporary sub-meters. The data could then be used to quantify project-specific cooling savings, validate the existing HVAC cooling savings factors applied to projects or be used to generate a new HVAC savings factor by cooling system type.
- **Heat reclaim measures in grocery stores had mixed evaluation results.** The evaluation initially included one heat reclaim Custom project comprised of two sites/installations. The methodology for estimating reported savings was based on an M&V study of stores that implemented the same technology in the Midwest, and relied on a few variables (primarily store hours, store area, and heating degree days [HDD]) to calculate savings.

  At one of the sites, gas meter data showed decreased usage following the installation, resulting in higher than reported savings after normalizing for weather and billing days. At the other site, however, we found that the

normalized natural gas energy usage increased after the installation. We contacted the store manager to determine if there had been any issues with the heat reclaim installation, to confirm the installation timeframe, and to ask if any other projects occurred at the site that may have impacted natural gas usage at the site (e.g., new gas cooking equipment). The manager stated that the heat reclaim was installed successfully and there were no other projects completed in the last two years at the site that would have impacted natural gas usage. There was not enough time left in the evaluation study to further investigate possible causes. Since we were unable to pinpoint the specific causes for the increased usage at this site, it was decided to drop the project from the evaluation sample. Nonetheless, the possibility that the savings were overestimated, or the reclaim equipment was malfunctioning could not be ruled out. Therefore, we offer the following recommendations for future heat reclaim projects:

- **Require a more robust analysis** that captures information on the heating systems that the heat reclaim units supplement, as well as the HDDs, store size, and store hours.
- **Require a commissioning validation report** proving that the heat reclaim unit is functional and, if possible, also require a seasonal commissioning report, particularly if heating season operation of the unit has not been verified.

Memo

To: Board of Directors

From: Cody Kleinsmith, Evaluation Project Manager
Patrick Urain, Sr. Program Manager – Commercial
Kathleen Belkhayat, Program Manager – Commercial
Katie Hughes, Sr. Program Manager – Business Lighting

cc:

Date: September 9, 2025

Re: Staff Response to the 2023 Existing Buildings Impact Evaluation

The 2023 Existing Buildings Impact Evaluation assessed the performance of projects claimed in the 2023 program year in the program's four main tracks: Strategic Energy Management (SEM), custom, lighting, and standard. The program management contractor (PMC) for 2023 was TRC, with delivery of the lighting track subcontracted to CLEAResult (program delivery contractor, or PDC). The results of the evaluation show the program performed well in 2023, with realization rates improving or remaining consistently high for all tracks. Overall program realization rates were high at 100% for electricity and 97% for natural gas.

The 2023 evaluation of the SEM program saw several distinct changes from the prior program years. The first is the shift back to modeled savings approaches after COVID-19 disruptions caused the program to resort to a prescriptive calculated approach for several years since 2020. The spring cohort of the 2023 program year continued to use this prescriptive approach, while the winter cohort was the first to shift back to modeled savings. The second noteworthy change was SEM implementation staff and participants used an online platform to track activities, communicate with one another, and model and claim savings. This was the first year that an impact evaluation was performed on models and savings outputs from this online platform for the Existing Buildings program. Despite these two significant changes, realization rates for the SEM track of the program improved since the last evaluation to 100% for both electricity and natural gas savings.

While realization rates improved, additional improvements in transparency could continue to improve SEM savings in future program years. These transparency improvements include avoiding hard-coded values with no metadata in the models and better noting when and why statistical criteria thresholds are not met would improve future evaluation results and validation. These changes will be explored by SEM implementation staff as they perform routine coach guideline edits and scope out online platform improvements with the system designer.

In 2023, the custom track had the lowest realization rates for both electricity (92%) and natural gas (89%) savings of any track. For electricity, this marks a significant improvement of 26 points over the results of the last impact evaluation performed on the 2021 program year. For gas, this marks a moderate degradation of savings realization of 10 points from the 2021 program year.

One of the key findings related to the custom track in 2023 was related to the program's post-installation verification (PIV) process. Currently, the program conducts a PIV visit on all projects which receive an Energy Trust incentive over $5,000 in commercial properties, which receive an incentive over $3,000 in multifamily properties and a small random sample of other projects. The evaluation found that savings-only projects that

were incentivized through the Oregon Department of Energy (ODOE) Schools Program (SB 1149) that did not move through the PIV process due to a $0 incentive value had lower realization rates of 52% and 82% for electricity and gas respectively. The PIV process is important for the program to ensure that projects are implemented as scoped and that customers understand their new equipment and systems as well as the key drivers of energy savings. The program has already amended their PIV process in response to this evaluation to perform PIVs on all savings-only projects that are incentivized through ODOE's Schools Program. In addition to this change, the program will also explore opportunities to increase the quality of PIVs across the entire program. In particular, the program will explore incorporating more spot-metering of individual measures or equipment components as well as administering the PIV process for projects where savings are seasonally bound during the season when savings are most present or require verification.

In addition to these changes to the PIV process, the program will explore a change to the baseline calculation methodologies. For many custom projects, project timelines can be long from original project scoping and technical analysis study to project implementation. In numerous cases in this evaluation, the baseline period utility data used to estimate savings was several years old by the time construction started or savings were claimed, in some cases as old as 2012. This created some savings realization fluctuation as energy use patterns changed dramatically during this baseline-construction gap. The program will explore establishing a policy for Allied Technical Assistance Contractors and program engineering staff to recalibrate baseline periods to more recent utility data.

The lighting track of the program returned a high realization rate of 100%, and no areas were identified as systematic places for improvement or adjustments. This finding is in line with the 2021 evaluation, which returned a 102% realization rate.

The standard track also saw high realization rates of 107% for electricity and 100% for natural gas. Similarly, this is consistent with the 2021 results (106% and 96% respectively) and no systematic areas of improvement were found for the standard track.

The impact evaluation of the 2024 program year of the Existing Buildings program is currently underway with results expected in 2026.

2. Background

The EB program was the largest single program in the Energy Trust of Oregon's 2023 portfolio, based on actual expenditure and annual therm savings, and the second largest based on annual electric energy savings.[4] The program had four main tracks that were subject to this evaluation:

- Custom
- Lighting (including downstream, direct-install, midstream/buydown, and street lighting measures)
- Standard (prescriptive)
- SEM

Table 8 shows the number of completed measures and sites and the total ex ante (claimed) savings by track for the 2023 program year. The program also implemented a few other tracks and pilots, which represent a small portion of program participants and savings and were excluded from this evaluation.

Table 8. 2023 Measures, Sites, and Savings by Track

Track	Measures	Projects	Sites	Ex Ante kWh Savings	% of Total Ex Ante kWh Savings	Ex Ante Therm Savings	% of Total Ex Ante Therm Savings
Custom	192	156	167	12,863,661	10%	660,419	26%
Lighting	13,184	1,817	4,224	73,669,806	59%	-	-
Direct Install	*5,714*	*742*	*738*	*10,624,934*	*9%*	-	-
Downstream	*1,430*	*678*	*664*	*14,002,559*	*11%*	-	-
Midstream/Buydown	*6,021*	*392*	*2,817*	*46,815,057*	*38%*	-	-
Street Lighting	*19*	*5*	*5*	*2,227,256*	*2%*	-	-
Standard	3,235	2,035	2,652	15,132,518	12%	836,940	33%
SEM	720	99	545	22,167,828	18%	1,022,984	41%
Program Total	**17,331**	**4,107**	**7,588**	**123.833,813**	**100%**	**2,520,343**	**100%**

Energy savings for Custom Track projects are estimated based on energy studies conducted by ATACs. These studies may include engineering calculations or energy simulation modeling. For Standard and Lighting Track measures, savings estimates are derived from Energy Trust MADs.

SEM provides tools and education to help businesses understand their building energy use and identify and eliminate energy waste. SEM savings are estimated based on a top-down analysis of building-level energy use and do not include savings from capital measures completed at the site through other program tracks during the SEM engagement.

2.1 Evaluation Objectives

The 2023 Existing Buildings evaluation addressed the following research objectives:

- Develop reliable estimates of EB program gas and electric savings for 2023 to establish realization rates, including realization rates provided separately for SEM and non-SEM measures.

[4] 2023 Annual Report to the Oregon Public Utility Commission and Energy Trust Board of Directors. April 15, 2024.

- Develop estimates of electric and gas demand savings at the measure category level and for the program overall, excluding SEM.
- Report observations from the evaluation and make recommendations to help Energy Trust understand substantial deviations from claimed savings, improve ex ante savings estimates, and increase the effectiveness of future engineering studies and impact evaluations of EB projects.

3. Methodology

We developed ex post estimates of the gross electric energy, electric demand, and natural gas impacts from the 2023 EB program. Impact evaluation activities, outlined in Table 9, included developing a sample plan, reviewing project and program documentation, recruiting customers, collecting primary data, and verifying engineering calculations and/or energy impacts to estimate program savings. The combination of evaluation activities for each project/site was based on factors such as the type, size, and complexity of energy efficiency measures. The following subsections provide a detailed description of each component.

Table 9. Summary of Evaluation Methodology

Evaluation Activity	Details
Sampling Plan	Designed to achieve 90/10 confidence/relative precision for Custom-Electric, Standard-Electric, Lighting, and SEM sampling domains, and 90/15 for Custom-Gas and Standard-Gas sampling domains
Documentation Review and Data Collection Planning	Review of project documentation, development of overarching Data Collection Guide, and individual SSEPs
Customer Recruitment	Recruitment of customers to facilitate data collection
Data Collection	Data collection via supplemental information requests, customer interviews, virtual site visits, and physical site visits
Impact Analysis	Review of ex ante savings assumptions and development of ex post gross savings estimates by project or site, track, fuel, and measure category

3.1 Sampling Plan

We developed a sampling plan based on the proposed methodologies, kickoff meeting discussion, and project data provided by Energy Trust. Our sampling plan relied on six domains: Custom-Electric, Custom-Gas, Lighting, Standard-Electric, Standard-Gas, and SEM. We developed a combined SEM domain for electric and gas savings since SEM generally covers energy usage across the facility, irrespective of fuel type, and all facilities are likely to have electric usage, including those without gas usage. The sampling unit for the non-SEM domains is the project, while the sampling unit for the SEM domain is the facility or site. (Within the Lighting Midstream/Buydown Track, each project frequently included multiple sites; we evaluated all sites associated with each sampled project.) We applied a probability proportional to size (PPS) sample design, where each project or site has a probability of selection proportional to project savings estimates or, in the case of SEM, site savings estimates. SEM site selection probability is proportional to total site savings, represented in MMBtus.

A summary of the sample design is presented in Table 10. We designed the sample to achieve 10% precision at a 90% confidence level for Custom-Electric savings, Standard-Electric savings, Lighting savings, and SEM savings, and 15% precision at a 90% confidence level for Custom Gas and Standard Gas savings.

Table 10. Sample Design and Population Comparison

Sampling Domain	Projects/Sites			Savings		
	Population	Sample	%	Population[5]	Sample	%
Custom-Electric	113	43	38%	12,864,818	8,766,427	68%
Standard-Electric	1,799	42	2%	15,132,518	5,507,942	36%
Lighting	1,548	25	2%	73,669,806	5,953,859	8%
Direct Install	741	5	1%	10,624,934	171,271	2%
Downstream	466	5	1%	14,002,559	170,090	1%
Midstream/Buydown	337	13	4%	46,815,057	4,378,596	9%
Street Lighting	4	2	50%	2,227,256	1,233,902	55%
Total Electric	**3,460**	**110**	**3%**	**101,667,142**	**20,228,228**	**20%**
Custom-Gas	84	22	26%	661,080	377,330	57%
Standard-Gas	468	20	4%	836,940	306,988	37%
Total Gas	**552**	**42**	**8%**	**1,498,020**	**684,318**	**46%**
SEM (Gas)	405	60	15%	1,022,984	665,254	65%
SEM (Electric)				22,167,828	12,500,747	56%

3.2 Documentation Review and Data Collection Planning

Energy Trust provided documentation for each sampled project or site. Based on our review of the types of documentation and level of detail usually included under each track, we developed an Overarching Data Collection Guide, which documents data collection guidelines, by track, to facilitate consistent evaluation approaches by all team members.

For the Custom and SEM Tracks, we developed individual SSEPs summarizing key details from the project documentation and outlining measurement and verification approaches for the project, including what additional data, if any, was to be collected from the customer or ATAC, and the means of data collection.

The SSEPs were shared with Energy Trust and PMC staff as they were developed for review; this provided an opportunity for either party to suggest alternate data collection approaches based on the customer relationship and knowledge of facility operations.

3.3 Customer Recruitment

Energy Trust provided contact information for each sampled Custom and SEM site. Customer recruitment began with the PMC distributing an electronic letter to all sampled Custom and SEM sites. The letter explained the purpose of the evaluation, introduced all parties, and included an incentive offer in the form of an electronic gift card to encourage participation in the evaluation. The incentive amount was based on the type of assistance requested, as detailed in Table 11.

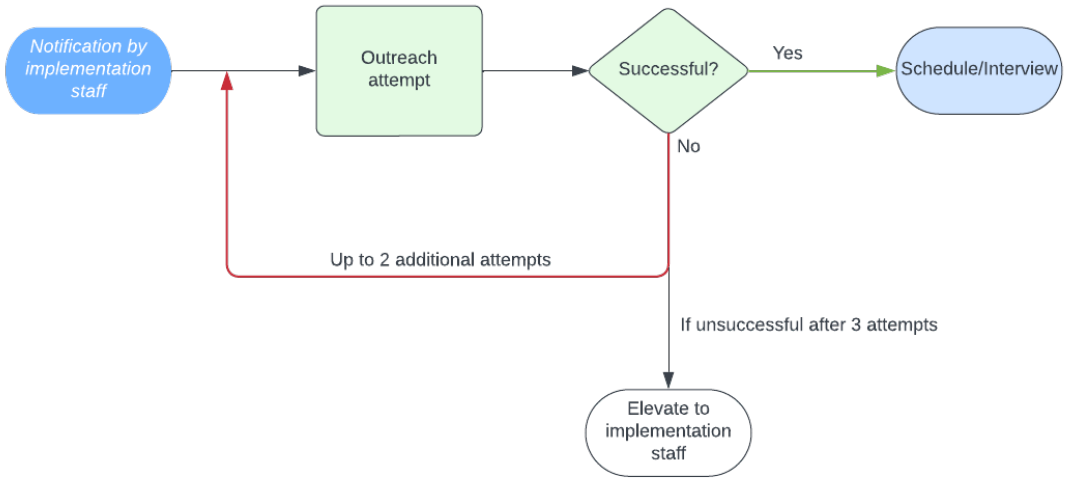
[5] The population savings for Custom-Electric and Custom-Gas are greater than the total ex ante kWh and therm savings because projects with negative savings were excluded for sampling purposes.

Table 11. Customer Participation Incentive Amounts

Type of Request	Incentive
Supplemental Information Request	$25
Facility Operator Interview	$50
Virtual Site Visit	$100
In-Person Site Visit	$125

The standard evaluation-led customer recruitment followed the process in Figure 4, which was approved as part of the Evaluation Workplan. After the initial notifications were distributed, we initiated contact with customers via email, reiterating the purpose of the evaluation and requesting one of the four items listed in Table 11, depending on the SSEP. As approved in the Evaluation Workplan, we made up to three attempts to reach the customer, spaced apart by two to three days. If the customer could not be reached after three attempts, we elevated the contact request to the PMC for assistance.

Figure 4. Recruitment Process



3.4 Data Collection and Facility Operator Interviews

We selected from the following data collection strategies based on the project's or measure's complexity, size, and data needs.

Desk Reviews. We used desk reviews for sampled projects with lower complexity, smaller savings, and straightforward data collection needs.

Desk reviews generally involve validating ex ante savings calculations or models, verifying key parameters from project documentation and/or data collection, and developing ex post savings by applying verified inputs to validated savings calculations or models. We also employed whole-building consumption data analysis, where feasible,[6] to provide additional insight regarding the actual impacts achieved. Desk reviews were completed for 27 of 52 unique Custom Track projects, 55 of 60 SEM sites, and all Standard and Lighting Track projects.

[6] In order for whole-building data consumption to be feasible, the facility must have a dedicated meter and 12 months of pre- and post-project meter data, and ex ante savings generally need to be 10% or more of pre-project energy usage.

Virtual Site Visits. For this data collection strategy, we used a video call with the facility operator to view and discuss affected systems. This method was particularly effective for controls-related projects, which accounted for 39 out of 52 unique projects reviewed. Virtual site visits allowed the evaluator to explore the BAS in real-time with the facility operator, facilitating the verification of controls settings and enabling the evaluator to probe for issues that could explain why observed savings deviate from ex ante savings.

In-Person Site Visits. For this data collection strategy, we arranged to go on-site, accompanied by customer personnel to verify measure installation and operation. This was only used for three of the most complex projects because it is the highest cost option. In-person site visits were particularly effective when there were multiple systems to verify and when the scope of the project was unclear or additional contextual information about the facility was needed.

Facility Operator Interviews. Interviews with facility operators or other personnel knowledgeable about the project under review were frequently employed as an add-on to the above data collection strategies. We used interviews to clarify information about facility and system operations or probe for exogenous factors that could account for discrepancies between predicted and observed energy use. For example, when conducting an operator interview with a Custom Track participant, we learned that previously nonfunctional electric strip heaters were repaired as part of the controls project under evaluation. Repairing the heaters was outside the scope of the measures under evaluation but was likely partially responsible for the higher-than-expected electric consumption post-project.

3.5 Impact Analysis

We conducted impact analyses on sampled projects to provide the following:

- Estimates of program- and track-level electric and gas savings
- Estimates of program, track, and measure category electric and gas realization rates
- Estimates of program and measure electric and gas demand savings (for non-SEM tracks only)

Our desk review methodology for each track is described below. A description of the roll-up process for producing track-level, measure category-level, and program-level impacts follows.

3.5.1 Standard and Lighting Track Impact Analysis

We performed desk reviews of sampled Standard and Lighting Track projects, reviewing project documentation to validate that the correct MAD version and associated per-unit savings were applied for each measure. We further reviewed the project documentation to verify the eligibility of the installed equipment and to validate the number of units installed. Where discrepancies were found, we applied the verified inputs to the Lighting Tool or verified MAD to produce ex post savings. (We did not evaluate the Lighting Tool or MAD savings assumptions.)

Since demand savings are not explicitly tracked, we first calculated the ex ante demand savings for each measure by cross-referencing its assigned load profile to the 2023 load factors provided by Energy Trust, using the utility-average figures. For the ex post demand savings, we used the utility-specific load figures but did not evaluate or change the assigned load factors for the Standard and Lighting desk reviews per Energy Trust instructions. We then calculated demand realization rates based on the ratio of ex post demand savings to ex ante demand savings. The measure-level demand realization rates were used for the measure category and track level roll-ups.

3.5.2 Custom Track Impact Analysis

We conducted desk reviews and M&V activities as needed for sampled Custom Track projects. Generally, the process consisted of reviewing and validating the ex ante savings calculations or models, reviewing the key inputs from project documentation or collected data, and updating the calculations or models with verified inputs to produce ex post savings. Onsite verification (virtual or in-person) focused on verifying equipment installations and operating parameters such as control setpoints, schedules, and operating hours that were key drivers of claimed savings. Operating conditions such as fan speed, supply air temperature, and operating schedules were frequently reviewed through the BAS with the help of the facility operator. In many cases, we requested trend data to verify longer term trends but often found that customer control systems were not equipped to store trend data. Customer interviews, conducted on a standalone basis or as part of a site visit, were helpful for understanding building systems and operations, and clarifying project scope. We frequently also used whole-building utility data consumption analyses (billing analyses) to inform our reviews where feasible.[7] In those cases where ex ante model files were missing or appeared to be obsolete because we could not reproduce the ex ante savings, we relied on billing analyses or used engineering calculations to gauge the reasonability of the ex ante savings.

We calculated demand savings for Custom projects as described above for Standard and Lighting desk reviews, but we added an extra step to select the best-fit load profile based on the measure characteristics.

3.5.3 SEM Impact Analysis

For sites from the 2023 Spring Cohort, which used the prescriptive SRTs methodology due to COVID-19 circumstances, we reviewed the ex ante savings to verify that the historical savings trends have been correctly applied by activity and building type.

For sites from the 2023 Winter Cohort, which used a standard regression model-based approach for estimating SEM savings, our evaluations focused on validating the ex ante model and applied inputs. Our methodology included the following steps:

1. **Review billing data used for analysis.** We checked consumption and facility operating data for missing observations and missing or erroneous values. We also conducted a review of opportunity registers and looked for any gaps or discrepancies in the baseline model definition to ensure that each model was appropriate for its respective facility.
2. **Verify weather variables.** We reviewed the weather data used for modeling to ensure no gaps or anomalies were present. If needed, we imported weather data from the National Climate Data Center to test the baseline model specification.
3. **Verify the baseline period.** We verified whether energy use during the baseline period appears to be representative of energy use during the evaluation period to ensure that the model provides a fair comparison in terms of the facility's nature of operation, schedules, and building footprint served by the meter.
4. **Review the model specification.** We reviewed the model specification provided for each sampled site from the PTTP. This review included
    a. Analysis of model residuals, and
    b. Review of industry standard model selection criteria, such as model R2, coefficient of variation (CV), F-test, and statistical significance of model coefficients.
5. **Verify capital projects and other non-routine adjustments.** We verified savings from any reported capital projects implemented during the SEM baseline and evaluation periods. Additionally, we investigated other facility

[7] In order for whole-building data consumption to be feasible, the following conditions must generally be met: the facility must have a dedicated meter, 12 months of pre- and post-project meter data must be available, and ex ante savings are 10% or more of pre-project energy usage.

activities, capital measure implementations, or non-SEM related factors (e.g., facility closures or equipment installations) that took place during these periods and were expected to have a significant impact on typical energy usage at the site.

6. **Verify the SEM-related savings.** We verified the claimed electric and gas savings for each sampled site and calculated realization rates. The ex post savings account for energy savings from any capital measures or energy savings associated with tracks other than the SEMs that were active during the baseline or evaluation periods.

We reached out to facility management when we observed data anomalies to confirm the data points and investigate possible causes. This allowed us to refine the regression models and adjust data where necessary to ensure accurate evaluation results. For example:

- For an athletic facility, we observed extremely low electricity usage during the baseline months of December 2020 and January 2021. We consulted the facility manager who confirmed that this reduction was due to scaled-back operations during the COVID-19 pandemic. Therefore, we applied a COVID adjustment factor to this period in the regression model to avoid underestimating energy savings.
- For a medical office building, model diagnostic checks revealed that two periods of data had an unusually high influence on the model. We reached out to the facility manager to investigate the cause, but no clear explanation was provided. Given the availability of sufficient baseline data, we decided to exclude these months from the baseline model construction.

3.5.4 Track, Measure Category, and Program-Level Analysis

To produce track-level ex post electric and gas savings, we first determined the population-level realization rate for each sampling domain by extrapolating project- or site-level realization rates to the sample frame from which they were drawn, weighting by the project or site's ex ante savings as a proportion of total sample frame savings. Next, we multiplied the total ex ante kWh and therm savings for each sample domain by its realization rate to produce track-level ex post savings by fuel. Program-level kWh and therm savings were determined by summing the track-level savings.

To determine measure category-level savings, we first aggregated ex ante kWh and therm savings from the program tracking data by measure-level and track. Next, we cross-referenced each measure category/track combination to the realization rate determined for the associated sample domain and calculated the ex post savings by multiplying the ex ante savings by the realization rate.

Demand savings for each track and measure category were calculated in a similar fashion using the demand savings realization rates described in Sections 3.5.1 and 3.5.2.

4. Findings

4.1 Recruitment

No unusual recruitment challenges were encountered for this study. As summarized in Table 12, 41 Custom sites and six SEM sites were contacted by an evaluator requesting supplemental information, an operator interview, a virtual site visit, or a physical site visit. Of these requests, 76% in Custom and 83% in SEM were successful, where "success" means the request was at least partially fulfilled. No Custom projects or SEM sites were dropped from the sample due to unsuccessful recruitment. though one Custom project involving a grocery heat reclaim system was dropped due to lack of clarity around a low realization rate finding. For those sites that could not be recruited, we employed alternate evaluation methods such as billing analyses or engineering calculations.

Table 12. Recruitment Summary

Track	Sample Size (unique projects/sites)	# Contacted	# Successful	% Success	# Gift Cards Offered	# Gift Cards Accepted	% Accepted
Custom	52	41	31	76%	17	10	59%
SEM	60	6	5	83%	1	1	100%

Overall, incentive (gift card) offers did not seem to significantly impact recruitment. Many customers, especially those who work for schools or other public entities, are unable to accept incentives. The return to more normal working conditions following the pandemic probably helped recruitment go more smoothly than in previous evaluations.

4.2 Ex Post Savings and Realization Rates

4.2.1 Track-Level Results

Table 13 and Table 14 present the gross electric and gas energy savings, respectively, by track. In total, the EB program achieved ex post savings of 124,290,305 kWh and 2,450,738 therms in 2023. On the electric side, the Lighting Track produced the most savings, accounting for 60% of program ex post electric savings. On the gas side, SEM produced the most savings, accounting for 42% of program ex post gas savings.

Electric energy realization rates ranged from 92% (Custom) to 107% (Standard), while gas energy realization rates ranged from 88% (Custom) to 100% (SEM and Standard). Overall, a realization rate of 100% was achieved for electric savings and 97% for gas savings.

Each track achieved 90% confidence at 10% relative precision on the electric side. On the gas side, the Custom Track did not achieve the 90/15 target, while SEM and Standard exceeded the 90/10 level.

Table 13. Electric Energy Savings and Realization Rates by Track

Track	Ex Ante Population Savings (kWh)	Ex Post Population Savings (kWh)	Realization Rate	Relative Precision (90% Confidence)
SEM	22,167,828	22,167,828	100%	0.0%
Custom	12,863,661	11,892,355	92%	10.1%
Lighting	73,669,806	74,011,564	100%	0.7%
Standard	15,132,518	16,218,558	107%	7.8%
Program Total	**123,833,813**	**124,290,305**	**100%**	**1.5%**

Table 14. Gas Energy Savings and Realization Rates by Track

Track	Ex Ante Population Savings (therms)	Ex Post Population Savings (therms)	Realization Rate	Relative Precision (90% Confidence)
SEM	1,022,984	1,024,800	100%	0.3%
Custom	660,419	588,855	89%	22.6%
Standard	836,940	837,084	100%	0.0%
Program Total	**2,520,343**	**2,450,738**	**97%**	**5.4%**

Table 15 presents the gross electric and gas demand savings by track. In total, the program achieved 16,918 kW and 18,109 kW in summer and winter electric demand savings, respectively. The Lighting Track contributed 61% of summer demand savings and 65% of winter demand savings. On the gas side, the program achieved 23,032 therms in winter peak day savings and 1,804 therms in winter peak hour savings, as shown in Table 16. The Standard Track accounted for just over half of winter peak hour and winter peak day savings.

Table 15. Electric Demand Savings and Realization Rates by Track

Track	Ex Ante Population Summer kW	Ex Ante Population Winter kW	Ex Post Population Summer kW	Ex Post Population Winter kW	Realization Rate, Summer kW	Realization Rate, Winter kW
Custom	2,989	1,597	2,835	1,998	95%	125%
Lighting	10,087	12,368	10,287	11,849	102%	96%
Standard	3,429	4,045	3,796	4,263	111%	105%
Program Total	**16,505**	**18,010**	**16,918**	**18,109**	**103%**	**101%**

Table 16. Gas Demand Savings and Realization Rates by Track

Track	Ex Ante Population Winter Therms/Hour	Ex Ante Population Winter Therms/Day	Ex Post Population Winter Therms/Hour	Ex Post Population Winter Therms/Day	Realization Rate, Winter Therms/ Hour	Realization Rate, Winter Therms/Day
Custom	786	9,947	843	10,768	107%	108%
Standard	999	12,766	960	12,264	96%	96%
Program Total	**1,785**	**22,713**	**1,804**	**23,032**	**101%**	**101%**

Below, we provide a summary of evaluation findings for each track.

SEM

Site-level electric and gas realization rates for the Winter PTTP-based cohort and Spring SRT-based cohort were uniformly 100%, except for one Winter cohort site. The reasons for the discrepancy stem from a change to the baseline model. The ex ante model used an indicator variable to account for two months of failed gas meter readings. We removed the failed readings from the baseline model calibration, reran the model, and found that the model diagnostics showed improved performance. The recalculated savings were slightly higher than the reported savings, yielding a gas realization rate of 108% for this project.

Standard

Evaluation of the sampled Standard Track projects produced few significant discrepancies between reported and ex post savings. High realization rates drove the overall 107% realization rate for Standard electric savings in two projects involving window replacements, for which the prescribed savings increased substantially between versions 3 and 4 of MAD 171. For both projects, we adjusted the savings for this measure to align with version 4, based on the installation date, resulting in realization rates of over 200% for both projects.

Lighting

Evaluation of the sampled Lighting projects also produced few significant discrepancies between reported and ex post savings. We summarize the discrepancies by Track below:

- Direct Install: No adjustments were made to ex ante savings.
- Downstream:
  - In one project, we adjusted a control factor which differed from the deemed control factor in the MAD. This change resulted in a 101% realization rate for the project.
- Midstream/Buydown:
  - Two projects had adjustments due to discrepancies in fixture quantity between tracking data and sales data. The discrepancies had a negligible impact on one, and a larger impact on the other resulting in a realization rate of 109%, the largest variance within the Lighting Track.
  - One project had a negligible adjustment in kWh savings resulting from the removal of two records in the ex post analysis: we removed one record because the fixtures were indicated as returned by the customer (not installed), and removed the other because we found the measures were installed but already counted under a different project.

- Street Lighting: No adjustments were made to ex ante savings.

Custom

Greater variance was found in the Custom Track. On an individual project level, realization rates ranged from 8% to 221% for electric savings, and from −12% to 246% for gas savings.[8]

Projects with HVAC controls-related measures were prevalent in the sample of Custom Track projects: 39 out of 51 unique projects involved controls upgrades and/or adjustments, accounting for 77% of ex ante electric savings and 91% of ex ante gas savings. Only two Custom projects with evaluated gas savings did not involve controls measures. Controls-related projects also had the highest variance in savings estimates, as illustrated in Figure 5 and Figure 6.[9] Greater variance with controls-related projects is not unexpected because they are difficult to specify and model accurately. In addition, control settings, unlike end-use equipment, can easily be changed following project completion.

[8] The negative realization rate is from a project in which the ex ante savings model produced negative savings when the verified inputs were entered.

[9] These figures are box and whisker charts. The box represents the interquartile (middle 50%, or quartile 1 through quartile 3) of data. The horizontal bars represent 1.5 times the interquartile range. The dots are outliers.

Figure 5. Custom Project Electric Realization Rates with and without Controls Measures

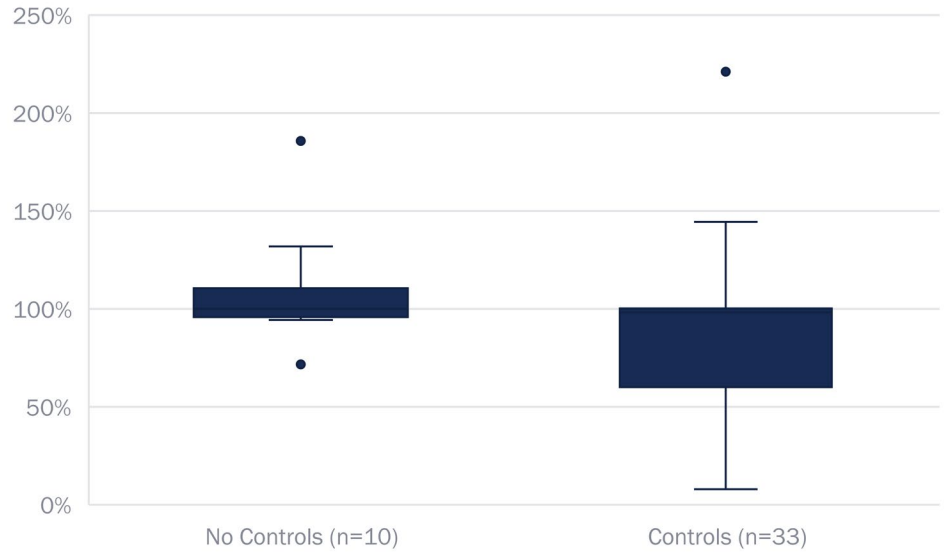
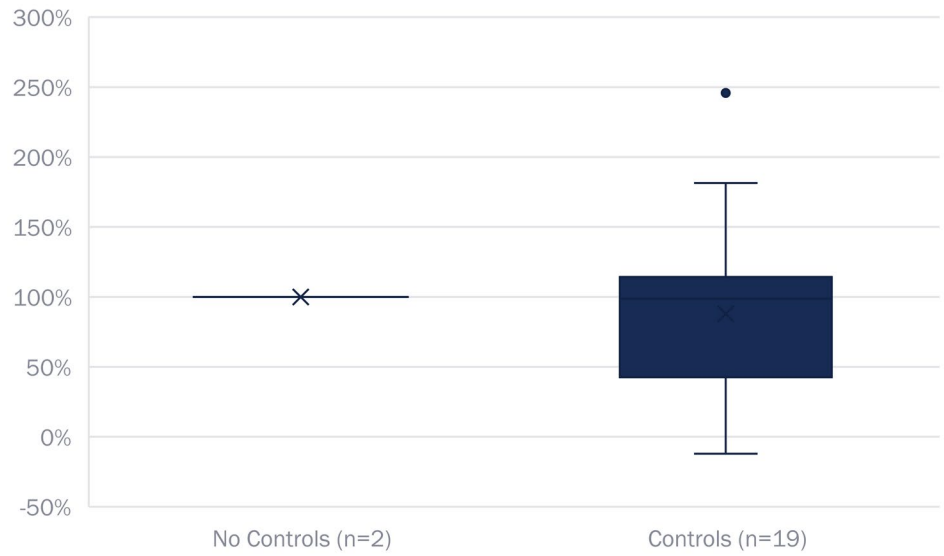


Figure 6. Custom Project Gas Realization Rates With and Without Controls Measures



4.2.2 Measure Category-Level Results

Ex ante and ex post energy and demand savings by measure category are presented in Appendix A. On the electric side, the Lighting and SEM measure categories represented the vast majority of energy savings, together accounting for nearly 90,000,000 kWh or 72% of total ex post energy savings. The next ten highest measure categories together account for 19% of total savings and are illustrated in Figure 7. Within the Lighting track, Midstream products accounted for six of the top ten categories. By technology, high/low bay fixtures, tubular LEDs (TLEDs), and interior fixtures/kits comprised the top ten savers, as shown in Figure 8.

Figure 7. Top Ten Measure Categories by Electric Energy Savings, Excluding Lighting and SEM Tracks

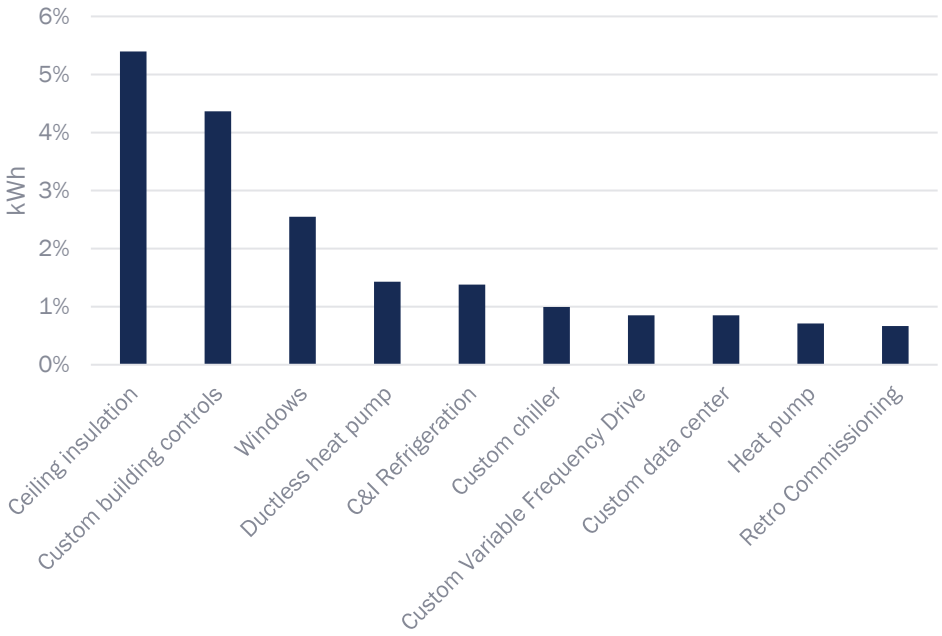
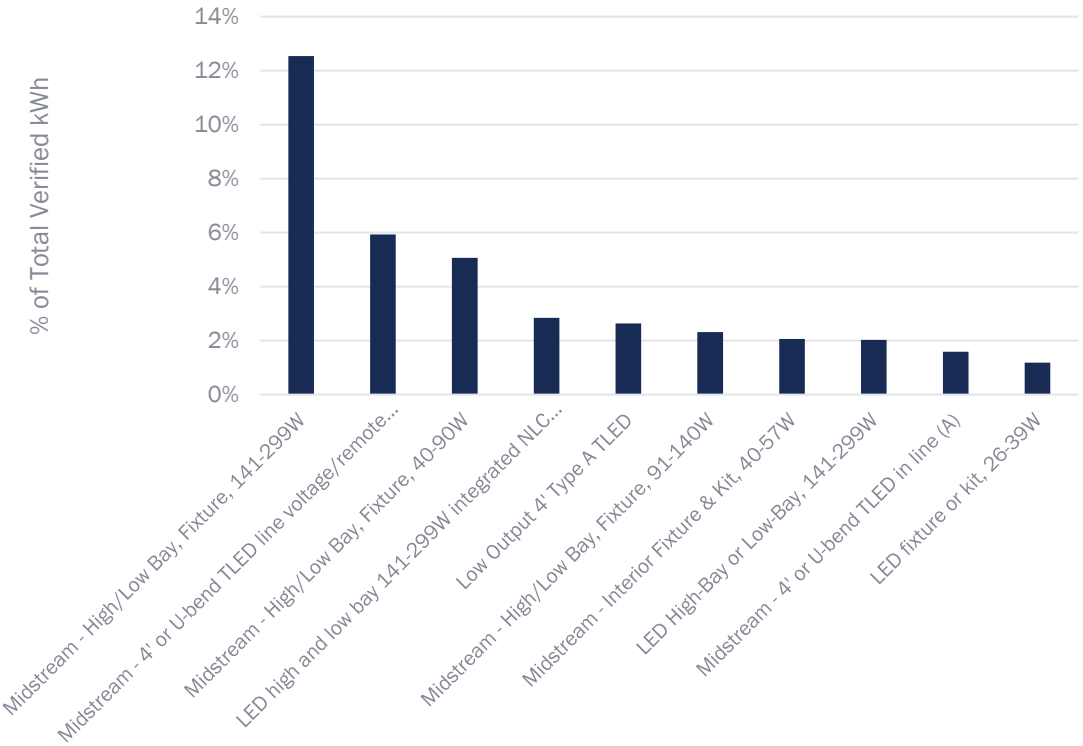
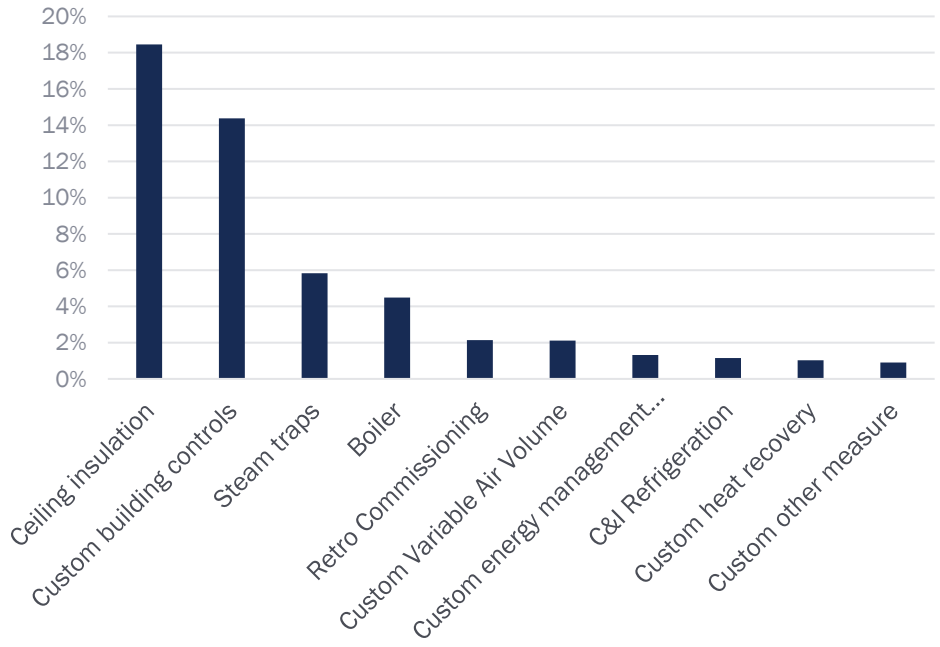


Figure 8. Top Ten Lighting Types by Electric Energy Savings



On the gas side, SEM accounted for 42% of total ex post energy savings. The next ten highest measure categories, by percentage of total savings, account for 52% of total savings and are illustrated in Figure 9.

Figure 9. Top Ten Measure Categories by Gas Energy Savings, Excluding SEM



5. Observations and Recommendations

5.1 Observational Questions

Beyond providing reliable savings estimates, Energy Trust sought answers to specific questions stated in the RFP. Below, we list each question in italics and provide our response.

- *Are there project files for every site and do those files contain complete information? Are there obvious errors in any of the assumptions used in the energy analysis?*
  - **Standard and Lighting Tracks.** Project documentation was complete. We did not evaluate the ex ante assumptions in the MADs or Lighting Tool.
  - **Custom Track.** For the most part, project documentation was complete, though some Custom Track projects had missing model files or model files that generated savings significantly different from the reported savings, suggesting that an obsolete version was inadvertently included with the documentation. Some projects we initially observed as missing documentation were rectified after coordinating with the Energy Trust project manager.

    Although project documentation was usually complete, the following file types that are important for savings verification of Custom projects were rarely included. While additional documentation requirements must be balanced against the extra burden on participants, we recommend that Energy Trust and PMC consider routinely collecting these files with incentive applications or during the post-inspection process:
    - **Construction drawings** are important for verifying that ex ante models align with as-built conditions.
    - **Commissioning reports** are often useful for verifying post-project conditions since they are broader in scope and provide more detail than PIVs.

    In addition, several Custom projects reviewed did not have PIVs because they were not required to have post-inspections under program rules. We discuss this issue separately in Section 5.6.

    Most of the projects reviewed did not contain obvious errors in assumptions. However, within the Custom Track, we noted that several projects with ex ante spreadsheet calculations included very low minimum fan speed (percent of full-load RPM) assumptions. Most fan control sequences include minimum speed settings because of adverse harmonic effects at low speed (typically between 20% and 40%). Because of the cubic relationship between fan speed and horsepower, calculations at very low fan speeds produce very high energy savings that are not achievable in practice.
  - **SEM Track.** For the SEM Track, we recommend the following improvements for future projects:
    - **Avoid hard-coded values to the extent possible.** Project information should be clearly and consistently documented across all sites. In addition, we urge the implementation team to be more transparent about their modeling methodologies. We found many instances with unclear computations and hard-coded values. While it is understandable that some hard coding is necessary up front for meter or temperature data, any further calculated values, including capital savings estimations and energy corrections, should be clearly linked in the workbooks so that the evaluators or other stakeholders are able to replicate the results of the program easily.
    - **Explain when statistical criteria for model fitness do not meet the thresholds set forth by the M&V Methodology Guideline**. From the Guideline: "Individual models may not meet all of these criteria; in those cases, the modeler should document the result of statistical tests and describe whether any of these missed criteria are significant or not and why." **We recommend that modelers provide more clarifying information**

and context when the statistical criteria are not met or acknowledge the associated model uncertainty when no explanation is available by flagging the unmet criteria.

- *Were there any post-installation changes in operating parameters and associated assumptions? If so, what were the consequent changes in energy savings estimates for individual projects (e.g., changes in operating hours for lighting)?*
  - There were many Custom projects where we verified that operating parameters differed from proposed conditions. However, because not every parameter was verified in every PIV, and not every project received a PIV, it was not always clear whether the parameter differed from the proposed condition at the time of installation or was changed after installation. Examples of Custom projects in which verifiable energy savings impacts resulted from variances in proposed operating parameters and associated assumptions are provided in Table 17.

Table 17. Examples of Custom Projects with Variances in Post-Installation Operating Parameters

Project	Ex Ante kWh (Realization Rate)	Ex Ante Therms (Realization Rate)	Summary of Operating Parameter Discrepancies
Example 1	250,100 (35%)		The low realization rate was driven, in part, by proposed overnight temperature setbacks in a facility with known 24/7 occupancy. We verified that the customer chose not to implement the proposed setbacks because of the 24/7 occupancy.
Example 2	160,667 (54%)	6,250 (43%)	During verification, several changes in control settings were noted, including changes to the occupancy schedule, duct static pressure resets, and return fan speed.
Example 3		−9,466 (−12%)	Air-handlers that were supposed to be running at minimum airflow were verified to be running at much higher airflows, resulting in an overall increase in energy usage.
Example 4	783,601 (83%)		Several air-handler fans that were assumed to be constantly running in the baseline and proposed conditions were observed to be off during verification, suggesting this assumption was not accurate.
Example 5	61,639 (46%)		Verification found that the summer occupancy schedule was reverted to its pre-case occupancy schedule because the school is often used during the summer. Differences in occupied and unoccupied temperature setpoints were also noted.

- *What are the factors that result in large variances in energy savings from program estimates (e.g., assumptions too conservative, incorrect hours of operation)?*
  - The specific factors behind the large variances in energy savings observed in some Custom Track projects vary, owing to the unique nature of projects in this track. In many cases, we were unable to identify specific causes. However, the most common factors were as follows:
  - **Discrepancies in verified post-installation parameters versus modeled parameters**: While modeled parameters were usually found to be consistent with proposed parameters (meaning as the associated measure was defined in the TAS), discrepancies in verified conditions versus modeled conditions were often identified, sometimes leading to large variances between ex post and claimed savings estimates. Several examples are provided in Table 17. Overall, assumptions in these projects tended to be overly aggressive (e.g., assuming very low minimum fan speed, high or low temperature setbacks, or more unoccupied hours than actual).
  - **Unrealistic or inaccurate modeling assumptions:** Unrealistic or inaccurate ex ante assumptions led to low realization rates in some projects. We provide examples in Table 18.

Table 18. Examples of Custom Projects with Unrealistic or Inaccurate Modeling Assumptions

Project	Ex Ante kWh (Realization Rate)	Ex Ante Therms (Realization Rate)	Summary of Discrepancies
Example 1	417,360 (50%)	38,385 (56%)	The relatively low realization rates for this project were driven, in part, by unrealistically low minimum fan speed assumptions in the ex ante calculations.
Example 2	250,100 (35%)		The low realization rate was partly driven by excessive baseline fan energy and caused an unrealistically high static pressure assumption.
Example 3	312,110 (76%)		Of the total reported energy savings, 93% were from fans. At the air handler unit level, the fan savings account for 90%–95% of savings, which implies that the fans were almost turned off completely, which did not occur.
Example 4	267,158 (93%)		The ex ante calculations assumed that the computer room air conditioner units effectively run constantly at full load. HVAC equipment is typically oversized to provide a "safety margin."

- *For Custom Track measures, are the projects using the appropriate baseline (existing conditions or current market) to estimate savings and cost-effectiveness?*
  - With few exceptions, the baseline scenario was not an issue in the projects we reviewed—most involved controls measures in which the existing conditions are properly considered the baseline. However, the baseline assumption was relevant in one project in which the customer replaced their gas furnaces with heat pumps. Here, the ex ante savings were calculated relative to a theoretical baseline of electric resistance heating and code-minimum efficiency air conditioners. While we recognize that this baseline assumption is allowable under code and acceptable under current fuel switching policies, we feel it is not realistic that the customer, in the absence of an incentive, would replace their gas heating with electric resistance heating, because their heating costs would increase significantly under current gas and electric rates. Stakeholder discussions on possible updates to program guidance in these scenarios may be warranted.
- *For Standard Track measures, do the measure approval documents used by the program include sufficient information to estimate reliable savings, and if not, what specific changes should be made to improve them?*
  - Yes, the MADs provided all the information necessary to verify equipment eligibility and claimed savings.
- *For the SEM sites, how did realization rates for each cohort compare to previous program years that used the excel tool? Were capital measures properly accounted for in the estimation of SEM savings?*
  - The realization rate of 100% for electricity is a significant improvement over the previous evaluation results for 2021 (84% using the SRT method and 90% using the PTTP method). The gas realization rate of 100% is also a significant improvement over 2021, depending on which method is referenced (98% using the SRT method and 56% using the PTTP method). Capital measures were properly accounted for; however, the estimation of the capital measures can be improved in terms of documentation transparency and traceability.
- *What changes to the guidelines would improve model development and the accuracy of savings estimates?*
  - We recommend revising the model estimation methodology to account for persistent SEM savings or other previously incentivized programs after model estimation is completed. Changing the response variable values (i.e., kWh, or monthly usage) fundamentally changes the relationship of that response variable with the predictor variables (e.g., HDD/CDD, production). These changes are particularly problematic when the changes

only affect part of the baseline period. In some sites, the energy corrections were only applied for a portion of the baseline period. For the sake of example, consider a linear relationship where a one-unit temperature increase leads to a 50-unit change in energy usage. The correction would rewrite this relationship to say that a one-unit change in temperature now only leads to a 30-unit change in energy usage. This has the potential to affect the estimation of energy savings dramatically.

- For sites with an 11-month reporting period, we recommend that the missing month is also removed from the baseline period for modeling purposes. Including a month that is not in the reporting year has the potential to bias the energy usage estimates by incorporating seasonality from the baseline period that is not present in the reporting year. For example, the reporting period for one site runs from November 4, 2022, through October 4, 2023, so October 2023 would have been the 12th month but is not included for the reporting year. Best practice suggests that October 2022 should also be excluded from the baseline period so that any seasonal effects from that period do not bias the savings estimation for the reporting months.

- *Were recommendations made in previous impact evaluations implemented, and if so, how have these changes affected the realization or verification of program savings?*
  - We provide detailed assessments of the implementation status of previous recommendations in Section 5.2. In general, the recommendations seem to have been implemented, or present conditions have rendered them moot. Figure 10 and Figure 11 compare 2023 savings realization rates to 2021 results.[10] As can be seen, realization rates remained high for the Standard and Lighting Tracks, while large improvements occurred in Custom electric and SEM electric and gas. The Custom gas realization rate decreased by about 10% from 2021 to 2023.

[10] The 2021 evaluation report presented the SEM realization rates as determined through two different methods: the SRT method (used by the Spring Cohort in the present evaluation) and the PTTP method (used by the Winter Cohort in the present evaluation). For simplicity, we present only the PTTP results for 2021 here.

Figure 10. 2021/2023 Evaluation Results Comparison, Electric Realization Rates

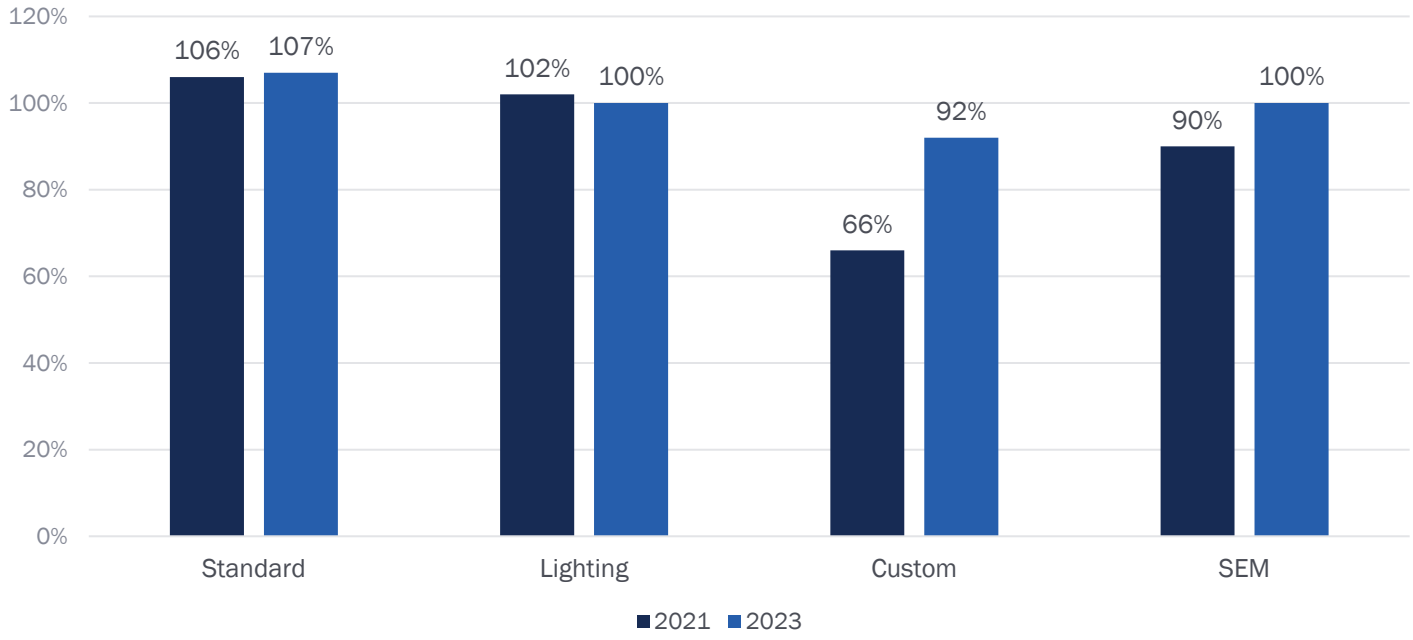
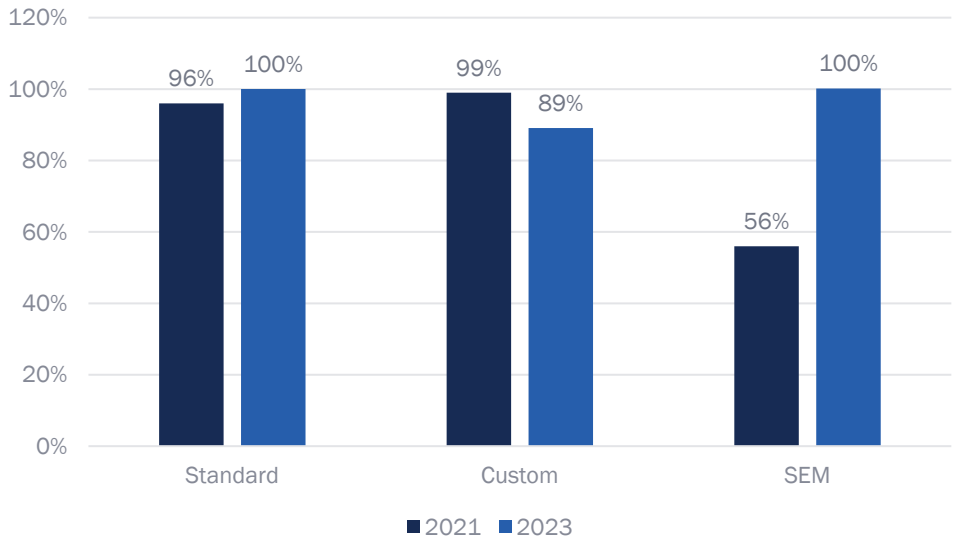


Figure 11. 2021/2023 Evaluation Results Comparison, Gas Realization Rates



- *What recommendations does the evaluator have regarding analysis approaches and assumptions, or customer behavior or decision-making that would be helpful to Energy Trust in designing, implementing, and evaluating its programs in the future?*

  Of the 51 unique Custom Track projects reviewed, 39 (76%) involved upgrading old HVAC control systems to new systems or recommissioning existing control systems. When new systems were installed, they often enabled new control strategies such as demand-control ventilation. Additionally, existing control strategies were recommissioned to better match current operations. For example, HVAC schedules were adjusted to better align with current building occupancy patterns.

  The measures implemented in the control projects reviewed are all proven energy saving strategies. However, we frequently observed that meter-based energy savings were significantly lower than the reported savings, or

not discernible. The reasons for this were not always clear but may have stemmed from inaccurate modeling of existing conditions, discrepancies between the control measures as proposed in the TAS and as implemented, or changes made after project completion. Given these challenges, we offer the following recommendations:

- **Trend data logs should be collected for key parameters.** For recommissioning projects or new DDC installations, understanding the existing system and its control logic is key. While these data are not available through an existing BAS in some instances, an effort should be made to install temporary data loggers to collect this information, which can then inform the facility energy modeling or savings calculations. Accurately and thoroughly characterizing existing conditions will help ensure that models accurately predict energy savings.
- **Ensure key parameters are thoroughly documented and reviewed in PIVs to verify post-conditions.** As we discuss in Section 5.6, PIV report quality varied in the sample of Custom projects reviewed. For HVAC controls-related projects, it is important to document control logic and key parameters in PIVs to demonstrate that the proposed changes were implemented. Thorough documentation of control settings in the PIV will reduce evaluation risk if evaluators find that settings have changed at the time of evaluation.
- **Time PIV implementation to verify key control changes.** In one project, an overnight setback during the winter months was a major energy savings driver for the project. During evaluation the customer reported that the setback was ultimately removed because the system was not able to recover sufficiently in the mornings. Unfortunately, the PIV was performed during the summer, so this measure could not be verified. We recommend the implementation team consider the ability to verify key parameter changes when scheduling PIVs, even if it means delaying close-out for some projects. The implementation team should also confirm with the facility manager that commissioning is fully complete and no further changes are planned prior to scheduling a PIV. The key parameter settings documented in the PIV should reflect stable conditions.

- Are there economic or other trends that are impacting the program's ability to forecast and estimate savings?
  - One trend that presents difficulties for forecasting savings in this market segment is varying building occupancy due to hybrid and remote employees. This trend was manifested in some projects where we found that the facility's energy usage in the year prior to installation had decreased from the pre-pandemic years, on which the baseline model was calibrated. Currently, many organizations that had been allowing large portions of their employees to work remotely on certain days are reverting to requiring more in-office days, which will result in higher energy use in many cases. The uneven implementation of this trend across the commercial building sector complicates the ability to forecast energy savings, as many measures commonly implemented in the EB program are occupancy-dependent.

5.2 Recommendations From Previous Evaluation

The authors of the *Existing Buildings 2021 Impact Evaluation Report* provided several recommendations for improving the effectiveness of the program and the accuracy of the expected savings. In the following subsections, we provide each recommendation in italics and follow with our assessment of implementation status.

5.2.1 Custom Track

***Custom Energy Models**: During the course of our model reviews, we noted that model calibration was inadequate for 12 of 16 models[…] Note that most of these models were developed under the previous PMC.*

- ***Recommendation:** We recommend that the PMC check to ensure that model calibration is being emphasized in technical reviews and that any explanations given by the ATAC for poor calibration are thoroughly reviewed to*

ensure that PMC calibration guidelines are adhered to. If a model is unable to be calibrated following these guidelines, we recommend that the model not be accepted and that a different calculation approach be used for the project."

- **Status:** This recommendation appears to have been largely implemented. Where possible, models were calibrated to billing data within prescribed tolerances. However, we note that many models were calibrated to older historical data, such as 2017–2019 average energy use, which made it challenging to isolate the effects of the energy efficiency measures being evaluated from other factors affecting energy use. We provide additional commentary on this issue in Section 5.6.

5.3 Standard Track

Standard Track MAD 47 (Insulation) and MAD 68 (Cooler Doors) Existing Conditions Documentation: *Existing conditions for insulation (MAD 68) and cooler doors (MAD 47) were not documented in some cases.*

- ***Recommendation:*** *Since the existing condition is a key input for measure savings/incentives, we recommend carefully checking this documentation before approving applications, and ensuring that the customer understands that this documentation is required per the MAD.*
- **Status:** We found that existing conditions for insulation measures were documented. Existing conditions for cooler doors were not explicitly documented. Although we were able to deduce the existing condition from the project documentation in the projects reviewed, we recommend that going forward, project documentation explicitly document the existing condition, which according to the MAD is supposed to be an open case.

5.4 SEM Track

SEM PTT Method: *For this evaluation, we used the PTT method to calculate realized savings. The overall sampling precision of the SEM realization rate based on the PTT results is very low due to the scatter in site-level realization rates and is not reflective of the accuracy of this method for estimating savings at the site level. At the site level, we were able to successfully model savings at each site and achieve acceptable model fit metrics with adjustments for NRAs such as those associated with the pandemic.*

- ***Recommendation:*** *We believe that this method, which utilizes actual site level data, is the preferred approach and can be successfully implemented during periods such as the recent pandemic.*
- **Status:** All modeling was done at the site level for sites that used PTT models.

SEM SRT Method: *Our analysis indicates that the program did a good job implementing the SRT method for claiming savings but that the SRT method itself could be improved if it is used in the future.*

- ***Recommendation:*** *If the SRT method is to be used in the future, we recommend basing the site-level savings not wholly on the historical savings rates for the program, but on a combination of the historical savings rates for the program and, if available, the historical savings rates for the site, or the participant. For example, we found nine PTT models in their second reporting year or greater where savings had never been realized in any of the previous reporting years. We found that seven of those nine did not have savings during the evaluation year, either, yet by the SRT method all nine of those sites had savings.*

  Additionally, if the program uses a similar method in the future, the evaluator should be informed that a higher sample size may be necessary to achieve desired precision targets since the claimed savings may vary significantly from the realized savings.

Finally, we recommend that the engagement factor (EF) be studied more closely to quantitatively assess the impact that the number and types of "qualifying projects" has on savings. Moreover, we would recommend assessing the engagement factor at the building level, if possible, rather than at the customer level.

- **Status:** The recommendation on incorporating historical site-specific savings in the SRT methodology was not implemented; however, we have no further comments as the prescriptive SRT methodology will no longer be used.
- ***SEM Monthly vs Interval Billing Data:*** *The SEM program has historically used monthly billing data when using the PTT modeling approach.*
  - ***Recommendation:*** *We strongly recommend using interval data (i.e. daily data) if at all possible for regression-based savings models. Interval data usually results in much smaller uncertainty as compared to monthly data. Our understanding is that interval data is difficult to obtain from utilities at the time of this report writing. Utilities would benefit greatly from sharing this data as it would increase model accuracy and therefore aid in increased energy efficiency.*
  - **Status:** Interval data are still facing the accessibility issue, but we believe using interval data may increase the accuracy of the models, especially when the savings percentages are relatively low.

5.5 General Recommendations

- ***Low Customer Recruitment/Participation:*** *[…]customer recruitment levels and cooperation were low in 2020, and despite greater focus on the recruitment process, were also low in 2021.*
  - ***Recommendation:*** *We believe that evaluation participation could be improved by increasing communication with the customer regarding the evaluation process, and continuing communication with them throughout the measure implementation process so that it is repeatedly clear what the expectations are if they are contacted for an evaluation. This would also include re-engaging the customer on this process if the customer contact person changes to avoid situations in which the site contact is unaware of the evaluation process. It may also be good to emphasize to the customer that participation in the evaluation process is technically required as part of their contract with Energy Trust. Finally, since this seems to be a persistent issue, it might benefit from further study perhaps as part of a process evaluation. This would help ensure that any barriers to participation are thoroughly identified.*
  - **Status:** As described in Section 4.1, no unusual recruitment challenges were encountered in this evaluation.
- ***Low Precision in Track Level Results:*** *Precision was much lower than targeted in both the Custom and SEM Tracks.*
  - ***Recommendation:*** *Precision was affected by low customer participation (lower final completed sample) in the Custom Track and high variability of results (claimed savings vs evaluated savings) in the SEM Track. One way to mitigate these factors in the future would be to use the relative precision and site completion rates (completed sites/originally sampled sites) from past evaluations to drive future evaluation sample sizes. A higher sample size for example would result in more sites being completed (in the case of low customer participation) and better statistical results (in the case of high scatter in results). This approach would require a higher evaluation budget to handle the increased effort for recruiting and evaluating more projects.*
  - **Status:** We selected the sample sizes based on error ratio assumptions from our experience evaluating similar programs. Ultimately, there was very little variance in the SEM, Standard, and Lighting Track savings estimates. More variance was seen in the Custom Track, but the precision goals of 90%/10% on the electric side and 90%/15% on the gas side were achieved except for the Custom-gas domain. In the absence of any major changes in program implementation, we recommend that future impact evaluations of the EB program allocate the largest sample and most resources toward the Custom Track.

5.6 Additional Observations and Recommendations

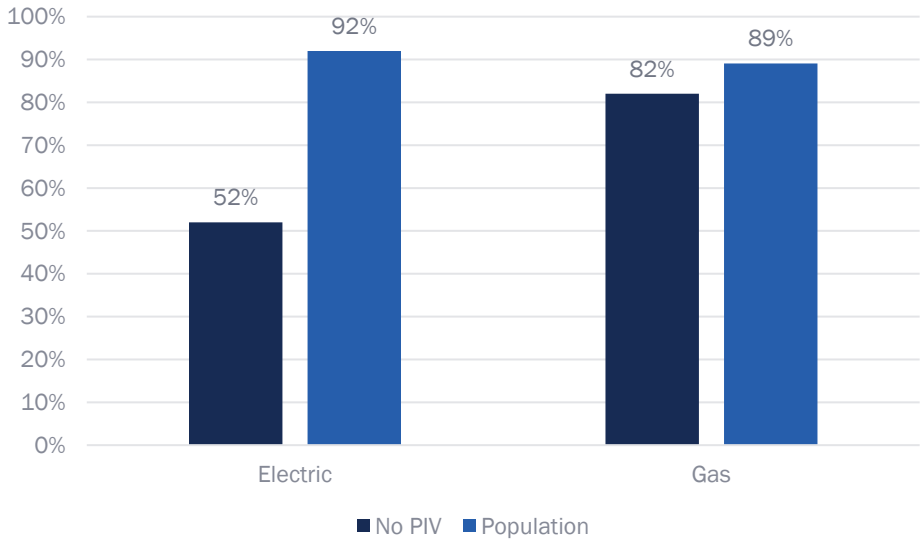
In addition to the specific observational questions posed by Energy Trust, we offer additional observations and recommendations below, all pertaining to the Custom Track.

Observation 1: Custom spreadsheet calculations that were hard to follow or not set up to be easily understood tended to have lower realization rates than those spreadsheets that were transparent in the calculation methodology and thoroughly documented. The main issues identified in the spreadsheet calculations were the following:

- **Lack of Transparency**: Custom spreadsheets that are difficult to follow, use proprietary calculations, or contain hard-coded numbers without clear documentation make it challenging to understand the basis for energy savings claims.
- **Undocumented Assumptions**: Many spreadsheets include numerous assumptions without citing sources or providing supporting data. When baseline setpoints, trend data, or the rationale for key values are not documented, it becomes unclear how savings estimates were derived, undermining confidence in the results.
- **Manual Data Entry and Errors**: Reliance on manual data entry increases the risk of human error, version control issues, and data inconsistencies. For example, some spreadsheets had over 8000+ rows of data and 20+ columns, across 10+ worksheets in one workbook. Without clear versioning or audit trails, it is difficult to track changes or identify the source of discrepancies.
- **Complex or Opaque Formulas**: Proprietary or overly complex calculations or hidden formulas made it challenging to follow the methodology or validate results. In one instance, proprietary software was used, and the output was provided as hard-coded numbers in an Excel sheet.
- **Poor Documentation and Organization**: Spreadsheets lacking clear documentation, explanatory worksheets, or a logical structure hinder understanding and review. When input data, calculations, and results are not clearly separated or labeled, the risk of misinterpretation increases.
- **Limited Scalability and Reusability**: Custom spreadsheets are often designed for a single project and are not easily adaptable or reusable for future analyses. This leads to inefficiencies and repeated errors, and the program and the evaluator need to review every spreadsheet from scratch.
- **Limited trend data used to derive savings:** For recommissioning or custom controls projects, understanding the existing system and its control logic is key. While these data are not available through an existing BAS in some instances, an effort should be made to install temporary data loggers to collect this information, which can then inform the energy savings calculations.
- Recommendations
  - **Set expectations for custom calculations in Program Guidelines.** Provide clear documentation guidelines for Custom projects using custom spreadsheet calculations to estimate energy savings. This should include acceptable default assumptions, required sources of supporting evidence (e.g., trend logs), and minimum levels of supporting documentation (e.g., as-built drawings). We provide specific recommendations for recommissioning and custom controls calculations in Section 5.1.
  - **Provide example templates to ATACs for calculations to standardize the output.** Provide example spreadsheet templates for common recommissioning and control adjustment measures to demonstrate exactly how they should be set up and documented.
  - **Continue to provide regular training to ATACs on templates and guidelines.** Continue to offer regular ATAC events including focused training opportunities on templates and guidelines for recommissioning and custom controls projects.

- **Observation 2: Custom projects with no PIV tended to have lower realization rates.** PIVs were not completed for 8 (15%) of the 52 unique Custom Track projects evaluated. As illustrated in Figure 12, the average electric and gas realization rates for these projects, 52% and 82% respectively, were significantly lower than the population realization rates of 92% and 89%.
- No incentive was paid for seven of the eight projects, suggesting they are Savings-Only projects (i.e., those for which savings are claimed but no incentive is paid because the project failed cost-effectiveness screening). For the eighth project, no incentive was paid for the largest savings measure, suggesting it also failed cost-effectiveness screening. Under Program Guidelines[11], Savings-Only projects do not receive PIVs, nor do most projects with incentives under $5,000.

Figure 12. Realization Rates for Custom Projects With No PIV Compared to Population



- **Recommendation:**
  - **Amend Program Guidelines to require PIVs for Savings-Only Projects with calculated incentives over $5,000.** We recommend amending program rules to require PIVs for projects that would have received an incentive of over $5,000, and therefore qualified for a PIV, had they not failed cost-effectiveness screening. Not requiring a PIV means the implementation team does not verify key operating parameters, creating a risk that savings are not occurring or are significantly diminished from the reported value.

Observation 3: Custom project PIV quality varied. We found that the quality of PIVs for custom projects varied in thoroughness and accuracy. While some PIVs were very thorough, others failed to verify key parameters driving claimed energy savings, for example:

- In one project, the PIV included a BAS graphic of an air-handler showing that the heat recovery coil was not repositioned downstream of the cooling coil as proposed in the TAS, which was a major driver of the claimed gas savings. The PIV did not mention this, suggesting it was overlooked. Removing this measure from the proposed energy model resulted in a gas savings realization rate of 60%.
- In one project, the electric and gas claimed savings were largely based on the facility switching from 24/7 occupied mode operation during the winter to daily occupied and unoccupied operation, with temperature setbacks and outdoor air dampers closed during unoccupied hours. However, the new schedule was not verified in

[11] Energy Trust of Oregon Existing Buildings Program Implementation Manual. December 29, 2023.

the PIV. We were unable to verify the new schedule with the customer and determined electric and gas realization rates of 76% and 19%, respectively.

- In one project, the PIV included photos and specification sheets of the new VAV terminal units but did not verify that average airflow was actually lowered, which was the primary driver of the claimed savings. Through a virtual site visit, we noticed that the BAS graphic indicated significantly higher airflows than proposed. This observation was confirmed by trend logs provided by the customer. With the higher airflows, the savings calculations showed that energy use increased due to the project, resulting in a realization rate of −12%. The implementation team often collects BAS screenshots to verify operating assumptions, but did not do so in this project.
- **Recommendations:**
  - **PIVs should itemize key parameters and findings.** In addition to verifying equipment installations, inspection personnel should focus on documenting the key parameters that influence savings. This is especially important for controls-related measures, which now account for the majority of Custom Track savings. We recommend that PIVs itemize key parameters and their proposed values and document the findings for each parameter.
  - **Consider additional steps to improve PIV quality,** such as assigning PIVs based on staff experience level, with more complex projects going to the most technically proficient personnel, or performing quality control reviews to ensure key parameters are verified.

Observation 4: Switch optimization projects generally resulted in higher evaluated savings than reported. The realization rates for the three switch optimization projects reviewed were greater than 100%. This is likely due to a few factors: the reported savings are based on 14 days of pre- and post-spot measurements which may not completely capture fluctuations in IT and electrical infrastructure loads over the full year; additionally, the spot measurements do not capture the impacts the switch optimization project has on the cooling system over the entire year.

- **Recommendation: Develop a more accurate method for capturing cooling savings.** While most projects incorporate an "HVAC factor" in the final reported savings, what this factor is based on is unclear. If the program expects additional switch optimization projects in the future, we recommend that the program invest in (1) collecting cooling system information at these sites and (2) developing a more accurate method for capturing the associated cooling savings.

Observation 5: Heat reclaim measures in grocery stores had mixed evaluation results. There was one heat reclaim Custom project comprised of two sites/installations initially included in the evaluations. Based on billing analyses, we found that one site showed greater than expected savings while the other showed negative savings (i.e., an increase in consumption post-installation) after normalizing for weather and billing days. We contacted the store manager at the latter site to determine whether there were any issues with the installation, to confirm the installation timeframe, and to ask if any other projects occurred at the site that may have impacted gas usage such as the installation of new gas cooking equipment. The manager stated that the heat reclaim was installed correctly and there were no other projects completed in the last two years that would have impacted gas usage. We were unable to complete additional investigation due to the evaluation timeline. Since we were unable to pinpoint the specific causes for the increased usage at this site, it was decided to drop this project from the sample.

- Recommendations
  - **Require a more robust analysis.** The methodology for estimating reported savings was based on an M&V study of stores that implemented the same technology in the Midwest and relied on a few variables (mainly store hours, store area, and heating degree days) to calculate savings. It is likely this method was not translatable without further details, such as the type of RTUs installed. We recommend requiring a more robust analysis that captures not just the HDDs and store size and hours but also information on the heating systems that the heat reclaim units supplement. Heating systems, zoning, and other variables are likely to change by region and store,and just using an M&V report based on whole-site savings and HDDs will not capture these variations.

- **Require a commissioning validation report** proving that the heat reclaim unit is functional, and if possible, also require a seasonal commissioning report, particularly if the unit is not verified to operate in the heating season upon project completion.

Observation 6: Many Custom project baseline models were calibrated to historical billing data. Baseline electricity and natural gas usage data used to calibrate the baseline model or spreadsheet calculations should represent a recent year. In the grocery store heat reclaim projects and several custom controls projects, the baseline energy usage referenced in the TAS report and used to calibrate the models went back several years before the project was implemented, sometimes as far as 2012. Additionally, in some cases, there were clearly some major changes in energy usage patterns compared to more recent years, which made it challenging to understand how the energy savings projects then impacted site energy usage.

- **Recommendation:** While we recognized that construction delays between initial project scoping and implementation frequently occur for a variety of reasons outside of the implementation team's control, **guidelines should require recalibration when baseline data reaches a certain age.** We recommend that Energy Trust work with stakeholders to develop a policy that balances practical considerations of program delivery with the need for representative baseline modeling.

Appendix A.Measure Category-Level Savings

Table 19. Measure Category-Level Electric and Gas Energy Savings

End Use / Measure Category	Ex Ante kWh	Ex Post kWh	kWh RR	Ex Ante therms	Ex Post therms	therms RR
Appliance	**289,042**	**309,787**	**107%**	**30**	**30**	**100%**
Clothes washer	5,711	6,121	107%	30	30	100%
Refrigerator	283,331	303,666	107%	0	0	
Data Center	**1,143,435**	**1,057,097**	**92%**	**0**	**0**	
Custom data center	1,143,435	1,057,097	92%	0	0	
Fans	**79,277**	**73,291**	**92%**	**3,445**	**3,072**	**89%**
Custom fan	79,277	73,291	92%	3,445	3,072	89%
Food Service	**51,014**	**54,676**	**107%**	**1,567**	**1,567**	**100%**
Food equipment	46,154	49,466	107%	1,567	1,567	100%
Icemaker	4,861	5,209	107%	0	0	
HVAC	**10,827,636**	**10,489,360**	**97%**	**798,678**	**742,085**	**92%**
Boiler	1,937	1,791	92%	110,143	109,912	100%
Boiler tune-up	0	0		14,966	13,344	89%
Central AC	1,845	1,978	107%	0	0	
Cooling tower	42,320	39,125	92%	0	0	
Custom building controls	5,867,211	5,424,191	92%	395,439	352,588	89%
Custom energy management system	401,728	371,394	92%	36,355	32,416	89%
Custom HVAC	466,841	431,591	92%	12,982	11,575	89%
Custom thermostat	1,253	1,158	92%	351	313	89%
Custom Variable Air Volume	524,868	485,236	92%	58,177	51,873	89%
Custom ventilation	1,994	1,843	92%	2,237	1,995	89%
Demand Control Ventilation	3,856	4,133	107%	5,172	5,173	100%
Ductless heat pump	1,837,717	1,943,321	106%	-2	-2	89%
Economizer	3,486	3,736	107%	0	0	
Gas fireplace	0	0		437	437	100%
Gas furnace	5,568	5,968	107%	17,860	17,804	100%
Heat pump	890,860	945,002	106%	-659	-587	89%
Heat pump replacement	458,750	491,674	107%	0	0	
Radiant heating	3,058	3,066	100%	2,344	2,344	100%
Server Closet Mini-split AC units	8,355	8,955	107%	0	0	
Steam traps	0	0		142,876	142,900	100%
Variable refrigerant flow	292,276	310,502	106%	0	0	
Ventilation	13,712	14,696	107%	0	0	
HVAC Controls	**46,239**	**49,558**	**107%**	**9,555**	**9,557**	**100%**
Heat Pump Advanced Controls	5,732	6,143	107%	0	0	
Thermostat	40,507	43,414	107%	9,555	9,557	100%
Industrial Process	**2,688**	**2,880**	**107%**	**0**	**0**	
Welder	2,688	2,880	107%	0	0	
Lighting	**73,669,806**	**74,011,564**	**100%**	**0**	**0**	
Custom lighting	534,931	535,234	100%	0	0	

End Use / Measure Category	Ex Ante kWh	Ex Post kWh	kWh RR	Ex Ante therms	Ex Post therms	therms RR
Custom lighting control	412,768	413,701	100%	0	0	
Lighting	67,298,216	67,607,625	100%	0	0	
Lighting controls	5,423,891	5,455,005	101%	0	0	
Motors	**1,273,752**	**1,196,678**	**94%**	**3,295**	**2,938**	**89%**
Custom Variable Frequency Drive	1,144,040	1,057,656	92%	3,295	2,938	89%
Motors	129,712	139,022	107%	0	0	
O & M	**22,167,828**	**22,167,828**	**100%**	**1,022,984**	**1,024,800**	**100%**
SEM	22,167,828	22,167,828	100%	1,022,984	1,024,800	100%
Other	**1,296,280**	**1,209,562**	**93%**	**109,738**	**100,490**	**91%**
Air conditioning	188	173	92%	0	0	
Battery Charger	60,551	64,896	107%	0	0	
Custom economizer	6,686	6,181	92%	1,575	1,404	89%
Custom other measure	315,597	291,767	92%	24,923	22,222	89%
Pool Cover	0	0		10,187	10,189	100%
Pool Heater	0	0		14,166	14,168	100%
Pool pump	15,231	16,324	107%	0	0	
Retro Commissioning	898,028	830,220	92%	58,887	52,506	89%
Process Cooling	**1,336,795**	**1,235,857**	**92%**	**292**	**260**	**89%**
Custom chiller	1,336,795	1,235,857	92%	292	260	89%
Process Heating	**7,717**	**7,134**	**92%**	**31,068**	**27,701**	**89%**
Custom boiler	-1,157	-1,070	92%	2,764	2,464	89%
Custom heat recovery	8,874	8,204	92%	28,304	25,237	89%
Pumps	**17,620**	**18,885**	**107%**	**720**	**689**	**95%**
Custom hydraulics	0	0		290	259	89%
Pump	15,918	17,060	107%	0	0	
Recirculation Pump Control	1,702	1,824	107%	430	430	100%
Refrigeration	**1,945,977**	**2,038,051**	**105%**	**28,240**	**28,245**	**100%**
C&I Refrigeration	1,600,490	1,715,355	107%	28,240	28,245	100%
Custom refrigeration	345,487	322,696	93%	0	0	
Vacuum	**544**	**503**	**92%**	**0**	**0**	
Custom filter	544	503	92%	0	0	
Water Heating	**1,806**	**1,936**	**107%**	**37,703**	**36,519**	**97%**
Domestic hot water measures	0	0		10,971	9,782	89%
Heat pump water heater	1,558	1,670	107%	0	0	
Pipe insulation	0	0		13,952	13,955	100%
Spa cover	248	265	107%	0	0	
Tanked water heater	0	0		10,395	10,397	100%
Tankless water heater	0	0		2,385	2,385	100%
Weatherization	**9,676,356**	**10,365,660**	**107%**	**473,028**	**472,786**	**100%**
Ceiling insulation	6,256,408	6,705,422	107%	452,102	452,179	100%
Custom insulation	35,000	32,357	92%	2,980	2,657	89%
Floor insulation	125,432	134,434	107%	1,131	1,131	100%
Wall insulation	303,914	325,726	107%	10,994	10,996	100%
Windows	2,955,602	3,167,721	107%	5,821	5,822	100%

End Use / Measure Category	Ex Ante kWh	Ex Post kWh	kWh RR	Ex Ante therms	Ex Post therms	therms RR
TOTAL	123,833,813	124,290,305	100%	2,520,343	2,450,738	97%

Table 20. Measure Category-Level Electric and Gas Demand Savings

End Use / Measure Category	Ex Post Summer kW	Ex Post Winter kW	Ex Post Winter Therms/Day	Ex Post Winter Therms/Hour
Appliance	**44**	**33**	**0**	**0**
Clothes washer	1	1	0	0
Refrigerator	43	33	0	0
Data Center	**136**	**192**	**0**	**0**
Custom data center	136	192	0	0
Fans	**20**	**13**	**59**	**5**
Custom fan	20	13	59	5
Food Service	**9**	**8**	**18**	**1**
Food equipment	8	7	18	1
Icemaker	**1**	**1**	0	0
HVAC	**2,264**	**2,848**	**13,124**	**1,027**
Boiler	0	0	1,695	132
Boiler tune-up	0	0	254	20
Central AC	5	0	0	0
Cooling tower	9	3	0	0
Custom building controls	1,267	976	6,732	527
Custom energy management system	104	33	618	48
Custom HVAC	138	47	221	17
Custom thermostat	0	0	6	0
Custom Variable Air Volume	139	48	989	77
Custom ventilation	0	0	38	3
Demand Control Ventilation	1	0	78	6
Ductless heat pump	397	1,025	0	0
Economizer	1	0	0	0
Gas fireplace	0	0	7	1
Gas furnace	1	2	298	22
Heat pump	46	392	-11	-1
Heat pump replacement	125	237	0	0
Radiant heating	1	0	35	3
Server Closet Mini-split AC units	1	1	0	0
Steam traps	0	0	2,163	170
Variable refrigerant flow	28	79	0	0
Ventilation	3	2	0	0
HVAC Controls	**13**	**20**	**159**	**12**
Heat Pump Advanced Controls	2	3	0	0
Thermostat	11	17	159	12
Industrial Process	**0**	**0**	**0**	**0**

End Use / Measure Category	Ex Post Summer kW	Ex Post Winter kW	Ex Post Winter Therms/Day	Ex Post Winter Therms/Hour
Welder	0	0	0	0
Lighting	**10,287**	**11,849**	**0**	**0**
Custom lighting	81	53	0	0
Custom lighting control	78	58	0	0
Lighting	9,443	10,815	0	0
Lighting controls	685	923	0	0
Motors	**284**	**121**	**56**	**4**
Custom Variable Frequency Drive	265	106	56	4
Motors	18	15	0	0
O & M	**0**	**0**	**0**	**0**
SEM	0	0	0	0
Other	**349**	**168**	**1,195**	**91**
Air conditioning	0	0	0	0
Battery Charger	9	11	0	0
Custom economizer	1	1	27	2
Custom other measure	94	48	97	8
Pool Cover	0	0	30	1
Pool Heater	0	0	41	2
Pool pump	2	2	0	0
Retro Commissioning	243	105	1,001	78
Process Cooling	**348**	**147**	**5**	**0**
Custom chiller	348	147	5	0
Process Heating	**1**	**1**	**528**	**41**
Custom boiler	0	0	47	4
Custom heat recovery	1	1	481	38
Pumps	**3**	**3**	**6**	**1**
Custom hydraulics	0	0	5	0
Pump	3	3	0	0
Recirculation Pump Control	0	0	1	0
Refrigeration	**267**	**229**	**426**	**34**
C&I Refrigeration	225	182	426	34
Custom refrigeration	42	46	0	0
Vacuum	**0**	**0**	**0**	**0**
Custom filter	0	0	0	0
Water Heating	**0**	**0**	**289**	**23**
Domestic hot water measures	0	0	42	3
Heat pump water heater	0	0	0	0
Pipe insulation	0	0	204	16
Spa cover	0	0	0	0
Tanked water heater	0	0	36	3
Tankless water heater	0	0	8	1
Weatherization	**2,892**	**2,478**	**7,166**	**565**
Ceiling insulation	1,917	842	6,828	539

End Use / Measure Category	Ex Post Summer kW	Ex Post Winter kW	Ex Post Winter Therms/Day	Ex Post Winter Therms/Hour
Custom insulation	12	3	54	4
Floor insulation	12	58	19	1
Wall insulation	80	64	166	13
Windows	871	1,510	98	7
TOTAL	**16,918**	**18,109**	**23,032**	**1,804**

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2023 Fast Feedback Survey
End of Year Report

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Executive Summary

ADM Associates ("ADM") conducted the Energy Trust of Oregon 2023 Fast Feedback program participant survey from March 2023 to the end of January 2024, which included program participants from January through December 2023. This report summarizes the analysis conducted by ADM and the results of the survey. The purpose of the analyses was to summarize Fast Feedback survey findings by program and quota group.

Residential Survey Summary

Results show very high overall satisfaction ratings for all measures. However, overall satisfaction showed a slight downward trend for all measures except smart thermostats and duct sealing. Customer satisfaction significantly decreased for the central air conditioners, and advanced heat pump controls measures in 2023. *Table ES-1* shows mean overall program satisfaction for each of two types of quota groups.[1] "Exclusive" quota groups are based on state (Oregon or Washington), and, within Oregon, type of measure installed; each respondent appears in only one of these quota groups. "Cross-cutting" quota groups are based on features that are independent of the exclusive quota group; a respondent may appear in more than one of these quota groups.

The overall program influence on purchase decisions was high for all quota groups except for the smart thermostats and gas fireplaces measures.[2] Factors influencing the purchase decision varied somewhat by measure type, but energy efficiency rating was the most commonly identified influencer (6 out of 16 quota groups; six out of seven measures for which energy efficiency rating of the equipment was an applicable factor). For these measures, contractor was the second most influential factor. For measures for which energy efficiency rating was not relevant, contractor remained the most influential factor in customers' decision making in 2023 similar to 2022.

Among participants who used a contractor, by far the most consistently identified way participants found that contractor was by word of mouth followed by web searches.

[1] For both residential and nonresidential surveys, satisfaction was defined as a rating of 4 or 5 on a scale from 1 (not at all satisfied) to 5 (very satisfied). "Don't know" and "no response" were excluded from the denominators for all analyses to be consistent with previous years.

[2] Influence was defined as a rating of 4 or 5 on a scale from 1 (did not have any influence) to 5 (had a great influence). "Don't know" and "no response" were excluded from the denominators for all analyses. For each respondent, "overall influence" rating was equal to the highest influence rating that respondent provided for all factors reflecting Energy Trust influence. See Section 1.1 for more details.

Table ES-1: Summary of Residential Overall Satisfaction and Program Influence

Quota Group	Number of Survey Respondents	Overall Satisfaction	Overall Influence
Exclusive Quota Groups			
Residential - Oregon	680	93%	89%
Smart Thermostats	64	96%	71%
Heat Pump Advanced Controls	60	88%	80%
Ceiling Insulation	60	94%	95%
Other Insulation	61	90%	85%
Ducted Heat Pumps	66	92%	97%
Ductless Heat Pumps	61	96%	98%
Central Air Conditioner	57	88%	92%
Windows	61	90%	80%
Gas Fireplaces	65	91%	78%
Gas Furnaces	68	96%	99%
Duct Sealing	57	100%	91%
Residential - Washington	176	94%	82%
Cross-Cutting Quota Groups			
Moderate Income Track	63	99%	99%
Rental Properties	59	95%	100%
Manufactured Home Promotions	18	95%	95%

Nonresidential Survey Summary

Results generally show high satisfaction ratings across all facets of program experience for all quota groups. A few groups (e.g., Existing Buildings-Healthcare and Production Efficiency-Agriculture) had somewhat lower mean ratings than others, but the group counts were too low to draw conclusions about such differences: none of the differences were statistically significant. Results were generally similar to 2022 categorically. But satisfaction with overall program experience and program representative significantly went down for Existing Buildings - Healthcare compared to 2022, from 100% and 100% in 2022 to 78% and 86% in 2023 respectively.

The overall program influence was high to very high for all quota groups except for Lighting (Non-DI) quota group which was slightly lower (78%). The small sample sizes argue for using caution in interpreting findings at the individual quota group level for the Production Efficiency program.

For the Existing Building program, services provided at no/low cost appeared to have the highest influence closely followed by Energy Trust-funded technical services. For the Production Efficiency program, Energy Trust-funded technical services had the highest influence followed by the vendor or installation contractor and Energy Trust incentive. Some other influencers stood out somewhat in particular tracks within particular programs but did not appear to have consistently high influence across programs and tracks.

Table ES-2 and Table ES-3 show mean overall program influence and satisfaction for each program and quota group. Again, each respondent appears in only one “exclusive” quota group but may appear in multiple cross-cutting quota groups.

Table ES-2: Summary of Nonresidential Overall Program Influence and Satisfaction: Existing Buildings

Quota Group	Number of Survey Respondents	Satisfaction		Overall Influence
		Overall Program Experience	Program Representative	
Exclusive Quota Groups				
Existing Buildings - Oregon Incentives	403	94%	94%	98%
Existing Buildings - Assembly/Religious	42	93%	90%	95%
Existing Buildings - Education	27	93%	96%	85%
Existing Buildings - Healthcare	23	78%	86%	91%
Existing Buildings - Office	34	97%	93%	97%
Existing Buildings - Other Commercial	56	98%	98%	96%
Existing Buildings - Restaurant	33	97%	100%	97%
Existing Buildings - Retail	64	95%	95%	97%
Existing Buildings - Warehouse	25	96%	90%	92%
Multifamily	99	94%	93%	85%
Commercial Solar	36	91%	87%	94%
Cross-Cutting Quota Groups				
Direct Install (DI)	180	94%	95%	98%
Lighting (Non-DI)	63	95%	93%	78%
Small and Medium Business	99	94%	93%	85%
Small Multifamily	57	92%	91%	86%

Table ES-3: Summary of Nonresidential Overall Program Influence and Satisfaction: Production Efficiency

Quota Group	Number of Survey Respondents	Satisfaction		Overall Influence
		Overall Program Experience	Program Representative	
Exclusive Quota Groups				
Production Efficiency	76	95%	89%	95%
Production Efficiency - Agriculture	6	83%	67%	80%
Production Efficiency - Compressed air	2	100%	100%	100%
Production Efficiency - HVAC and controls	4	100%	100%	100%
Production Efficiency - Lighting	47	94%	90%	96%
Production Efficiency - Other industrial mea	6	100%	83%	100%
Production Efficiency - Pumps and Motors	11	100%	100%	82%
Production Efficiency - Refrigeration	0	n/a	n/a	n/a
Cross-Cutting Quota Groups				
Custom Projects	11	100%	87%	100%
Standard Projects	18	92%	89%	85%
Agriculture Sector	40	94%	97%	94%
Food & Beverage Sector	12	93%	85%	86%
High Tech Sector	4	100%	100%	100%
Metals Sector	0	n/a	n/a	n/a
Wood & Paper Sector	4	100%	100%	100%

1 Introduction

Energy Trust has been using a monthly Fast Feedback survey since 2010 to assess free-ridership, satisfaction, and selected other aspects of program experiences in samples of customers who participated in Energy Trust residential and nonresidential programs in the prior month.

ADM Associates ("ADM") conducted the 2023 Energy Trust Energy Trust Fast Feedback program participant satisfaction survey from March 2023 through January 2024, covering customers who participated in Energy Trust programs from January through December 2023. In 2023, Energy Trust set a goal of achieving 10% relative precision at 90% confidence (90/10 precision) for satisfaction and influence results at the program level on a quarterly basis and for individual quota groups on an annual basis.

Quota groups are defined somewhat differently for the residential and nonresidential surveys. The residential survey has two types of quota groups. The first is based primarily on the type of measure the participant installed, but also includes a quota group for all residential participants from Washington. We refer to these as the "exclusive" quota groups. For the first time in 2023, Residential Solar information is collected by a different survey instrument called Guild Quality that is administered by the Renewables program and hence it is no longer included in the Fast Feedback survey.

The second type of residential quota group is based on characteristics that may or may not apply to a project that are independent of the type of measure or location of the participant. We refer to these as "cross-cutting" quota groups. Thus, for example, someone may have received incentives for a variety of measures through the program's "Moderate Income" track or the "Manufactured Home Promotions" track. Table 1 shows the quota groups and indicates which cross-cutting quota groups apply to which exclusive quota groups.

Table 1: Residential Survey Quota Groups

Exclusive Quota Groups	Cross-Cutting Quota Groups		
	Moderate Income Track	Rental Properties	Manufactured Home Promotions
Smart Thermostats	✓		
Heat Pump Advanced Controls			
Ceiling Insulation	✓	✓	
Other Insulation	✓	✓	
Ducted Heat Pumps	✓	✓	✓
Ductless Heat Pumps	✓	✓	✓
Central Air Conditioner	✓		
Windows			
Gas Fireplaces			
Gas Furnaces	✓	✓	
Duct Sealing			
Residential Washington		✓	

The nonresidential survey also has separate sets of quota groups for each of the two programs (Existing Buildings and Production Efficiency). Existing Buildings and Production Efficiency have both exclusive quota groups and cross-cutting quota groups.

For Existing Buildings, the exclusive quota groups are based primarily on building end-use or business type but also include quota for participants with commercial solar projects. The four Existing Buildings cross-cutting quota groups are related to measure implementation, a combination of measure type (lighting) and implementation or building type. For Production Efficiency, the exclusive quota groups are based primarily on application end-use or measure type. The seven Production Efficiency cross-cutting quotas are related to project track or market sub-sector. Table 2 shows the nonresidential survey quota groups.

Table 2: Nonresidential Survey Quota Groups

Existing Buildings Program	Production Efficiency Program
Exclusive Quota Groups	
Assembly/Religious Education Healthcare Office Other Commercial Restaurant Retail Warehouse Multifamily Commercial Solar	Agriculture Compressed air HVAC and controls Lighting Other industrial measures Pumps and Motors Refrigeration
Cross-Cutting Quota Groups	
Direct Install (DI) Lighting (Non-DI) Small and Medium Business Small Multifamily	Custom Projects Standard Projects Agriculture Sector Food & Beverage Sector High Tech Sector Metals Sector Wood & Paper Sector

This report describes the Fast Feedback survey methods and the results for each quota group. The remainder of this report is divided into the following sections.

Section Two provides a brief explanation of the survey's implementation, information on contact information availability, a summary of survey responses by sector and group, and a description of how ADM weighted the combined data to control for possible mode and sampling effects.

Sections Three and Four present the Fast Feedback summary findings for the residential and nonresidential sectors. They are subdivided by survey topic and include assessment of satisfaction and influence ratings by time (program year) by quota groups.

Finally, Section Five presents our conclusions from the Fast Feedback data collection.

2 Methods and Survey Response

This section describes the survey modes and experimental conditions, the availability of contact information and the number of survey responses by sector and group, and the method for weighting the combined data to control for possible mode effects.

2.1 Sample Development

Each month, Energy Trust Evaluation staff provided ADM with a dataset of recent survey-eligible residential and non-residential participants. ADM carried out similar data cleaning and sampling procedures for both the residential and nonresidential data sets. ADM used an Excel workbook tool that cleaned and deduplicated data sets and then used a weighted randomization process to select participants for the sample. The workbook tool accomplished this while keeping the original data set received from Energy Trust intact, rather than deleting records or splitting files, which may introduce error.

The tool first flagged as ineligible for selection any records identified as "do not contact" or as having been surveyed recently (defined as in the past year for residential records and in the past six months for nonresidential records).

The tool then identified each unique participant, where "unique participant" is any participant that does not match another record on the unique Contact ID or Project ID fields or on any combination of name and any phone number or email address. The tool used a combination of name, phone number, and email to identify a unique participant, as any given field may have different information in two or more records, but the totality of information given indicates a common participant – e.g., two records may give different names but the same mobile phone number or email address. On the other hand, two individuals may have the same name or even the same email address.[3] The tool created a new ID number for each unique participant and applied that ID number to all instances of that participant.

If a given unique participant had multiple records, the tool selected one record for inclusion in the sample frame using a weighted random number. The weight was based on each quota group's frequency relative to the target number of completions needed for that group. Those that appeared with the least relative frequency relative had the highest weights. Adding the random element prevented a less-frequent quota group from always having a higher weight – and, therefore, always being selected – than one with greater frequency.

Once a record was selected for each unique, eligible participant, the tool used a separate random number to order all records selected into the sample frame. Finally, the tool selected records until there were at least five records for each quota group (including cross-cutting quota groups) for each targeted completion, or a census of records in cases with fewer than five records.

[3] Some email addresses are not unique to an individual. For example, some companies may have an "info" or "sales" email address that may be accessed or used by multiple individuals.

2.2 Survey Fielding

ADM administered the residential survey first on the web, with follow-up phone calls to non-respondents. At the beginning of the monthly survey, ADM sent a recruitment email to all sampled residential participants with a valid email address. The email included a short recruitment message with a survey web link. The recruitment email offered all residential participants a $10 gift card for completing the survey. ADM sent reminder emails to non-respondents approximately one week after the initial contact. Residential participants that did not respond to the survey within approximately one week after the reminder were then queued for phone follow-up. Customers who did not have a valid email address on file were immediately advanced to the phone survey.

ADM administered the nonresidential survey somewhat differently from the residential survey. In previous years, the nonresidential survey had been administered as a phone-only survey. However, when contacted for the survey, some nonresidential participants asked to be sent a link to the survey to complete it online. In the end, relatively few participants completed the survey online, but to accommodate those who preferred taking the survey online, we changed the survey to include email recruitment with online completion. Unlike the residential survey, however, we launched the email recruitment only a few days before starting the phone survey. The email recruitment indicated that we would follow up by phone within the next few days. We tracked online completions and updated the call lists regularly to minimize phone contacts to those who completed the survey online.

2.3 Availability of Contact Information

Table 3 shows the percentages of all residential and nonresidential program participants with phone and email contact information. In the residential and nonresidential sectors, participants were somewhat more likely to have phone than email information. But in the nonresidential sector there was less difference in the availability of phone versus email information. All participants had at least some type of contact information.

Table 3. Availability of Contact Information by Sector and Type

Type of Information	Residential Sector (*n* =11,531)	Nonresidential Sector (*n* = 2,596)
Phone	96%	99%
Email	78%	96%
Both	75%	95%
Either	100%	100%

2.4 Number of Respondents

Table 4 shows the total number of residential survey responses by quota group. ADM completed 856 residential surveys in 2023. Residential responses met or exceeded 12-month quotas for six of the 11 measure groups. They fell short of the three cross-cutting goals, particularly for Manufactured Home

Promotions for which only 18 survey response is completed compared to the goal of 62. Overall, the survey fell short of about half quotas (8 out of 15).

ADM made multiple contact attempts with all available participants in these quota groups.

The overall residential survey response rate was 30%. The response rate for those contacted by email with phone follow up (the large majority of respondents) was 30%, and the response rate for those contacted only by phone was 24%. The overall and phone-only response rates represented increases compared to the 2022 percentages of 28% and 16%, respectively. Seventy percent of surveys were completed online and 30% by phone. The comparable split in 2022 was 81% online and 19% by phone.

Table 4. Number of Residential Responses by Mode and Quota Group

Measure Group	Web	Phone	Total	12-Month Quota
Oregon Incentives (Exclusive Quotas)				
Smart Thermostats	46	18	64	66
Heat Pump Advanced Controls	33	27	60	60
Ceiling Insulation	50	10	60	66
Other Insulation	52	9	61	60
Ducted Heat Pumps	53	13	66	66
Ductless Heat Pumps	43	18	61	64
Central Air Conditioner	32	25	57	62
Windows	49	12	61	68
Gas Fireplaces	53	12	65	64
Gas Furnaces	38	30	68	64
Duct Sealing	23	34	57	56
Subtotal: Oregon Incentives	**472**	**208**	**680**	**696**
Residential WA (Exclusive Quota)				
Residential - Washington	129	47	176	176
Cross-Cutting Quotas				
Moderate Income Track	43	20	63	64
Rental Properties	26	33	59	62
Manufactured Home Promotions	14	4	18	62
Program Total[1]	**601**	**255**	**856**	**872**

[1] The Program Total includes both Oregon and Washington. The Moderate Income Track applies to both Oregon and Washington projects, while the other cross-cutting quotas apply only to Oregon projects.

Table 5 shows the number of nonresidential survey responses by quota group. As with the previous year, low participation made the nonresidential survey a challenge. Despite ADM's having made multiple contact attempts with all available participants in these quota groups and achieving an overall nonresidential survey response rate of 32% (significantly decreased compared to 41% in 2022 and 55% in 2021). The survey fell short in 4 out of 10 quota groups for Existing Buildings and 12 out of 14 quota groups

for Production Efficiency.[4] Overall, Existing Buildings exceeded the total 12-month quota (437 vs. 356) and Production Efficiency only met about 50% of the 12-month quota (76 vs 152) as industrial customers are historically and commonly harder to reach.

Table 5. Number of Nonresidential Responses by Quota Group

Measure Group	Web	Phone	Total	12-Month Quota
Existing Buildings				
Oregon Incentives (Exclusive Quotas)				
Assembly/Religious	32	10	42	26
Education	14	13	27	28
Healthcare	15	7	22	20
Office	20	14	34	32
Other Commercial	35	21	56	44
Restaurant	15	17	32	42
Retail	31	33	64	40
Warehouse	11	14	25	28
Multifamily	42	57	99	50
Subtotal: Building Type Quotas	**215**	**186**	**401**	**310**
Commercial Solar (Exclusive Quota)				
Commercial Solar	21	15	36	42
Cross-Cutting Quotas				
Direct Install (DI)	117	62	179	48
Lighting (Non-DI)	25	38	63	60
Small and Medium Business	42	57	99	42
Small MF	18	39	57	46
Total: Existing Buildings	**236**	**201**	**437**	**356**
Production Efficiency				
Agriculture	3	3	6	26
Compressed air	2	0	2	14
HVAC and controls	1	3	4	20
Lighting	22	25	47	32
Other industrial measures	3	3	6	28
Pumps and Motors	1	10	11	22
Refrigeration	0	0	0	10

[4] Production Efficiency quotas were especially difficult to reach, as changes made in Energy Trust's internal data systems resulted in samples that were limited for much of the year.

Measure Group	Web	Phone	Total	12-Month Quota
Cross-Cutting Quotas				
Custom projects	6	5	11	22
Standard projects	4	14	18	36
Agriculture sector	13	27	40	34
Food & beverage sector	4	8	12	20
High tech sector	1	3	4	12
Metals sector	0	0	0	8
Wood & paper sector	4	0	4	18
Total: Production Efficiency	**32**	**44**	**76**	**152**

2.5 Language of Survey and Language Barriers

All surveys were offered in English and Spanish. All completed residential surveys and all but one completed nonresidential survey (Existing Buildings-Retail) were done in English. We encountered no instances of language barriers in either sector.

2.6 Creation and Application of Data Weights

ADM applied three types of weights to survey data:

- For both the residential and nonresidential surveys, in any analyses performed across quota groups, we applied quota group weights to ensure that program-level results are representative of the respective participant populations. This is necessary because – in both the residential and nonresidential sectors – attaining the completion quotas for the various quota groups results in overall samples that are not representative of the project population as a whole.
- For just the residential survey, we applied survey mode weights is to control for any possible survey mode effects that might arise from differences in the likelihood that a residential participant would complete the phone or web survey as a result of the different recruitment methods.
- For each quota group, ADM created a Quota Group weight that was equal to that group's share of the program population divided by that group's share of the survey completions for that program, or:

(Equation 1)

$$\frac{\textit{Quota group \% of population}}{\textit{Quota group \% of survey completions}}$$

This assigns greater weight to observations for which the completions under-represent the population, and less weight to observations for which the completions over-represent the population.

Some analyses were performed just on respondents within a given cross-cutting quota group. Such participants were not distributed uniformly across the various measure-level, or exclusive, quota groups.

Therefore, for those analyses, we calculated and applied a separate set of Quota Group weights for each cross-cutting quota group.

Survey results are reported separately for each program. Therefore, we calculated Quota Group weights separately for each program in both the residential and nonresidential sectors. In the residential sector, Residential – Oregon and Residential – Washington are considered separate programs for the purpose of creating weights. Thus, the weights for the various quota groups within Residential - Oregon are based on the distribution of the sample and the population across just those groups. Since Residential – Washington has only one quota group, its Quota Group weight is by definition 1.0.

In the nonresidential sector, we calculated Quota Group weights separately for Existing Buildings - Oregon, Commercial Solar, and Production Efficiency. Again, as Commercial Solar is considered to be one quota group, its Quota Group weight is by definition 1.0.

For the residential survey, ADM created Mode weights based on both the mode of recruitment and the mode of survey completion. Recall that participants with available email contact information were in an email-first-then-phone ("email-phone") recruitment condition. Participants with no available email information were in a phone-only recruitment condition. The two recruitment modes did not correspond to two separate modes of survey completion: someone in the phone-only recruitment condition could complete the survey only by phone, but someone in the email-phone condition could complete the survey by phone or email.

The above arrangement complicates the creation of the weights. If it were simply a matter of weighting by recruitment mode, then the weight would be equal to the overall survey response rate divided by the response rate for that recruitment mode, or:

(Equation 2)

$$\frac{\textit{Overall response rate}}{\textit{Recruitment mode response rate}}$$

This assigns greater weight to observations recruited through the mode with the lower response rate (in this case, phone-only), and less weight to those recruited through the mode with the greater response rate (in this case, email-phone).

This, however, does not completely control for mode differences, as it would assign the same weight to all individuals in the email-phone recruitment condition regardless of whether they completed the survey by phone or web. We therefore calculated a second weight to adjust for the respective probabilities of completing the phone or web survey, given the email-phone recruitment. For each survey completion mode, we calculated the weight as:

(Equation 3)

$$\frac{\textit{Overall email-phone response rate / 2}}{\textit{Percentage of completions from email-phone recruitment}}$$

The overall response rate divided by two represents the mean response rate for each mode, where the denominator is all completions from the email-phone recruitment condition. We then multiplied this second weight by the overall recruitment mode weight (Equation 2) to generate a final Mode weight for

each survey completion mode in the email-phone recruitment condition. For respondents in the phone-only recruitment condition, the Mode weight was equal to the recruitment mode weight (Equation 2).

ADM weighted each residential survey response with the product of the Quota Group weight and the Mode weight. ADM weighted nonresidential survey responses only by the Quota Group weight.

Unless otherwise specified, all residential and nonresidential results reported below are based on analyses with weighted data.

3 Residential Survey Results

The following subsections provide information on the demographics and program experience of residential survey participants.

3.1 Residential Demographics

We excluded "don't know" and "refused" from the denominator for all percentages for residential demographic characteristics to facilitate comparison with Census data.

Due to an undetected programming error the ownership condition of the respondent (rent/own) was not recorded in the survey for January through June participants. Residential respondents were largely the occupants of the property where the participation occurred, nearly all of whom were the owners.[5] The majority of those who were not occupants were the landlord (Table 6).

Table 6: Occupancy of Home Where Participation Occurred, Residential Respondents

Response	Residential Oregon	Residential Washington	Oregon (US Census)	2022 Customer Awareness and Participation Study[1]
Occupancy[2]				
	(n = 678)	(n = 175)	n/a[2]	(n = 1,641)
Occupant	87%	98%	n/a	100%
Not occupant	13%	2%		0%
Ownership (Occupants)				
	(n = 610)	(n = 172)	n/a[3]	(n = 1,635)
Own	99%	98%	64%	67%
Rent, other	1%	2%	36%	31%
Relationship to Premise (Non-Occupants)				
	(n = 55)	(n = 2)	n/a[2]	n/a[2]
Landlord	96%	100%	n/a	n/a
Property manager	4%	0%		

[1] https://www.energytrust.org/wp-content/uploads/2023/04/Energy-Trust-of-Oregon_CAP-Study-Report-2022_Final-wSR.pdf.
[2] No comparable data are available. The Census data on occupancy status of dwellings are not an appropriate comparison for survey occupancy status. The former is based on whether or not a dwelling is occupied. The latter is based on whether respondents occupy or do not occupy a specific dwelling that was treated through Energy Trust programs. The "not occupant" percentage is *not* the percentage of dwellings that are not occupied but the percentage of survey respondents that do not occupy the treated dwelling. The latter includes owners who rent to someone else, and so it includes occupied dwellings.
[3] Ownership percentages are based on US Census Table DP04, 2021 5-year (most recent) estimates.

[5] We exclude "don't know" and "refused" from the denominator for all residential characteristics percentages to facilitate comparison with Census data.

The distribution of self-identified race and ethnicity was similar across Oregon and Washington and the various quota groups, with majority (>86%) of respondents reporting White race (Table 7 through Table 11). Reported income level was skewed toward higher incomes. The most commonly reported age bracket was 65 and older and the most commonly reported size of household was three individuals.

Table 7: Demographics of Residential Respondents[1]

Demographic Characteristic	Residential Oregon	Residential Washington	Oregon (US Census)[2]
Race/Ethnicity[3]			
	(n = 612)	(n = 159)	n/a
Asian only	3%	4%	4%
Black only	2%	0%	2%
Hispanic/Latino, any race	2%	1%	14%
Native American only	1%	0%	1%
Other only	1%	1%	<1%
Two or more	5%	5%	5%
Persons of color – total	14%	11%	14%
White only	86%	89%	86%
Income			
	(n = 427)	(n = 114)	n/a
Under $30k	7%	0%	18%
$30k to under $50k	12%	12%	14%
$50k to under $70k	17%	12%	13%
$70k to under $100k	21%	23%	17%
$100k to under $200k	32%	36%	8%
$200k+	11%	17%	10%
Age (Years)			
	(n = 679)	(n = 175)	n/a
Less than 18	0%	0%	19%
18 to 24	0%	0%	
25 to 34	7%	5%	
35 to 44	17%	14%	18%
45 to 54	14%	14%	17%
55 to 64	17%	25%	18%
65 or older	45%	41%	28%
Household Size (Number of People in Household)			
	(n = 666)	(n = 171)	n/a
One	3%	1%	27%
Two	20%	14%	37%
Three	47%	47%	15%
Four	15%	16%	12%
Five	11%	16%	5%
Six or more	5%	5%	3%

[1]Denominators for percentages exclude nonrespondents. [2]We used the 2022 American Community Survey tables DP05 (race/ethnicity), S1901 (Income), S2502 (Age), and B25009 (Household Size). For Census brackets that overlap the Fast Feedback brackets, we allocated the percentages within those brackets proportionally to the Fast Feedback brackets. [3] Native American includes Alaska Native; Asian includes Asian Indian, Hawaiian, and Other Pacific Islanders.

Table 8: Race or Ethnicity by Residential Quota Group

Quota Group	Asian or Asian Indian Only	Black or African American Only	Hispanic, Latino, or Spanish Only	Native American or Alaska Native Only	Other Only	Two or more	White or European Only	Persons of Color - Total
Oregon Incentives (Exclusive Quotas)								
Overall (n = 562)	2%	2%	3%	1%	1%	4%	88%	12%
Smart Thermostats (n = 58)	6%	0%	7%	4%	0%	5%	78%	22%
Heat Pump Advanced Controls (n = 52)	0%	0%	6%	0%	0%	0%	94%	6%
Ceiling Insulation (n = 54)	0%	4%	0%	1%	1%	9%	84%	16%
Other Insulation (n = 55)	2%	0%	2%	0%	2%	8%	87%	13%
Ducted Heat Pumps (n = 60)	1%	1%	4%	0%	0%	5%	88%	12%
Ductless Heat Pumps (n = 55)	3%	5%	4%	0%	0%	1%	87%	13%
Central Air Conditioner (n = 49)	1%	4%	1%	0%	0%	1%	93%	7%
Windows (n = 58)	6%	0%	0%	4%	4%	4%	82%	18%
Gas Fireplaces (n = 61)	0%	0%	0%	0%	0%	2%	98%	2%
Gas Furnaces (n = 61)	1%	3%	3%	0%	0%	4%	89%	11%
Residential WA (Exclusive Quota)								
Residential - Washington (n = 159)	4%	0%	1%	0%	1%	5%	89%	11%
Cross-Cutting Quotas								
Moderate Income Track (n = 57)	1%	0%	3%	0%	0%	6%	90%	10%
Rental Properties (n = 51)	1%	5%	1%	1%	0%	2%	89%	11%
Manufactured Home Promotions (n = 16)	0%	0%	18%	0%	0%	5%	76%	24%
Oregon Population								
US Census	4%	2%	14%	1%	<1%	5%	86%	14%

Table 9: Income by Residential Quota Group

Quota Group	Under $30k	$30k to <$50k	$50k to <$70k	$70k to <$100k	$100k to <$200k	At Least $200k
Oregon Incentives (Exclusive Quotas)						
Oregon Overall (n = 397)	5%	12%	16%	23%	32%	12%
Smart Thermostats (n = 42)	2%	15%	7%	27%	33%	17%
Heat Pump Advanced Controls (n = 28)	5%	30%	8%	25%	27%	5%
Ceiling Insulation (n = 42)	2%	4%	23%	27%	35%	8%
Other Insulation (n = 42)	0%	2%	19%	21%	40%	19%
Ducted Heat Pumps (n = 50)	12%	18%	17%	28%	18%	7%
Ductless Heat Pumps (n = 37)	9%	20%	14%	11%	45%	0%
Central Air Conditioner (n = 22)	0%	4%	11%	36%	29%	21%
Windows (n = 46)	4%	11%	11%	13%	47%	13%
Gas Fireplaces (n = 46)	2%	7%	16%	16%	41%	18%
Gas Furnaces (n = 42)	13%	10%	28%	28%	5%	16%
Residential WA (Exclusive Quota)						
Residential - Washington (n = 114)	0%	12%	12%	23%	36%	17%
Cross-Cutting Quotas						
Moderate Income Track (n = 43)	22%	16%	45%	23%	13%	0%
Rental Properties (n = 31)	5%	3%	28%	40%	21%	32%
Manufactured Home Promotions (n = 13)	61%	33%	11%	11%	43%	0%
US Census						
US Census	18%	14%	13%	17%	8%	10%

Table 10: Age (Years) by Residential Quota Group

Quota Group	Less than 18	18 to 24	25 to 34	35 to 44	45 to 54	55 to 64	At Least 65
Oregon Incentives (Exclusive Quotas)							
Oregon Overall (n = 622)	0%	0%	8%	14%	15%	19%	44%
Smart Thermostats (n = 64)	0%	0%	18%	21%	16%	25%	19%
Heat Pump Advanced Controls (n = 60)	0%	0%	13%	4%	14%	6%	62%
Ceiling Insulation (n = 60)	0%	0%	12%	23%	16%	11%	39%
Other Insulation (n = 61)	0%	0%	10%	22%	14%	22%	31%
Ducted Heat Pumps (n = 65)	0%	0%	1%	12%	15%	20%	53%
Ductless Heat Pumps (n = 61)	0%	0%	9%	13%	10%	25%	43%
Central Air Conditioner (n = 57)	0%	0%	7%	9%	14%	21%	49%
Windows (n = 61)	0%	0%	9%	28%	12%	6%	45%
Gas Fireplaces (n = 65)	0%	0%	1%	14%	17%	22%	47%
Gas Furnaces (n = 68)	0%	0%	1%	7%	17%	27%	49%
Residential WA (Exclusive Quota)							
Residential - Washington (n = 175)	0%	0%	5%	14%	14%	25%	41%
Cross-Cutting Quotas							
Moderate Income Track (n = 63)	0%	0%	1%	6%	9%	23%	61%
Rental Properties (n = 59)	0%	0%	4%	9%	20%	25%	42%
Manufactured Home Promotions (n = 18)	0%	0%	0%	4%	27%	25%	44%
Oregon Population							
US Census	19%			18%	17%	18%	28%

Table 11: Household Size (Number of Members) by Residential Quota Group

Quota Group	One	Two	Three	Four	Five	At Least Six
Oregon Overall (n = 598)	2%	17%	39%	11%	8%	3%
Smart Thermostats (n = 62)	0%	0%	0%	0%	0%	0%
Heat Pump Advanced Controls (n = 58)	0%	0%	0%	0%	0%	0%
Ceiling Insulation (n = 58)	4%	20%	43%	20%	14%	1%
Other Insulation (n = 60)	7%	18%	53%	12%	9%	1%
Ducted Heat Pumps (n = 64)	1%	19%	47%	16%	13%	4%
Ductless Heat Pumps (n = 60)	9%	37%	37%	14%	1%	1%
Central Air Conditioner (n = 53)	1%	16%	58%	10%	14%	3%
Windows (n = 57)	0%	16%	55%	15%	13%	9%
Gas Fireplaces (n = 62)	0%	22%	66%	8%	4%	1%
Gas Furnaces (n = 64)	3%	23%	45%	14%	13%	9%
Residential WA (Exclusive Quota)						
Residential - Washington (n = 170)	1%	14%	47%	16%	16%	5%
Cross-Cutting Quotas						
Moderate Income Track (n = 60)	0%	0%	0%	0%	0%	0%
Rental Properties (n = 56)	15%	27%	41%	22%	16%	7%
Manufactured Home Promotions (n = 18)	6%	59%	23%	47%	6%	0%
Oregon Population						
US Census	27%	37%	15%	12%	5%	3%

3.2 Residential Program Experience by Quota Group

We excluded "don't know" and "refused" responses from the calculation of all satisfaction and influence percentages. Results show high overall program satisfaction and moderately high to high program influence for all measures (Table 12).[6,7]

Table 12: Residential Program Overall Satisfaction and Influence, by Quota Group

Quota Group	Satisfaction with Overall Experience		Overall Program Influence	
	n	%	*n*	%
Oregon Incentives (Exclusive Quotas)				
Smart Thermostats	62	96%	63	71%
Heat Pump Advanced Controls	49	88%	59	80%
Ceiling Insulation	58	94%	60	95%
Other Insulation	54	90%	60	85%
Ducted Heat Pumps	60	92%	66	97%
Ductless Heat Pumps	52	96%	59	98%
Central Air Conditioner	51	88%	57	92%
Windows	56	90%	61	80%
Gas Fireplaces	63	91%	65	78%
Gas Furnaces	60	96%	68	99%
Duct Sealing	49	100%	57	91%
Residential Oregon & Residential Washington (Exclusive Quotas)				
Residential - Oregon	614	93%	675	89%
Residential - Washington	147	94%	175	82%
Cross-Cutting Quotas				
Moderate Income Track	54	99%	62	99%
Rental Properties	52	95%	58	100%
Manufactured Home Promotions	16	95%	17	95%

The following subsections show results for key survey variables, separately for each quota group as well as for the participants comprising the cross-cutting quotas (moderate income track, rental properties, and manufactured home promotions). For the various subgroups, the sample counts for both satisfaction and

[6] Satisfaction was defined as a rating of 4 or 5 on a scale from 1 (not at all satisfied) to 5 (very satisfied). "Don't know" and "no response" were excluded from the denominators for all analyses to be consistent with previous years.

[7] Influence was defined as a rating of 4 or 5 on a scale from 1 (did not have any influence) to 5 (had a great influence). "High" influence = a rating of 4 or 5; "Medium" influence = a rating of 3; "Low" influence = a rating of 1 or 2. For each respondent, we calculated an "overall influence" rating that was equal to the highest influence rating that respondent provided for any of the following rated influence factors: the Energy Trust incentive, information and materials received from Energy Trust, the salesperson or retailer, the respondent's contractor, information received from a solar workshop. It did not include the influence of the equipment's efficiency rating.

influence ratings may vary from the total count of participants in those subgroups and may vary among the satisfaction or influence indices for a given subgroup. This is for two reasons: 1) some satisfaction and influence indices did not apply to some groups and so were not assessed; and 2) we excluded "don't know" and "refused" responses from the percentages, and some respondents gave such responses to some items and not others.

Results show high satisfaction ratings across all facets of program experience for all measures. However, overall satisfaction showed a slight downward trend over time for all measures except smart thermostats and duct sealing that showed a minor increase in overall satisfaction.

The level of influence of various factors on the purchase decision varied somewhat by measure type. As Table 13 shows, contractors tended to have a large amount of influence across all applicable measures, with about two-thirds or more of applicable respondents indicating high influence. The energy efficiency rating was applicable to fewer measures, but more than two-thirds of applicable respondents indicated it had high influence. Energy Trust information or materials appeared to be most influential for heat pump advanced controls, duct sealing, ceiling insulation, and ducted heat pumps, while the Energy Trust incentive appeared to have the greatest influence for insulation, duct sealing, and ducted heat pumps.

Table 13: Residential Measure Influencers: Percentage of Applicable Respondents Indicating High Influence Rating (4 or 5 on 5-Point Scale) [1]

	Energy Trust Incentive	Energy Trust Information or Materials	Salesperson or Retailer	Contractor	Energy Efficiency Rating
Smart Thermostats	53%	62%	51%	n/a	n/a
Heat Pump Adv. Controls	46%	92%	n/a	81%	n/a
Ceiling Insulation	88%	77%	n/a	86%	n/a
Other Insulation	75%	56%	n/a	76%	n/a
Ducted Heat Pumps	71%	69%	n/a	84%	n/a
Ductless Heat Pumps	60%	52%	n/a	77%	90%
Central Air Conditioner	46%	41%	n/a	71%	80%
Windows	41%	44%	n/a	73%	n/a
Gas Fireplaces	47%	58%	n/a	63%	70%
Gas Furnaces	55%	49%	n/a	68%	91%
Duct Sealing	78%	85%	n/a	n/a	n/a

[1]Darker cell shadings indicate higher percentages.

Word of mouth was by far the most consistently identified way of finding a contractor (Table 14). Web searches, Energy Trust website, contractor advertisements, and use of an online referral or rating service (e.g., Yelp or Angi), were also frequently identified for most quota groups.

Table 14: Most Common Sources for Finding Contractors, by Quota Group

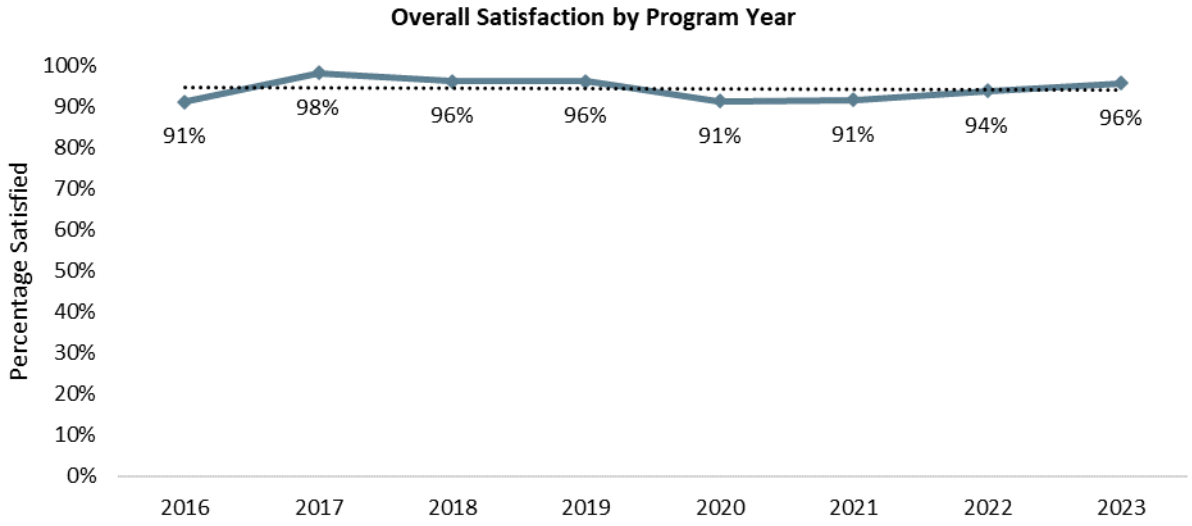
Quota Group	Most Common	Second Most Common	Third Most Common
Heat Pump Advanced Controls	Word of mouth	Web search	Online service
Ceiling Insulation	Web search	Word of mouth	Energy Trust website
Other Insulation	Word of mouth	Web search	Energy Trust website
Ducted Heat Pumps	Word of mouth	Web search	Energy Trust website
Ductless Heat Pumps	Word of mouth	Web search	Advertisement
Central Air Conditioner	Word of mouth	Web search	Online service, Energy Trust website
Windows	Advertisement	Word of mouth	Web search
Gas Fireplaces	Word of mouth	Web search	Online service
Gas Furnaces	Word of mouth	Web search	Advertisement
Residential - Washington	Word of mouth	Web search	Advertisement

3.2.1 Smart Thermostats

Smart thermostat participants (*n* = 62) showed very high levels of satisfaction with all facets of the experience; overall satisfaction is consistent with that in previous years though has gone slightly up since 2021 (Table 15 and accompanying chart).

Table 15: Satisfaction Ratings: Smart Thermostat

Satisfaction	Percent
Overall experience (n = 62)	96%
Performance of new measure (n = 61)	93%
Comfort of home after new measure (n = 61)	91%
Incentive application form (n = 53)	92%
Time it took to receive incentive (n = 54)	89%



The overall program influence on participant purchase decisions was moderate (71%). The Energy Trust information or materials was the most influential factor and salesperson, or retailer had the least influence (51%) as shown in Table 16.

Table 16: Influence Ratings: Smart Thermostats

Influence Level	Overall Influence (n = 63)	Energy Trust Incentive (n = 58)	Energy Trust Information or Materials (n = 24)	Salesperson or Retailer (n = 60)
High	71%	53%	62%	51%
Medium	14%	13%	19%	11%
Low	14%	35%	19%	37%

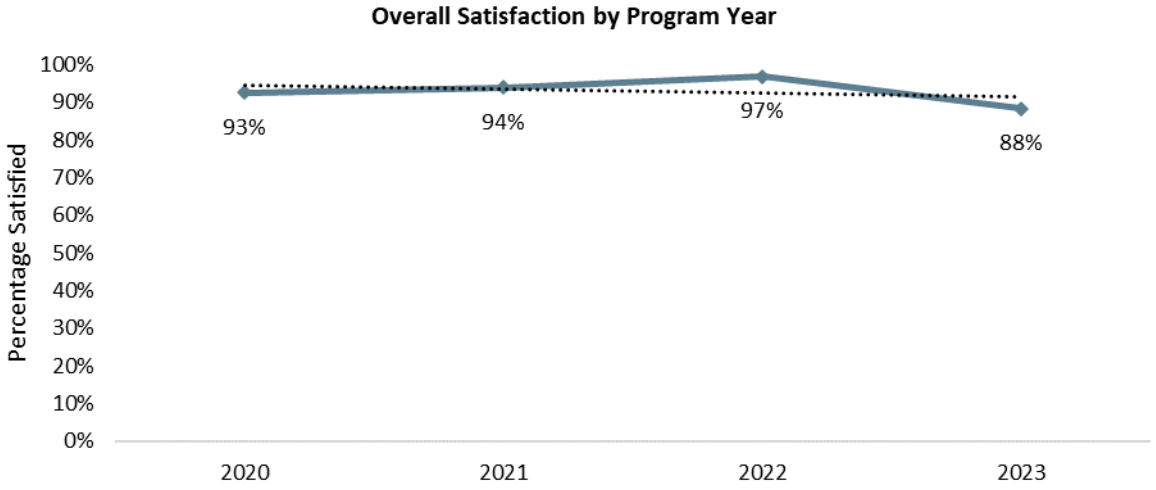
None of the smart thermostat participants used a contractor to install their thermostat.

3.2.2 Heat Pump Advanced Controls

Participants (*n* = 49) showed very high satisfaction with all facets of the experience except for the information about incentives provided by the contractor (Table 17 and accompanying graphic). Overall satisfaction is somewhat down from last year.

Table 17: Satisfaction Ratings: Heat Pump Advanced Controls

Satisfaction	Percent
Measure Satisfaction	
Overall experience (n = 49)	88%
Performance of new measure (n = 57)	93%
Comfort of home after new measure (n = 57)	93%
Incentive application form (n = 22)	97%
Time it took to receive incentive (n = 28)	95%
Contractor Satisfaction	
Overall experience (n = 58)	93%
Quality of installation work (n = 58)	92%
Information about incentives (n = 41)	75%
Communication (n = 58)	88%
Assistance with application (n = 27)	97%



Some open-ended comments may shed some light on the satisfaction levels.

One customer who indicated low satisfaction with the incentive information provided by the contractor indicated a desire for "[b]etter language to explain the qualifications on the website for customers, the website is a little confusing and not that easy to find information. They need to explain how the communication with the contractor and the process is going to go for the incentive and the project overall on the website."

Other customers mentioned that they could be educated more in terms of how the controls work:

- "It would've been good if they had more training on how the equipment worked so that they wouldn't have had to come back and fix the settings."
- "There was no instruction manual provided with the thermostat [heat pump advanced controls], so I don't feel competent in making future temperature adjustments. The contractor very kindly set up the system for winter weather and it seems to be working fine this winter, but it will be necessary for me to change to cooling mode for summer. I will probably be able to make the necessary changes, but I have some anxiety about doing this, and I think a user-friendly instruction manual would be helpful… especially in lessening my anxiety about making any necessary future adjustments to the system. The contractor said that no manual was available either in-hand or on-line, indicating that the system was designed to be used in office settings, so a customer-friendly user manual was not available for homeowners."

The overall program influence on participant purchase decisions was high (80%). Energy Trust information or materials was the most influential factor although respondents are relatively few (n = 11). In contrast and on average, respondents rated Energy Trust incentive as having low influence (46%) for this measure (Table 18). This could also be related to the previously mentioned issue regarding some of the customers' lack of knowledge about the provided incentives.

Table 18: Influence Ratings: Heat Pump Advanced Controls

Influence Level	Overall Influence (n = 59)	Energy Trust Incentive (n = 45)	Energy Trust Information or Materials (n = 11)	Contractor (n = 56)
High	80%	46%	92%	81%
Medium	9%	11%	0%	10%
Low	11%	43%	8%	9%

Respondents most commonly found their contractor through word of mouth (Table 19).

Table 19: Where Respondent Found the Contractor: Heat Pump Advanced Controls

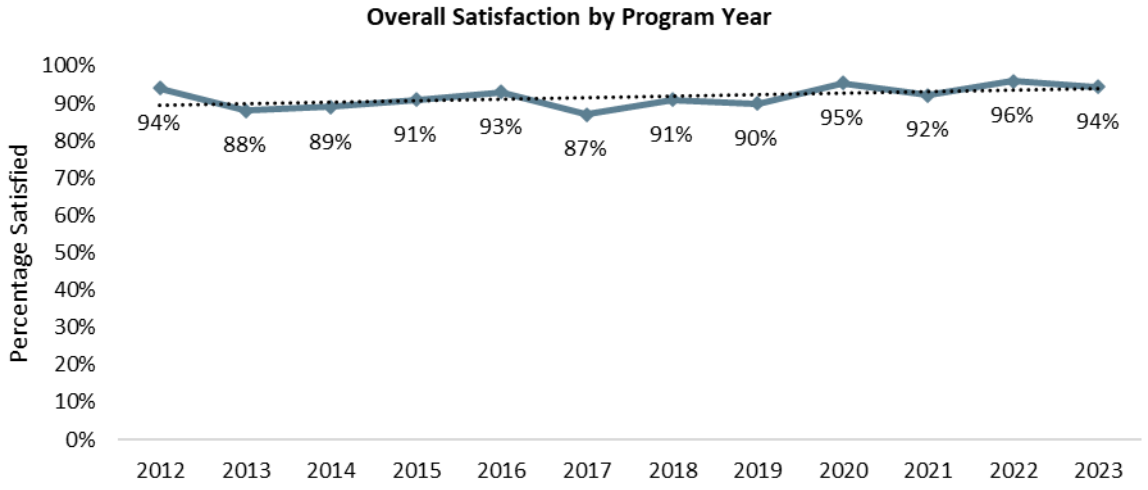
Contractor Source (n = 60)	Percent
Word of mouth	61%
Online service	5%
Web search	20%
Advertisement	5%
Energy Trust website	4%
Energy Trust referral	1%
Not applicable	4%
Don't know	6%
Prefer not to answer	2%

3.2.3 Ceiling Insulation

Ceiling insulation participants (*n* = 58) showed very high levels of satisfaction with all facets of the experience; overall satisfaction is consistent with that in previous years (Table 20 and accompanying chart).

Table 20: Satisfaction Ratings: Ceiling Insulation

Satisfaction	Percent
Measure Satisfaction	
Overall experience (n = 58)	94%
Performance of new measure (n = 53)	92%
Comfort of home after new measure (n = 53)	95%
Incentive application form (n = 43)	98%
Time it took to receive incentive (n = 42)	85%
Contractor Satisfaction	
Overall experience (n = 57)	99%
Quality of installation work (n = 58)	96%
Information about incentives (n = 54)	90%
Communication (n = 57)	95%
Assistance with application (n = 42)	85%



The overall program influence on participant purchase decisions was high (95%). The most influential factor was Energy Trust incentive, closely followed by contractors (Table 21).

Table 21: Influence Ratings: Ceiling Insulation

Influence Level	Overall Influence (n = 60)	Energy Trust Incentive (n = 56)	Energy Trust Information or Materials (n = 37)	Contractor (n = 59)
High	95%	88%	77%	86%
Medium	3%	10%	15%	4%
Low	3%	1%	8%	10%

The most commonly reported way that these respondents found their contractor was web search (Table 22).

Table 22: Where Respondent Found the Contractor: Ceiling Insulation

Contractor Source (n = 60)	Percent
Word of mouth	27%
Online service	9%
Web search	37%
Advertisement	5%
Energy Trust website	21%
Energy Trust referral	0%
Not applicable	5%
Don't know	0%
Prefer not to answer	0%

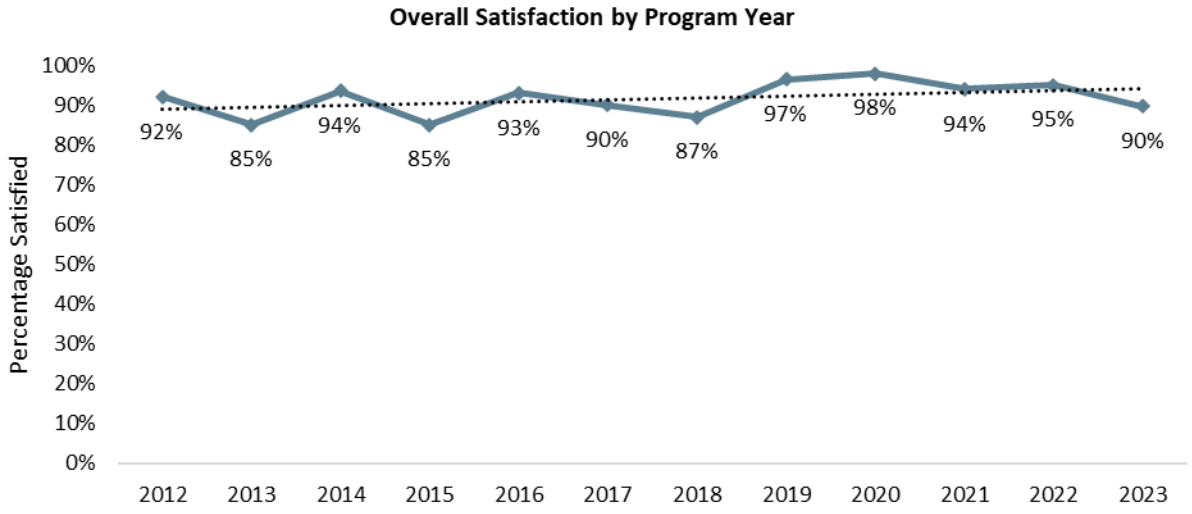
3.2.4 Other Insulation

Other insulation participants (*n* = 54) showed very high levels of satisfaction with all facets of the experience; overall satisfaction while still high went slightly down compared to the last few years (Table 23 and accompanying chart).[8]

[8] "Other insulation" consists of wall insulation and floor insulation. Before 2020, the survey assessed satisfaction for each of these separately. To provide a point of comparison for 2020 and this year, we took the mean of the overall satisfaction ratings for wall insulation and floor insulation for the previous years.

Table 23: Satisfaction Ratings: Other Insulation

Satisfaction	Percent
Measure Satisfaction	
Overall experience (n = 54)	90%
Performance of new measure (n = 56)	93%
Comfort of home after new measure (n = 55)	97%
Incentive application form (n = 45)	88%
Time it took to receive incentive (n = 47)	81%
Contractor Satisfaction	
Overall experience (n = 55)	91%
Quality of installation work (n = 54)	94%
Information about incentives (n = 53)	89%
Communication (n = 55)	90%
Assistance with application (n = 43)	91%



The overall program influence on participant purchase decisions was high (85%). Contractors and the Energy Trust incentive had the greatest influence (Table 24).

Table 24: Influence Ratings: Other Insulation

Influence Level	Overall Influence (n = 60)	Energy Trust Incentive (n = 58)	Energy Trust Information or Materials (n = 41)	Contractor (n = 65)
High	85%	75%	56%	76%
Medium	13%	23%	26%	17%
Low	1%	3%	18%	7%

Respondents most commonly reported finding their contractor through word of mouth, followed by web search (Table 25).

Table 25: Where Respondent Found the Contractor: Other Insulation

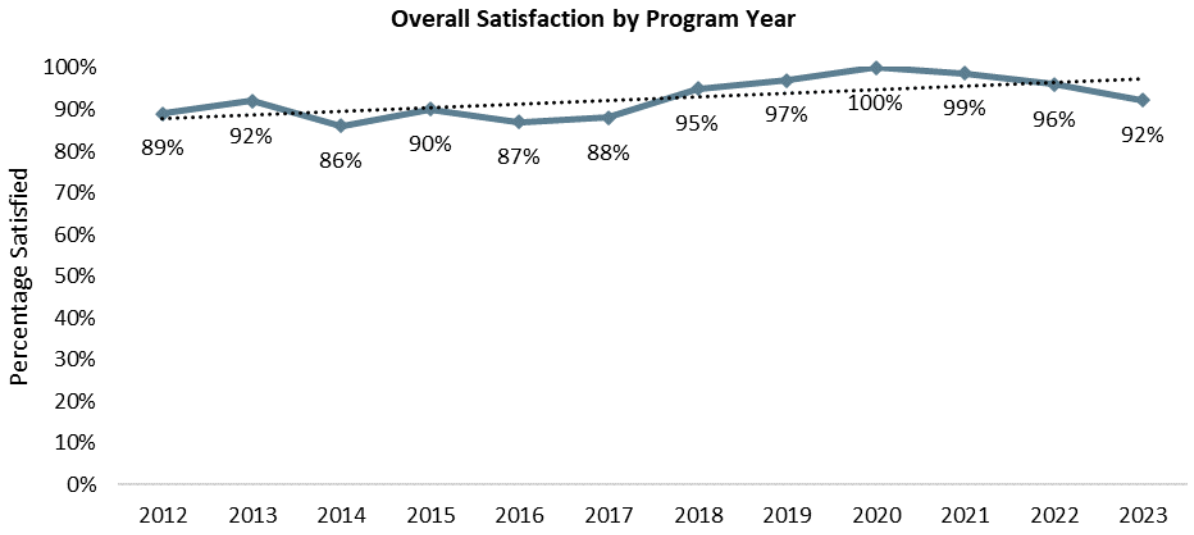
Contractor Source (n = 61)	Percent
Word of mouth	34%
Online service	15%
Web search	29%
Advertisement	4%
Energy Trust website	20%
Energy Trust referral	3%
Not applicable	12%
Don't know	0%
Prefer not to answer	0%

3.2.5 Ducted Heat Pump

Ducted heat pump participants (*n* = 60) showed very high levels of satisfaction with all facets of the experience; overall satisfaction while still high has been going slightly down for a few consecutive years (Table 26 and accompanying chart).

Table 26: Satisfaction Ratings: Ducted Heat Pump

Satisfaction	Percent
Measure Satisfaction	
Overall experience (n = 60)	92%
Performance of new measure (n = 65)	99%
Comfort of home after new measure (n = 65)	99%
Incentive application form (n = 23)	93%
Time it took to receive incentive (n = 24)	90%
Contractor Satisfaction	
Overall experience (n = 66)	97%
Quality of installation work (n = 66)	97%
Information about incentives (n = 57)	92%
Communication (n = 66)	99%
Assistance with application (n = 24)	97%



The overall program influence on participant purchase decisions was exceptionally high (97%). Contractor showed the greatest influence (Table 27).

Table 27: Influence Ratings: Ducted Heat Pump

Influence Level	Overall Influence (n = 66)	Energy Trust Incentive (n = 58)	Energy Trust Information or Materials (n = 41)	Contractor (n = 65)
High	97%	71%	69%	84%
Medium	1%	14%	12%	6%
Low	2%	14%	19%	10%

Word of mouth was the most commonly reported contractor source (Table 28).

Table 28: Where Respondent Found the Contractor: Ducted Heat Pump

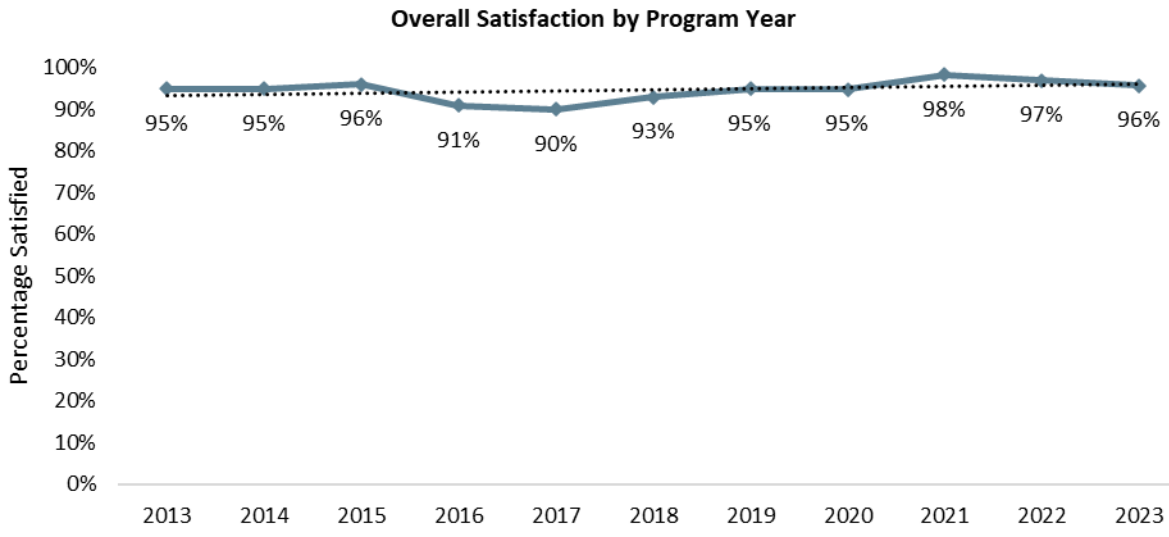
Contractor Source (n = 66)	Percent
Word of mouth	39%
Online service	8%
Web search	23%
Advertisement	14%
Energy Trust website	19%
Energy Trust referral	7%
Not applicable	3%
Don't know	0%
Prefer not to answer	0%

3.2.6 Ductless Heat Pump

Ductless heat pump participants (*n* = 52) showed very high levels of satisfaction with all facets of the experience expect time it took to receive the incentive; overall satisfaction was consistent with previous years (Table 29 and accompanying chart).

Table 29: Satisfaction Ratings: Ductless Heat Pump

Satisfaction	Percent
Measure Satisfaction	
Overall experience (n = 52)	96%
Performance of new measure (n = 57)	99%
Comfort of home after new measure (n = 58)	96%
Incentive application form (n = 23)	85%
Time it took to receive incentive (n = 24)	78%
Contractor Satisfaction	
Overall experience (n = 58)	99%
Quality of installation work (n = 59)	98%
Information about incentives (n = 52)	89%
Communication (n = 58)	99%
Assistance with application (n = 28)	91%



The overall program influence on participant purchase decisions was exceptionally high (98%). Ductless heat pump's energy efficiency rating had the greatest influence (Table 30).

Table 30: Influence Ratings: Ductless Heat Pump

Influence Level	Overall Influence (n = 59)	Energy Trust Incentive (n = 54)	Energy Trust Information or Materials (n = 30)	Contractor (n = 59)	Energy Efficiency Rating (n = 58)
High	98%	60%	52%	77%	90%
Medium	0%	19%	24%	11%	7%
Low	2%	21%	24%	12%	3%

Word of mouth was most commonly reported as where the respondent found the contractor, followed by web search (Table 31).

Table 31: Where Respondent Found the Contractor: Ductless Heat Pump

Contractor Source (n = 61)	Percent
Word of mouth	37%
Online service	10%
Web search	26%
Advertisement	11%
Energy Trust website	10%
Energy Trust referral	11%
Not applicable	3%
Don't know	0%
Prefer not to answer	0%

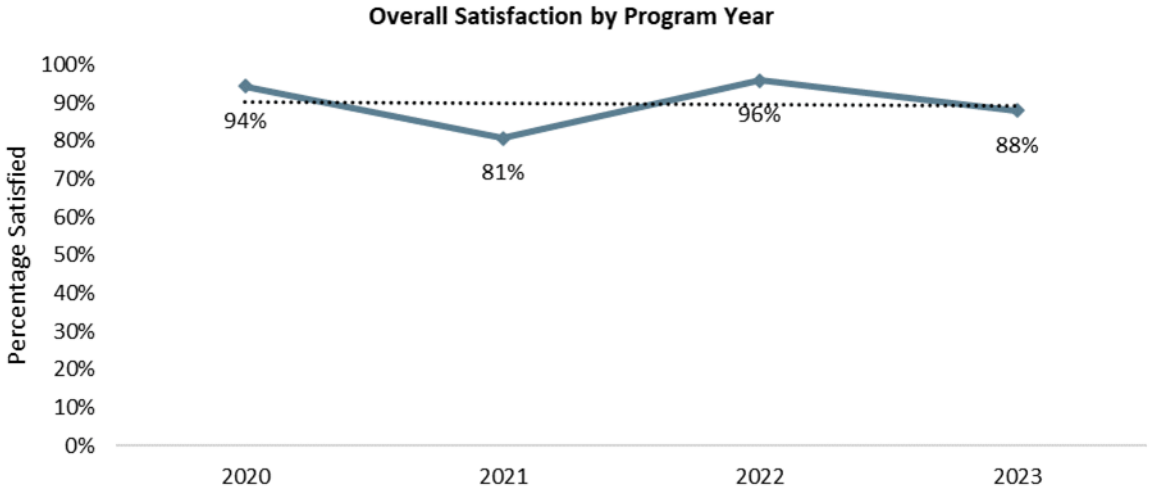
3.2.7 Central Air Conditioner

Participants with this measure (*n* = 51) showed moderately high to high levels of satisfaction with all facets of the experience except time it took to receive the incentive, information about incentives, and assistance with completing the application (Table 32 and accompanying chart). While overall satisfaction was high (88%) in 2023, it has been volatile over the course of this measure making it hard to discern any real trends from the spike and fall pattern. However, the variance ranges from high to very high satisfaction levels as opposed to high and low satisfaction.

Table 32: Satisfaction Ratings: Central Air Conditioner

Satisfaction	Percent
Measure Satisfaction	
Overall experience (n = 51)	88%
Performance of new measure (n = 47)	99%
Comfort of home after new measure (n = 48)	99%
Incentive application form (n = 31)	79%
Time it took to receive incentive (n = 37)	68%

Satisfaction	Percent
Contractor Satisfaction	
Overall experience (n = 57)	90%
Quality of installation work (n = 57)	88%
Information about incentives (n = 51)	77%
Communication (n = 57)	90%
Assistance with application (n = 36)	79%



The overall program influence on participant purchase decisions was very high (92%). The air conditioner's energy efficiency rating had the greatest influence (Table 33).

Table 33: Influence Ratings: Central Air Conditioner

Influence Level	Overall Influence (n = 57)	Energy Trust Incentive (n = 52)	Energy Trust Information or Materials (n = 18)	Contractor (n = 57)	Energy Efficiency Rating (n = 54)
High	92%	46%	41%	71%	80%
Medium	4%	15%	16%	12%	10%
Low	5%	40%	44%	17%	10%

Word of mouth was most commonly reported as where the respondent found the contractor, followed by web search (Table 34).

Table 34: Where Respondent Found the Contractor: Central Air Conditioner

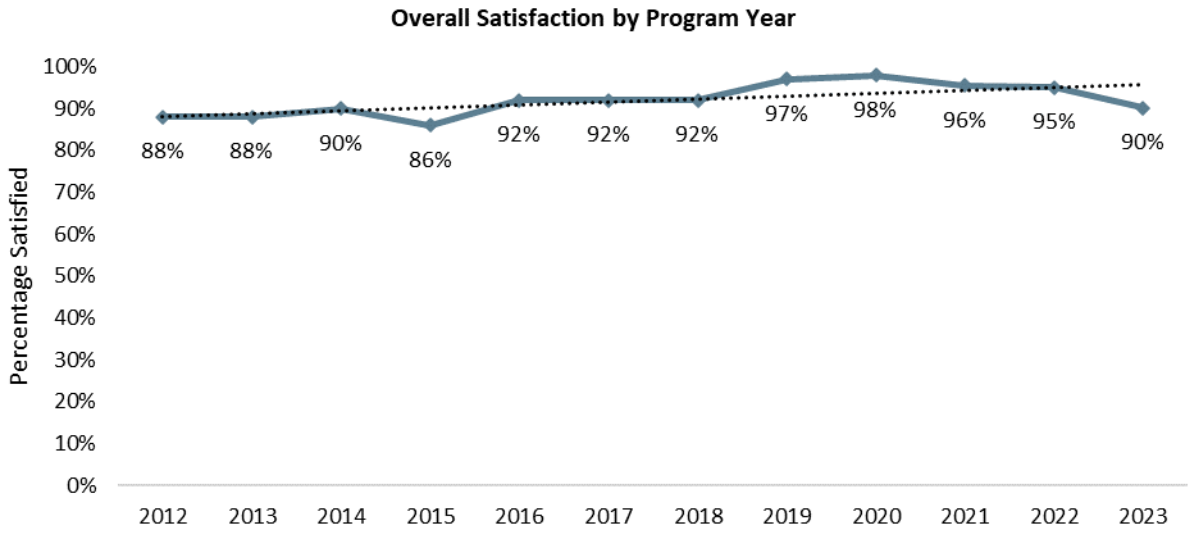
Contractor Source (n = 57)	Percent
Word of mouth	44%
Online service	10%
Web search	30%
Advertisement	5%
Energy Trust website	10%
Energy Trust referral	0%
Not applicable	8%
Don't know	9%
Prefer not to answer	0%

3.2.8 Windows

Windows participants (*n* = 56) showed high levels of satisfaction with all facets of the experience except information about incentives; and assistance with application provided by the contractor. Overall satisfaction while still very high (90%) is lower than that for 2022 (95%) and lower than the general trend since 2012 (Table 35 and accompanying chart).

Table 35: Satisfaction Ratings: Windows

Satisfaction	Percent
Measure Satisfaction	
Overall experience (n = 56)	90%
Performance of new measure (n = 58)	100%
Comfort of home after new measure (n = 60)	99%
Incentive application form (n = 47)	90%
Time it took to receive incentive (n = 51)	82%
Contractor Satisfaction	
Overall experience (n = 61)	82%
Quality of installation work (n = 61)	85%
Information about incentives (n = 55)	74%
Communication (n = 60)	84%
Assistance with application (n = 52)	78%



The overall program influence on participant purchase decisions was high (80%) with contractors having the greatest influence (Table 36).

Table 36: Influence Ratings: Windows

Influence Level	Overall Influence (n = 61)	Energy Trust Incentive (n = 57)	Energy Trust Information or Materials (n = 21)	Contractor (n = 61)
High	80%	41%	44%	73%
Medium	11%	18%	34%	12%
Low	9%	40%	23%	15%

The contractor's advertising was most commonly reported as where the respondent found the contractor, closely followed by word of mouth (Table 37).

Table 37: Where Respondent Found the Contractor: Windows

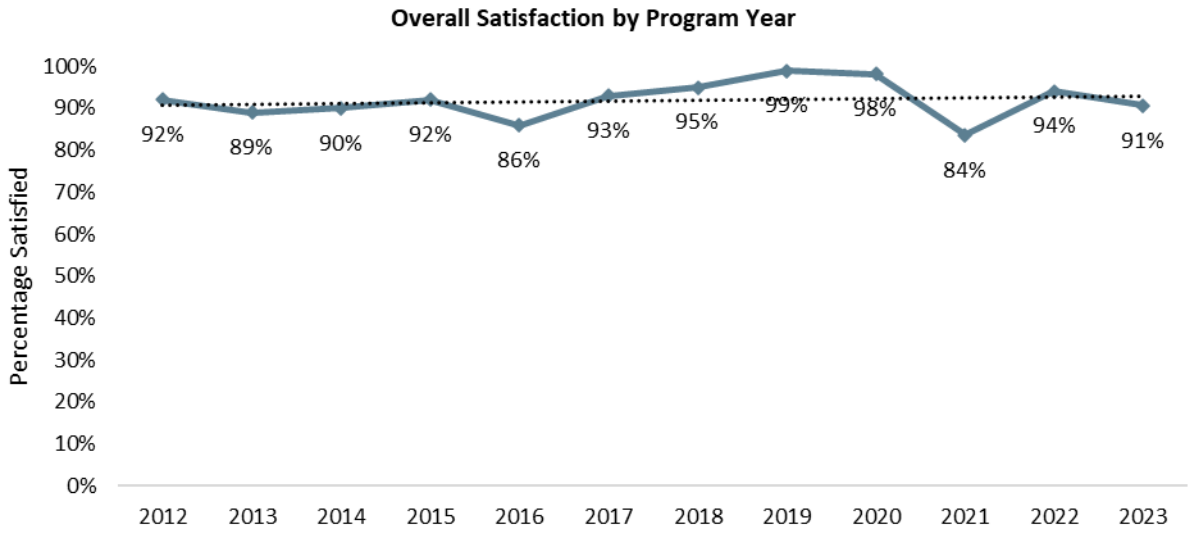
Contractor Source (n = 61)	Percent
Word of mouth	31%
Online service	9%
Web search	28%
Advertisement	32%
Energy Trust website	4%
Energy Trust referral	2%
Not applicable	5%
Don't know	4%
Prefer not to answer	0%

3.2.9 Gas Fireplaces

Gas fireplace participants (*n* = 63) showed high levels of satisfaction with all facets of the experience; overall satisfaction (91%) is slightly lower than that for 2022 (94%) but it is still aligned with the historical trend (Table 38 and accompanying chart).

Table 38: Satisfaction Ratings: Gas Fireplaces

Satisfaction	Percent
Measure Satisfaction	
Overall experience (n = 63)	91%
Performance of new measure (n = 64)	100%
Comfort of home after new measure (n = 63)	98%
Incentive application form (n = 58)	87%
Time it took to receive incentive (n = 62)	84%
Contractor Satisfaction	
Overall experience (n = 65)	94%
Quality of installation work (n = 65)	97%
Information about incentives (n = 64)	87%
Communication (n = 65)	94%
Assistance with application (n = 59)	88%



The overall program influence on participant purchase decisions was moderate (78%). Energy efficiency rating of the fireplace showed the greatest influence (Table 39).

Table 39: Influence Ratings: Gas Fireplaces

Influence Level	Overall Influence (n = 65)	Energy Trust Incentive (n = 65)	Energy Trust Information or Materials (n = 28)	Contractor (n = 64)	Energy Efficiency Rating (n = 62)
High	78%	47%	58%	63%	70%
Medium	13%	15%	8%	7%	19%
Low	9%	38%	34%	30%	11%

Word of mouth was by far most commonly reported as where the respondent found the contractor (Table 40).

Table 40: Where Respondent Found the Contractor: Gas Fireplaces

Contractor Source (n = 65)	Percent
Word of mouth	40%
Online service	11%
Web search	25%
Advertisement	5%
Energy Trust website	6%
Energy Trust referral	6%
Not applicable	9%
Don't know	1%
Prefer not to answer	0%

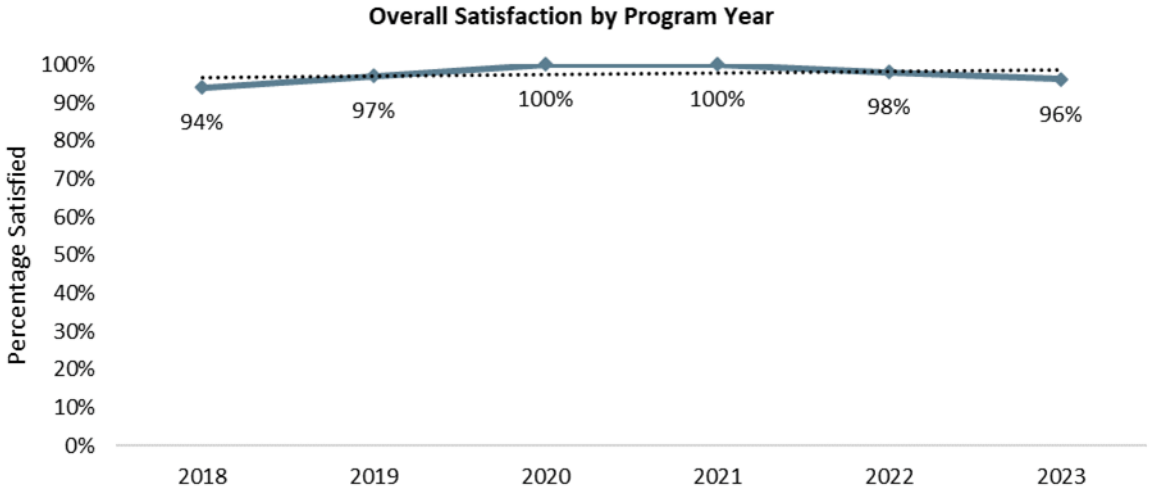
3.2.10 Gas Furnaces

Gas furnace participants (*n* = 60) showed very high levels of satisfaction with all facets of the experience, creating a consistently high satisfaction over time (Table 41 and accompanying chart).

Table 41: Satisfaction Ratings: Gas Furnaces

Satisfaction	Percent
Measure Satisfaction	
Overall experience (n = 60)	96%
Performance of new measure (n = 64)	99%
Comfort of home after new measure (n = 64)	99%
Incentive application form (n = 33)	98%
Time it took to receive incentive (n = 30)	91%

Satisfaction	Percent
Contractor Satisfaction	
Overall experience (n = 68)	97%
Quality of installation work (n = 68)	93%
Information about incentives (n = 62)	94%
Communication (n = 68)	94%
Assistance with application (n = 36)	96%



The overall program influence on participant purchase decisions was exceptionally high (99%). Furnaces' energy efficiency rating had by far the greatest influence (Table 42).

Table 42: Influence Ratings: Gas Furnaces

Influence Level	Overall Influence (n = 68)	Energy Trust Incentive (n = 63)	Energy Trust Information or Materials (n = 27)	Contractor (n = 68)	Energy Efficiency Rating (n = 65)
High	99%	55%	49%	68%	91%
Medium	1%	16%	31%	17%	2%
Low	0%	28%	20%	15%	7%

Word of mouth was by far most commonly reported as where the respondent found the contractor (Table 43).

Table 43: Where Respondent Found the Contractor: Gas Furnaces

Contractor Source (n = 68)	Percent
Word of mouth	65%
Online service	2%
Web search	13%
Advertisement	11%
Energy Trust website	7%
Energy Trust referral	1%
Not applicable	3%
Don't know	0%
Prefer not to answer	0%

3.2.11 Duct Sealing

Duct sealing participants (*n* = 49) showed exceptionally high levels of satisfaction with all facets of the experience (Table 44). Overall satisfaction (100%) was consistent with 2022 (99%), when the measure was reintroduced into the program after previously having been discontinued.[9]

Table 44: Satisfaction Ratings: Duct Sealing

Satisfaction	Percent
Measure Satisfaction	
Overall experience (n = 49)	100%
Performance of new measure (n = 56)	93%
Comfort of home after new measure (n = 55)	92%
Contractor Satisfaction	
Overall experience (n = 57)	95%
Quality of installation work (n = 57)	98%
Information about incentives (n = 45)	97%
Communication (n = 57)	97%

The overall program influence on the installation decision was very high (91%). Energy Trust information and material showed the greatest influence (Table 45).

[9] This is the second year satisfaction is reported for this measure which is not enough to identify a trend over time.

Table 45: Influence Ratings: Duct Sealing

Influence Level	Overall Influence (n = 57)	Energy Trust Incentive (n = 56)	Energy Trust Information or Materials (n = 33)
High	91%	78%	85%
Medium	2%	3%	8%
Low	7%	19%	7%

3.2.12 Residential - Washington

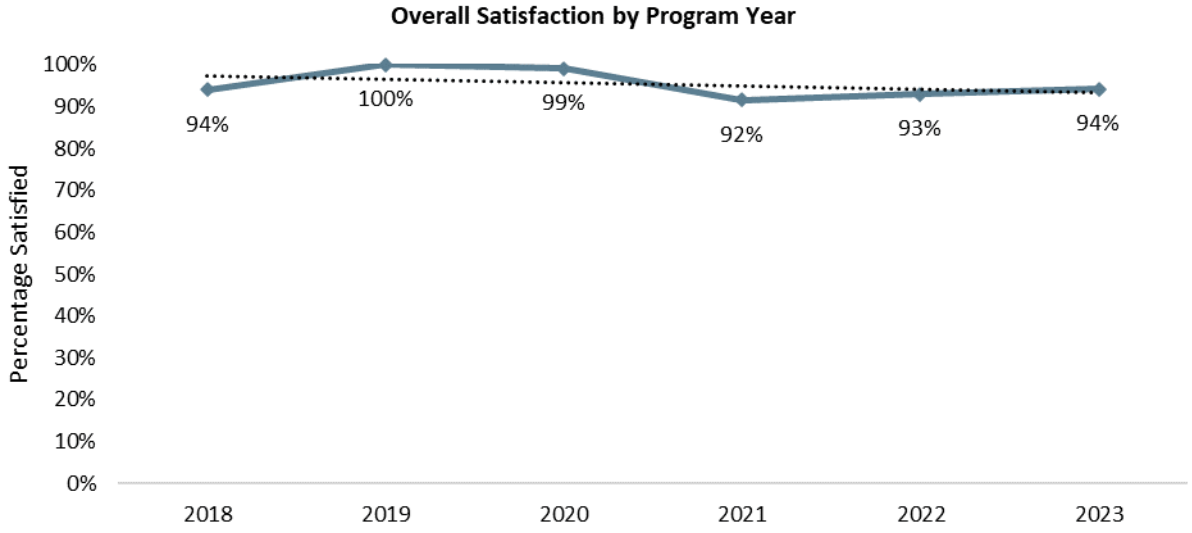
Residential Washington participants (*n* = 176) installed six types of measures: gas furnaces (*n* = 71), windows (*n* = 52), thermostats[10] (*n* = 33), ceiling insulation (*n* = 10), floor insulation (*n* = 5), and gas fireplaces (*n* = 5).

These participants showed moderately high to very high levels of satisfaction with all facets of the experience; overall satisfaction remained very close to last year's aligning with the leveled off trend over time (Table 46 and accompanying chart).

[10] Either smart thermostats or heat pump advanced controls.

Table 46: Satisfaction Ratings: Residential - Washington

Satisfaction	Percent
Measure Satisfaction	
Overall experience (n = 147)	94%
Performance of new measure (n = 169)	99%
Comfort of home after new measure (n = 163)	98%
Incentive application form (n = 108)	94%
Time it took to receive incentive (n = 107)	83%
Contractor Satisfaction	
Overall experience (n = 141)	92%
Quality of installation work (n = 141)	90%
Information about incentives (n = 120)	85%
Communication (n = 141)	91%
Assistance with application (n = 83)	92%



The overall program influence on participant purchase decisions was high (82%). The measure's energy efficiency rating showed the greatest influence, followed by contractors (Table 47).

Table 47: Influence Ratings: Residential - Washington

Influence Level	Overall Influence (n = 175)	Energy Trust Incentive (n = 162)	Energy Trust Information or Materials (n = 66)	Salesperson or Retailer (n = 30)	Contractor (n = 139)	Energy Efficiency Rating (n = 72)
High	82%	53%	56%	41%	72%	89%
Medium	5%	18%	16%	3%	11%	6%
Low	13%	29%	28%	57%	17%	5%

Word of mouth was most commonly reported as where the respondent found the contractor, closely followed by a web search (Table 48).

Table 48: Where Respondent Found the Contractor: Residential - Washington

Contractor Source (n = 176)	Percent
Word of mouth	39%
Online service	9%
Web search	38%
Advertisement	15%
Energy Trust website	7%
Energy Trust referral	2%
Not applicable	3%
Don't know	0%
Prefer not to answer	0%

3.2.13 Moderate Income Track

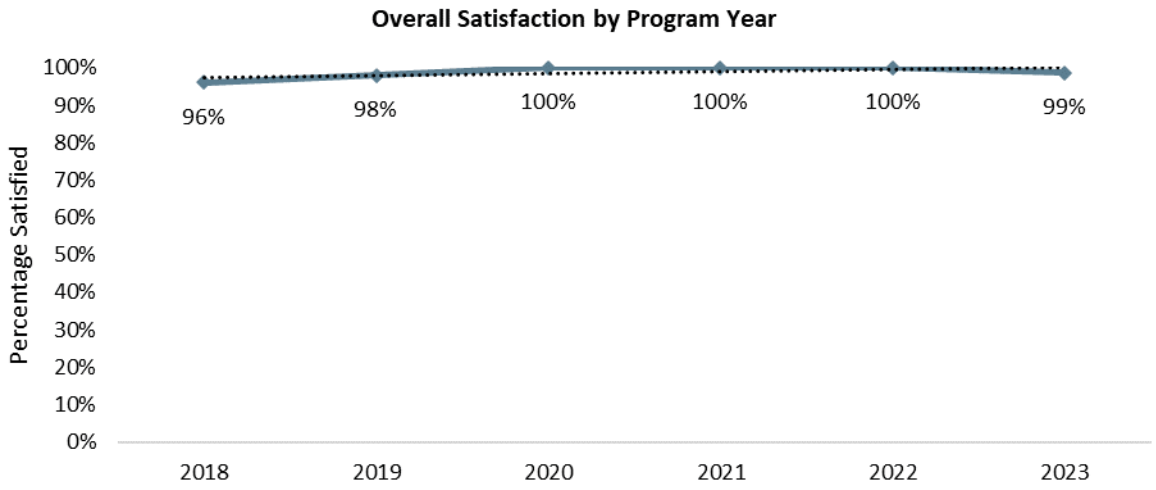
Moderate Income Track participants (*n* = 63) installed seven types of measures: gas furnaces (*n* = 37), ductless heat pumps (*n* = 12), ducted heat pumps (*n* = 5), thermostats (*n* = 3), other insulation (*n* = 3), ceiling insulation (*n* = 2), and central air conditioners (*n* = 1).

These participants showed very high levels of satisfaction with all facets of the experience; overall satisfaction is consistently very high over time (Table 49 and accompanying chart).

Table 49: Satisfaction Ratings: Moderate Income Track

Satisfaction	Percent
Measure Satisfaction	
Overall experience (n = 54)	99%
Performance of new measure (n = 60)	99%
Comfort of home after new measure (n = 61)	99%
Incentive application form (n = 54)	98%
Time it took to receive incentive (n = 47)	94%

Satisfaction	Percent
Contractor Satisfaction	
Overall experience (n = 60)	96%
Quality of installation work (n = 59)	95%
Information about incentives (n = 58)	94%
Communication (n = 60)	97%
Assistance with application (n = 57)	98%



The overall program influence on participant purchase decisions was exceptionally high (99%). Reflecting the high proportion of gas furnaces in this group, the equipment's energy efficiency rating showed the greatest influence, followed by contractor and Energy Trust information or materials (Table 50).

Table 50: Influence Ratings: Moderate Income Track

Influence Level	Overall Influence (n = 62)	Energy Trust Incentive (n = 60)	Energy Trust Information or Materials (n = 28)	Contractor (n = 60)	Energy Efficiency Rating (n = 52)
High	99%	72%	78%	79%	85%
Medium	1%	13%	12%	16%	8%
Low	0%	14%	9%	6%	6%

Word of mouth was most commonly reported as where the respondent found the contractor (Table 51).

Table 51: Where Respondent Found the Contractor: Moderate Income Track

Contractor Source (n = 63)	Percent
Word of mouth	55%
Online service	1%
Web search	12%
Advertisement	20%
Energy Trust website	12%
Energy Trust referral	2%
Not applicable	5%
Don't know	0%
Prefer not to answer	0%

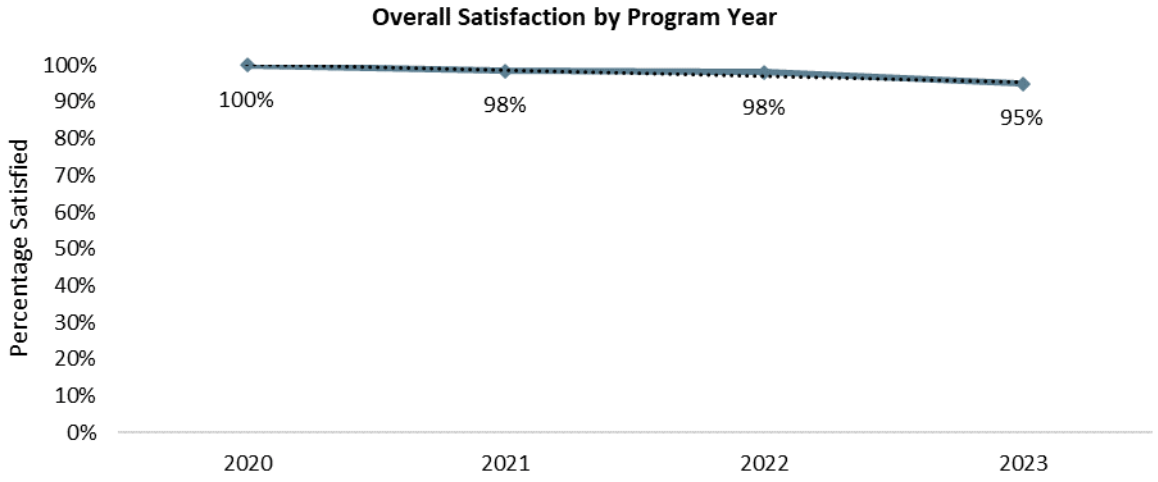
3.2.14 Rental Properties

Rental Properties participants (*n* = 59) installed six measure types: gas furnaces (*n* = 32), ductless heat pumps (*n* = 10), ceiling insulation (*n* = 9), floor insulation (*n* = 6), wall insulation (*n* = 1), and ducted heat pumps (*n* = 1).

These participants showed very high levels of satisfaction with all facets of the experience; the overall satisfaction trend is consistently very high, although the five-percentage-point drop over the four years of measurement may warrant attention (Table 52 and accompanying chart).

Table 52: Satisfaction Ratings: Rental Properties

Satisfaction	Percent
Measure Satisfaction	
Overall experience (n = 52)	95%
Performance of new measure (n = 54)	100%
Comfort of home after new measure (n = 53)	100%
Incentive application form (n = 10)	89%
Time it took to receive incentive (n = 10)	89%
Contractor Satisfaction	
Overall experience (n = 56)	99%
Quality of installation work (n = 57)	96%
Information about incentives (n = 48)	94%
Communication (n = 56)	94%
Assistance with application (n = 9)	87%



The overall program influence on participant purchase decisions was exceptionally high (100%). The measure's energy efficiency rating showed the greatest influence (Table 53).

Table 53: Influence Ratings: Rental Properties

Influence Level	Overall Influence (n = 58)	Energy Trust Incentive (n = 49)	Energy Trust Information or Materials (n = 26)	Contractor (n = 57)	Energy Efficiency Rating (n = 42)
High	100%	60%	50%	78%	96%
Medium	0%	16%	34%	11%	0%
Low	0%	24%	17%	12%	4%

Word of mouth was most commonly reported as where the respondent found the contractor (Table 54).

Table 54: Where Respondent Found the Contractor: Rental Properties

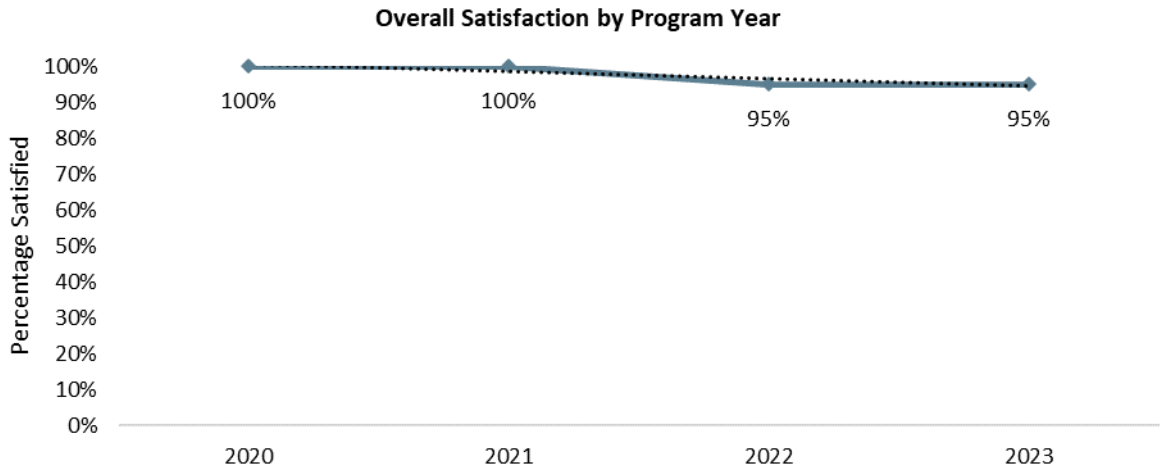
Contractor Source (n = 59)	Percent
Word of mouth	53%
Online service	4%
Web search	22%
Advertisement	9%
Energy Trust website	5%
Energy Trust referral	3%
Not applicable	4%
Don't know	0%
Prefer not to answer	0%

3.2.15 Manufactured Home Promotions

This group was previously called "Fixed Price Promotions." Manufactured Home Promotions participants (*n* = 16) installed two measure types: ducted heat pumps (*n* = 14) and ductless heat pumps (*n* = 4). These participants showed very high levels of satisfaction with all facets of the experience (Table 55 and accompanying chart), although satisfaction levels in the past two years are slightly below those for the first two years.

Table 55: Satisfaction Ratings: Manufactured Home Promotions

Satisfaction	Percent
Measure Satisfaction	
Overall experience (n = 16)	95%
Performance of new measure (n = 17)	100%
Comfort of home after new measure (n = 17)	100%
Incentive application form (n = 0)	n/a
Time it took to receive incentive (n = 0)	n/a
Contractor Satisfaction	
Overall experience (n = 17)	95%
Quality of installation work (n = 17)	100%
Information about incentives (n = 13)	93%
Communication (n = 17)	95%
Assistance with application (n = 0)	n/a



The overall program influence on participant purchase decisions was very high (95%). Energy Trust information or materials showed the greatest influence (Table 56).

Table 56: Influence Ratings: Manufactured Home Promotions

Influence Level	Overall Influence (n = 17)	Energy Trust Information or Materials (n = 11)	Contractor (n = 27)	Energy Efficiency Rating (n = 15)
High	95%	90%	84%	56%
Medium	5%	10%	11%	28%
Low	0%	0%	5%	16%

Word of mouth was by far most commonly reported as where the respondent found the contractor (Table 57).

Table 57: Where Respondent Found the Contractor: Manufactured Home Promotions

Contractor Source (n = 18)	Percent
Word of mouth	48%
Online service	0%
Web search	0%
Advertisement	13%
Energy Trust website	27%
Energy Trust referral	13%
Not applicable	3%
Don't know	0%
Prefer not to answer	0%

4 Nonresidential Survey Results

The following subsections provide information on the firmographics, demographics, and program experience of nonresidential survey participants. All results are shown separately for Existing Buildings - Oregon, Commercial Solar, and Production Efficiency participants.

4.1 Nonresidential Firmographics and Demographics

In reporting firmographic and demographic responses, we excluded "no response" from the denominator of percentages. The tables show the percentages and counts of all respondents that answered the various questions and the percentage that each answer makes up of all answers given.

Respondents most commonly reported that their firm or organization owns the property or properties that participated in the respective program (Table 58), followed by businesses leasing their property.

Table 58: Participating Firm or Organization's Ownership of Participating Property or Properties (Existing Buildings, Commercial Solar, and Production Efficiency)

Ownership	Existing Buildings - Oregon	Commercial Solar	Production Efficiency
Responding %	99.7%	97.1%	98.7%
Responding n	(n = 320)	(n = 34)	(n = 74)
Own	69%	97%	53%
Lease	28%	0%	47%
Other	3%	3%	0%

More than half of Existing Buildings participants and two-thirds of Production Efficiency participants who reported leasing the participating property said their firm or organization had authority to make any type of upgrade decision (Table 59).

Table 59: Participating Firm or Organization's Authority for Upgrade Decisions (Existing Buildings, Commercial Solar, and Production Efficiency Participants Who Reported Leasing Building Only)

Level of Authority for Upgrades	Existing Buildings - Oregon	Commercial Solar	Production Efficiency
Responding %	100%	n/a	100%
Responding n	(n = 108)	(n = 0)	(n = 32)
Yes, any type of upgrade	57%	n/a	66%
Yes, but only some types of upgrades	38%	n/a	28%
No	5%	n/a	6%

Participants in all programs reported a range of company sizes, in terms of number of employees, but skewed somewhat toward fewer employees, with one to five employees being by far most common (Table 60).

Table 60: Number of Oregon Employees

Number of Employees	Existing Buildings - Oregon	Commercial Solar	Production Efficiency
Responding %	97.1%	100%	100%
Responding n	(n = 332)	(n = 34)	(n = 72)
1 to 5	55%	65%	34%
6 to 9	8%	9%	8%
10 to 19	9%	0%	17%
20 to 99	11%	12%	20%
100 to 499	7%	9%	16%
500 or more	10%	6%	6%

More than half (60%) of the respondents were an owner or someone in an executive or decision-making role and about one in five were a manager of some sort (Table 61).

Table 61: Respondent's Position in Firm or Organization

Title or Role	Existing Buildings - Oregon	Commercial Solar	Production Efficiency
Responding %	98.6%	100%	100%
Responding n	(n = 360)	(n = 35)	(n = 76)
Owner	54%	71%	38%
Executive or decision-maker	8%	17%	4%
Manager	17%	11%	33%
Employee	4%	0%	1%
Other	17%	0%	24%

Respondents' businesses represented a range of ownership structures, with close to one-half being individual or sole proprietorships, including LLCs, and the next most common being C or S corporations (Table 62).

Table 62: Business Ownership Structure

Title or Role	Existing Buildings - Oregon	Commercial Solar	Production Efficiency
Responding %	96%	100%	100%
Responding n	(n = 337)	(n = 35)	(n = 74)
Individual/sole proprietor/LLC	25%	23%	19%
C Corporation	6%	6%	24%
S Corporation	8%	20%	10%
Partnership	5%	6%	3%
Trust/estate	4%	3%	1%
Limited liability company	15%	23%	25%
Government	4%	0%	3%
Education	4%	9%	0%
Nonprofit	5%	6%	0%
Religious	2%	0%	0%
Not specified[1]	17%	0%	12%
Residence	2%	6%	0%
[1]For example, "Corporation," "Publicly traded entity," "Investment group."			

Nearly all respondents reported that English was the primary language spoken in their business (Table 63). Spanish and Korean were the only other languages identified, both representing fewer than 1% of the respondents.

Table 63: Primary Language of Business

Title or Role	Existing Buildings - Oregon	Commercial Solar	Production Efficiency
Responding %	95.3%	96.8%	100%
Responding n	(n = 225)	(n =30)	(n = 35)
English	99%	100%	100%
Spanish	<1%	0%	0%
French	0%	0%	0%
Mandarin	0%	0%	0%
Vietnamese	0%	0%	0%
Tagalog	0%	0%	0%
Armenian	0%	0%	0%
Korean	<1%	0%	0%
Russian	0%	0%	0%
Persian	0%	0%	0%
Other	0%	0%	0%

Finally, respondents were somewhat more likely to identify as male than female, with about 1% reporting another gender identity (Table 64). In addition, 1% of respondents reported they were transgender.

Table 64: Respondent's Gender Identity

Title or Role	Existing Buildings - Oregon	Commercial Solar	Production Efficiency
Responding %	94.5%	96.8%	97.1%
Responding n	(n = 223)	(n = 30)	(n = 34)
Female	44%	23%	23%
Male	55%	77%	77%
Non-binary/third gender	1%	0%	0%
Transgender	1%	0%	4%

4.2 Nonresidential Program Experience by Program Track and Quota Group

The following subsections show results for key survey variables by program track and quota group. Results mostly show high satisfaction ratings across all facets of program experience for all quota groups, with a few moderate satisfaction ratings. In most cases, satisfaction with the overall program experience and with interactions with program representatives significantly improved since 2022, especially for the commercial solar quota group.

Respondents across all quota groups reported influence from multiple factors, with no single factor showing consistently greater influence than any other.

4.2.1 Existing Buildings - Oregon

Existing Buildings - Oregon participants (*n* = 403) generally showed high levels of satisfaction and reported high overall program influence across quota groups consistently (Table 65). Relatively, Lighting (Non-DI) group showed lower program influence (78%) and Healthcare showed lower satisfaction with overall program experience (78%).

Table 65: Key Satisfaction and Influence Metrics by Quota Group: Existing Buildings - Oregon

Existing Buildings - Oregon Incentives Quota Group	Satisfaction		Overall Influence
	Overall Program Experience	Interaction with Program Representative	
Existing Buildings - Oregon Incentives (n = 403)	94%	94%	98%
Building Type Quotas (Exclusive Quotas)			
Assembly/Religious (n = 42)	93%	90%	95%
Education (n = 27)	93%	96%	85%
Healthcare (n = 23)	78%	86%	91%
Multifamily (n = 99)	94%	93%	85%
Office (n = 34)	97%	93%	97%
Other Commercial (n = 56)	98%	98%	96%
Restaurant (n = 33)	97%	100%	97%
Retail (n = 64)	95%	95%	97%
Warehouse (n = 25)	96%	90%	92%
Commercial Solar (n = 36)	91%	87%	94%
Cross-Cutting Quota Groups			
Direct Install (DI) (n = 180)	94%	95%	98%
Lighting (Non-DI) (n = 63)	95%	93%	78%
Small and Medium Business (n = 99)	94%	93%	85%
Small Multifamily (n = 57)	92%	91%	86%

Looking at Existing Buildings - Oregon as a group, participants showed high levels of satisfaction with all facets of the experience (Table 66).

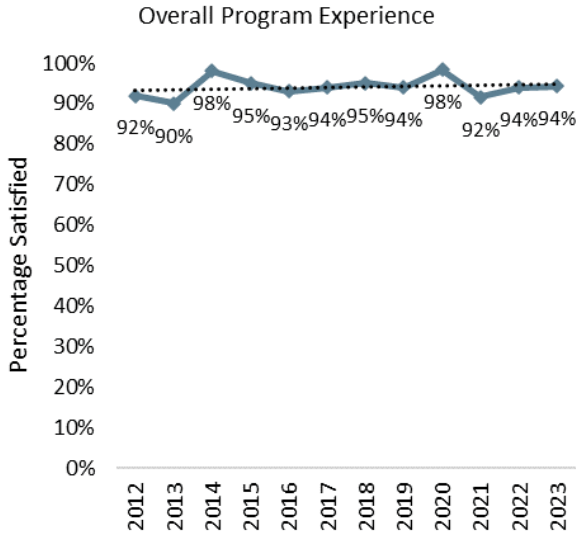
Table 66: Satisfaction by Program Element: Existing Buildings – Oregon

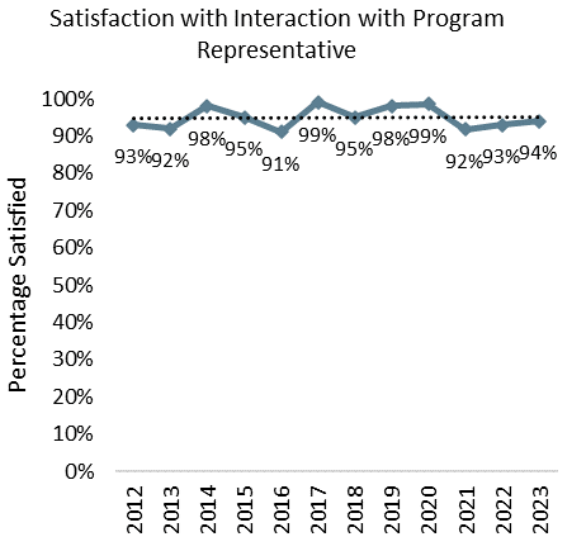
Program Element	Percent
Program-Level Satisfaction by Program Element	
Overall experience with Energy Trust (n = 390)	94%
Interaction with Energy Trust representative (n = 353)	94%
Incentive application process (n = 381)	90%
Information and materials from Energy Trust (n = 356)	89%
Site assessment or walk-through survey (n = 178)	94%

Program Element	Percent
Energy Trust-funded technical services (n = 60)	99%
The scheduling process to receive services (n = 178)	82%
Turnaround time to receive your incentive (n = 197)	87%
Performance of the measure (n = 361)	97%
The vendor or installation contractor, if applicable (n = 369)	95%
Overall Experience by Program Track	
Custom (n = 0)	n/a
Lighting (n = 237)	95%
Standard (n = 153)	94%
Direct Install (n = 176)	94%
Interaction with Program Representative by Program Track	
Custom (n = 0)	n/a
Lighting (n = 227)	94%
Standard (n = 126)	94%
Direct Install (n = 177)	95%

Satisfaction with the overall program experience and interactions with program representatives were similar to those of 2022 creating a consistently high satisfaction trend.

Time Trend in Key Satisfaction Indicators: Existing Buildings - Oregon





Respondents across all program tracks reported influence from multiple factors (Table 67).[11] As shown in Table 65, above, the overall program influence was high to very high for all quota groups, ranging from 85% to 98% except for Lighting (Non-DI) quota group (slightly lower at 78%). No single item was consistently more influential than any other across the quota groups. But on average, services provided at no/low cost (99%), Energy Trust-funded technical services (93%), and site assessment or walk-through survey (87%), closely followed by Energy Trust program representative (85%) had the greatest influence.

[11] Influence was defined as a rating of 4 or 5 on a scale from 1 (did not have any influence) to 5 (had a great influence). "Don't know" and "no response" were excluded from the denominators for all analyses to be consistent with previous years. As with the residential survey, we calculated an "overall influence" rating for each respondent that was equal to the highest influence rating that respondent provided for any rated influence factor.

Table 67: Influencers by Quota Group: Existing Buildings – Oregon

Quota Group	Energy Trust Incentive		Information and materials		Services provided at no/low cost		Energy Trust program representative		Site assessment or walk-through survey		Energy Trust-funded technical services		Vendor or installation contractor	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Assembly/Religious	42	73%	42	71%	42	97%	42	78%	42	79%	42	100%	42	74%
Education	27	67%	27	71%	27	100%	27	84%	27	100%	27	92%	27	50%
Healthcare	23	50%	23	71%	23	100%	23	82%	23	81%	23	75%	23	70%
Office	34	73%	34	73%	34	100%	34	90%	34	90%	34	100%	34	73%
Other Commercial	55	68%	56	73%	56	97%	56	84%	56	79%	56	75%	56	77%
Restaurant	33	83%	33	91%	33	100%	33	97%	32	100%	33	100%	32	93%
Retail	64	71%	63	84%	63	98%	63	90%	64	93%	64	100%	63	83%
Warehouse	25	85%	25	70%	25	100%	25	68%	25	75%	25	100%	25	73%
Multifamily	99	64%	99	63%	99	100%	99	68%	98	79%	99	100%	98	72%
Commercial Solar	36	71%	36	54%	36	n/a	36	65%	36	n/a	36	n/a	36	80%
Total/Wtd Mean	**303**	**72%**	**303**	**76%**	**303**	**99%**	**303**	**85%**	**303**	**87%**	**304**	**93%**	**302**	**76%**
Direct Install (DI)	180	n/a	179	81%	179	98%	179	88%	179	87%	180	n/a	178	80%
Lighting (non-DI)	62	73%	63	71%	63	n/a	63	78%	63	n/a	63	86%	63	74%
Small-Medium Business	99	64%	99	63%	99	100%	99	68%	98	79%	99	100%	98	72%
Small Multifamily	57	68%	57	67%	57	n/a	57	65%	57	67%	57	100%	57	71%

4.2.2 Commercial Solar

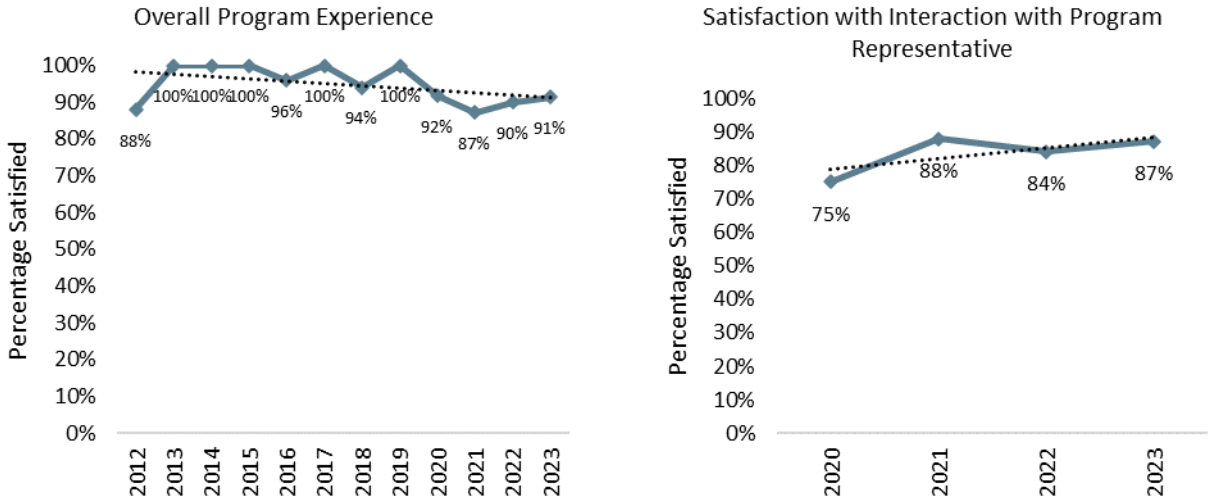
Commercial Solar participants (*n* = 36) showed high satisfaction with key program elements and reported high overall program influence which was a significant improvement since 2022 (Table 68 and accompanying chart).

Table 68: Key Satisfaction and Influence Metrics by Quota Group: Commercial Solar

Quota Group	Satisfaction		Overall Influence
	Overall Experience with Energy Trust	Interaction with Energy Trust Representative	
Commercial Solar (n = 36)	91%	87%	94%

Satisfaction with the overall program experience and interactions with program representatives slightly improved since 2022 aligning with an upward trend since 2021.

Time Trend in Key Satisfaction Indicators: Commercial Solar PV



Satisfaction across various program elements was rated high consistently with the lowest satisfaction level (79%) being related to site assessment or walk-through survey (Table *69*)

Table 69: Satisfaction by Program Element: Commercial Solar

Program Element	Percent
Overall experience with Energy Trust (n = 35)	91%
Interaction with Energy Trust representative (n = 35)	87%
Incentive application process (n = 31)	87%
Information and materials from Energy Trust (n = 34)	91%

Program Element	Percent
Site assessment or walk-through survey (n = 34)	79%
Energy Trust-funded technical services (n = 0)	n/a
The scheduling process to receive services (n = 0)	n/a
Turnaround time to receive your incentive (n = 0)	n/a
Performance of the measure (n = 0)	n/a
The vendor or installation contractor, if applicable (n = 34)	85%

Respondents reported influence from multiple factors (Table 70) but were least influenced by the information and materials from Energy Trust and Energy-Trust-funded technical services which was consistent with 2022.

Table 70: Influencers: Commercial Solar

Influencer	Percent
Overall influence (n = 35)	94%
The Energy Trust Incentive (n = 35)	91%
Information and materials from Energy Trust (n = 35)	54%
The Energy Trust program representative (n = 0)	n/a
Energy Trust-funded technical services (n = 31)	65%
The vendor or installation contractor, if applicable (n = 0)	n/a

4.2.3 Production Efficiency

Production Efficiency participants (*n* = 76) showed high satisfaction with key program elements and reported high overall program influence across quota groups except Agriculture (*n* = 6) at 67%; small sample sizes argue for caution in comparing across groups or with previous years (Table 71 and accompanying charts).

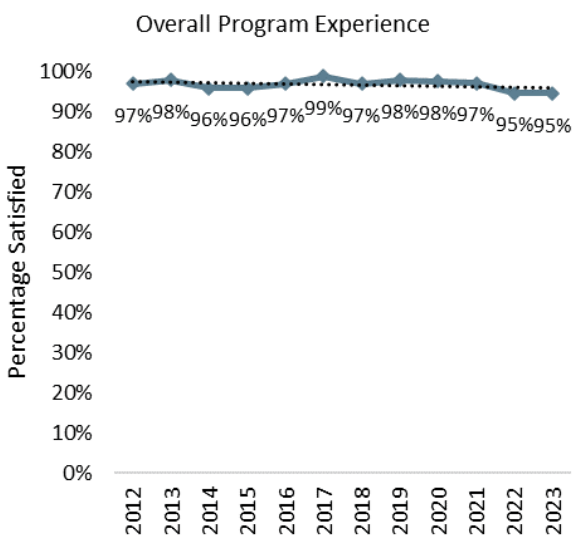
Table 71: Key Satisfaction and Influence Metrics by Quota Group: Production Efficiency

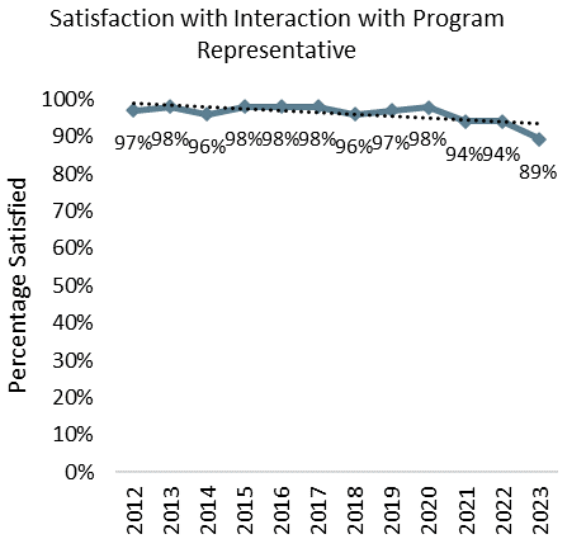
Quota Group	Satisfaction		Overall Influence
	Overall Program Experience	Interaction with Program Representative	
Production Efficiency (n = 76)	95%	89%	95%
End-Use Quotas (Exclusive Quotas)			
Agriculture (n = 6)	83%	67%	80%
Compressed air (n = 2)	100%	100%	100%
HVAC and controls (n = 4)	100%	100%	100%
Lighting (n = 47)	94%	90%	96%
Other industrial measures (n = 6)	100%	83%	100%
Pumps and Motors (n = 11)	100%	100%	82%
Refrigeration (n = 0)	n/a	n/a	n/a

Quota Group	Satisfaction		Overall Influence
	Overall Program Experience	Interaction with Program Representative	
Cross-Cutting Quota Groups			
Custom Projects (n = 11)	100%	87%	100%
Standard Projects (n = 18)	92%	89%	85%
Agriculture Sector (n = 40)	94%	97%	94%
Food & Beverage Sector (n = 12)	93%	85%	86%
High Tech Sector (n = 4)	100%	100%	100%
Metals Sector (n = 0)	n/a	n/a	n/a
Wood & Paper Sector (n = 4)	100%	100%	100%

Satisfaction with the overall program experience aligns with the consistently high satisfaction rate over time. However, satisfaction with interactions with program representatives is somewhat lower than previously.

Time Trend in Key Satisfaction Indicators: Production Efficiency





Looking at Production Efficiency participants as a group, they showed very high levels of satisfaction with all facets of the experience (Table 72).

Table 72: Satisfaction by Program Element: Production Efficiency

Program Element	Percent
Overall experience with Energy Trust (n = 76)	95%
Interaction with Energy Trust representative (n = 67)	89%
Incentive application process (n = 0)	n/a
Information and materials from Energy Trust (n = 69)	91%
Site assessment or walk-through survey (n = 0)	n/a
Energy Trust-funded technical services (n = 35)	89%
The scheduling process to receive services (n = 0)	n/a
Turnaround time to receive your incentive (n = 73)	81%
Performance of the measure (n = 71)	99%
The vendor or installation contractor, if applicable (n = 63)	90%

Respondents across all program tracks reported influence from multiple factors (Table 73). No single item was consistently more influential than any other across quota groups.

Table 73: Influencers by Quota Group: Production Efficiency

Quota Group	Energy Trust Incentive		Information and materials		Energy Trust program representative		Energy Trust-funded technical services		Vendor or installation contractor	
	n	%	n	%	n	%	n	%	n	%
Agriculture	6	80%	6	50%	6	33%	6	100%	6	100%
Compressed Air	2	100%	2	100%	2	100%	2	100%	2	100%
HVAC and Controls	4	75%	4	75%	4	100%	4	100%	4	100%
Lighting	46	84%	47	77%	46	80%	46	82%	47	79%
Other Industrial Measures	6	67%	6	60%	6	67%	6	60%	6	80%
Pumps and Motors	11	73%	11	82%	11	64%	11	100%	11	78%
Refrigeration	0	n/a	0	n/a	0	n/a	0	n/a	0	n/a
Total/Wtd Mean	**75**	**81%**	**76**	**75%**	**75**	**75%**	**75**	**86%**	**76**	**82%**
Custom Projects	11	73%	11	70%	11	82%	11	78%	11	89%
Standard Projects	18	76%	18	75%	18	60%	18	100%	18	85%
Agriculture Sector	39	84%	40	86%	39	82%	39	100%	40	87%
Food & Beverage Sector	12	75%	12	64%	12	64%	12	67%	12	73%
High Tech Sector	4	100%	4	100%	4	50%	4	100%	4	50%
Metals Sector	0	n/a	0	n/a	0	n/a	0	n/a	0	n/a
Wood & Paper Sector	4	100%	4	75%	4	100%	4	100%	4	100%

5 Summary and Conclusions

Both residential and nonresidential participants generally showed high satisfaction with their program experience. These findings indicate that Energy Trust continues to do a good job administering and managing its programs.

In the residential survey, the overall program influence on purchase decisions was high for all quota groups except for the smart thermostats and gas fireplaces measures. Factors influencing the purchase decision varied somewhat by measure type, but contractors and the energy efficiency rating appeared to have the most consistently high influence across measure quota groups. The consistent importance of efficiency ratings confirms that more customers pay attention to those ratings and points to the value of continuing to push for clear efficiency labeling on products. It also indicates that trade allies should market products using those ratings. The influence of contractors points to the importance of contractors and the value of maintaining strong and consistent outreach to contractors, including through the trade ally network as well as other means.

Compared to contractors and the energy efficiency rating, Energy Trust information or materials and the Energy Trust incentive had less consistently high influence across groups. However, one or both of these appeared to have nearly as much influence as contractors or the energy efficiency rating (or, in some cases, more influence) for heat pump advanced controls, ceiling insulation, other insulation, and ducted heat pumps.

Among participants who used a contractor, by far the most consistently identified way participants found that contractor was by word of mouth. Web search was also frequently identified for most quota groups. The problem with "word of mouth" is that it does not tell us how the respondent's source originally learned about the contractor. Most likely, it was from one of the other common sources. However, it might be valuable to investigate whether certain sources are more likely than others to generate word of mouth.

Residential customer survey respondents revealed a good amount of information in their responses to open-ended questions. Based on the analysis of responses to identify themes and patterns, they collectively expressed a complex landscape of experiences and perceptions regarding Energy Trust programs, with a consistent call for clearer communication, more streamlined processes, and increased awareness. Some encountered issues like difficulty finding information or dissatisfaction with incentive amounts. Suggestions for improvement included simpler processes and better access to information online and the ability to track the incentive status online. Several respondents appreciated the assistance from Energy Trust representatives in navigating applications or resolving issues.

Contractor Experience. Many respondents expressed satisfaction with contractors, praising their quality of work and professionalism. Some homeowners received assistance from contractors with paperwork, highlighting their integral role in the process. There were a few concerns related to issues with installations, confusion about eligibility, unauthorized charges, lack of transparency, and poor workmanship. Although these were relatively infrequent, they do warrant attention.

Desire for Simplification and Transparency. There is a recurring desire for simpler processes, clearer communication, and more transparency regarding incentive status (such as adding an online incentive tracker) and application procedures. Suggestions included making forms available online, providing confirmations, and improving the status portal.

Regarding the application process, suggestions for improvement included clearer wording, estimated rebate amounts, and ensuring accurate contractor listings.

Positive Impact of Upgrades. Satisfaction with improvements like increased comfort and reduced bills is common among respondents. There is a sense of gratitude for the incentives and services provided, particularly when tangible benefits are realized. Gratitude for programs aimed at improving efficiency and combating climate change reflects a broader awareness of environmental issues.

Desire for More Information. Some express a desire for more information about incentives and energy-saving options. Anxiety about using products effectively due to the lack of product information or instruction manuals is highlighted.

Desire for More Incentives. Some respondents mention that incentives influenced their decisions, while others express disappointment with amounts or eligibility criteria. Many desire expanding incentives or higher amounts to further motivate energy-efficient upgrades.

Awareness and Communication. Some respondents lack awareness about Energy Trust programs, suggesting better communication and advertising. Increasing awareness and education about the program are suggested to reach more homeowners. A few respondents suggested enhancing communication, improving website clarity, and better contractor training. Some respondents faced delays and unclear information, indicating challenges in communication with Energy Trust.

Technical Issues. Some encounter technical issues with the website or forms, suggesting the need for updates.

The nonresidential results generally show very high satisfaction ratings across all facets of program experience for all quota groups except Existing Buildings - Healthcare with the lowest satisfaction with overall program experience (78%) and Production Efficiency – Agriculture with the lowest satisfaction with program representative (67%). In most cases, satisfaction with the overall program experience and interactions with program representatives did not significantly vary from those of 2022 except Existing Buildings - Healthcare which went down from 100% and 100% in 2022 to 78% and 86% in 2023 respectively.

The overall program influence was high to very high for all quota groups except for Lighting (Non-DI) quota group which was relatively lower (78%). The small sample sizes argue for using caution in interpreting findings at the individual quota group level for the Production Efficiency program.

For the Existing Building program, services provided at no/low cost appeared to have the highest influence (99%) closely followed by Energy Trust-funded technical services (93%). For the Production Efficiency program, Energy Trust-funded technical services had the highest influence followed by the vendor or installation contractor and Energy Trust incentive. Some other influencers stood out somewhat in particular tracks within particular programs but did not appear to have consistently high influence across programs and tracks. These results were similar to survey findings in 2022.

Finally, contractor miscommunication and the process taking longer than the customer expected either related to application, assessment and installation or receiving the incentive was the common theme in terms of customers' descriptive complaints. Among all the quota groups, Existing Buildings – Multifamily and Retail and Production Efficiency – Lighting appeared to have the highest number of complaints. This issue can be addressed through contractor education and training. Additionally, several open-ended comments suggested that Energy Trust's website is somewhat hard to navigate. It may be valuable to add a question to the surveys about how user friendly the website is. This poses as an opportunity for improvement as more people rely on online resources for information on energy efficiency.

The continuing importance of technical services and information by Energy Trust is emerging in both residential and nonresidential participant surveys. It seems that customers are putting a lot of weight on the education and technical services that enable them to navigate their energy efficiency decisions, even more than incentives. This is a takeaway that should inform future program designs.

Appendix E

Trade Ally Interviews 2023

A Report for Energy Trust of Oregon

Final Report Submitted by Evergreen Economics

May 23, 2024

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1 Executive Summary

Energy Trust of Oregon deploys a Trade Ally Network to provide 1) training for and support to contractors; 2) referrals to customers; and 3) information about Energy Trust standards, incentives, and quality requirements. Supporting the Trade Ally Network helps to fulfill Energy Trust's mission to bring affordable clean energy to all.

In the past, Energy Trust distributed an online survey to solicit feedback from its Trade Ally Network. Energy Trust has placed a greater emphasis on fostering a more collaborative and discussion-oriented relationship with the trade allies; with this in mind, Energy Trust hired Evergreen Economics and BrightLine Group (the Evergreen team) to conduct interviews to hear directly from trade allies in a more personal way.

1.1 Research Topics and Methodology

The four main research topics the study addressed are:

1. Demographic and firmographic characteristics of trade ally firms;
2. Compensation and benefits;
3. Professional workforce development practices, tools, and courses; and
4. Barriers and opportunities.

The Evergreen team conducted phone interviews and offered a $100 gift card incentive for trade ally participation. The interviews each took between 20 and 90 minutes and covered all research questions identified by the team, as well as some additional questions requested by the Oregon Department of Energy (ODOE).

We utilized a multi-modal recruitment effort to leverage Energy Trust's existing relationships, in-person events, and traditional recruitment methods such as email, phone, and mailers. Overall, this recruitment approach was successful, and we met all interview completion targets by sector with an overall response rate of 43 percent.

To gather representative information from key segments of Energy Trust's Trade Ally Network, we designed our sample to achieve a 90/10 confidence and precision target across sectors (residential, commercial, industrial, and renewables). We also targeted firms with certain characteristics to explore how different characteristics impacted their responses. The targeted characteristics included early and later trade allies (defined by when the firm joined the Trade Ally Network), firms certified by or self-identified in alignment with Oregon's Certification Office for Business Inclusion and Diversity (COBID), and trade allies that do not have a Portland office.

Table 1 summarizes the program data we used to segment the trade ally population, by sector and targeted characteristics.

Table 1: Summary of Sample and Response Rates

Sector	Active Trade Allies[1]	Sampled	Target	Completed	Response Rate
Serves Residential Sector	599	215	62	68	32%
Serves Commercial Sector	307	163	56	82	50%
Serves Industrial Sector	78	78	37	45	58%
Serves Renewables Sector	60	61	33	37	56%
Targeted Characteristics	**Active Trade Allies**	**Sampled**	**Target**	**Completed**	**Response Rate**
Early Trade Allies (2012 and before)	405	175	59	79	45%
Later Trade Allies (2013 to present)	341	167	57	69	41%
COBID-Certified or Self-Identified	68	67	35	36	61%
Trade Allies with No Portland Office	445	195	60	77	39%
Overall	**746**	**342**	**140 – 180**	**148**	**43%**

1.2 Findings

The Evergreen team documented all interview responses and summarized them by the variables of importance listed below:

- COBID enrollment
- Firm size
- Number of projects completed annually
- Percentage of projects that used Energy Trust incentives
- Whether the firm has an office in Portland city limits
- Primary service area
- Sectors served
- Years involved with Energy Trust

Table 2 through Table 5 document headline findings from each section, and each includes the corresponding sections where the reader can find more detail, such as quotes from the interviews, additional context, and statistical significance.

[1] For this research, we defined active trade allies as those that have completed one or more projects since 2022.

Table 2: Summary of Findings – Demographic and Firmographic Characteristics

Section	Findings
3.1.1	**Sixty-one percent of respondents were not aware of what COBID certification** is. Even respondents from firms that were COBID-certified were often not aware that their firms were COBID-certified.
3.1.2	**Forty-nine percent of respondent firms can only support customers in English**. Southern and Central Oregon firms were more likely to only support customers in English (75%), and firms that serve Portland were less likely to only support customers in English (35%).
3.1.2	**Twenty-one percent of owners of firms said they are interested in hiring to support more languages** in the future.
3.1.3	Most trade ally firm owners self-identified as Caucasian (82%) and male (76%).

Table 3: Summary of Findings – Compensation and Benefits

Section	Findings
3.2.1	**Forty-four percent of respondents reported that they faced some internal bottlenecks with projects and workflow due to challenges in hiring employees**. Trade allies that serve Eastern Oregon were more likely to report impacts due to hiring challenges.
3.2.1	**Twelve percent of firms interviewed reported that their employees were enrolled in a union**. Firms that serve commercial or industrial customers were more likely to be enrolled.
3.2.2	**Ninety-four percent of respondents reported that their firm provides some sort of non-wage benefits**, such as health care, paid time off, retirement, paid training, sick days, and company vehicles.
3.2.2	Owners and non-owners both reported that culture, wages, and flexibility of work were the **most important reasons employees stay with their firm.**
3.2.2	**Fifty-nine percent of firms reported working with clients that require wage reporting**. The most common challenge reported with working with clients that require wage reporting was paperwork.

Table 4: Summary of Findings – Professional Workforce and Development Practices and Tools

Section	Findings
3.3.1	**A majority of trade allies reported that their firm offers training resources (95%).** The most common training resources offered were on-the-job (45%) and manufacturer product training (18%).
3.3.2	**Almost half (45%) of respondents think there are gaps in training** offered by their firm. Firms that have been involved with Energy Trust for less than four years were more likely to report gaps (71%).
3.3.3	**Eighty-four percent of respondents said they were interested in Energy Trust offering professional development resources**, and 44 percent said they were extremely interested.
3.3.4	**Most respondents (93%) are interested in pursuing new work** that may result from the Inflation Reduction Act (IRA) to support residential energy efficiency**,** and many (63%) would require additional training to complete the types of projects that may arise from the IRA.

Table 5: Summary of Findings – Barriers and Opportunities for Trade Allies

Section	Findings
3.4.1	**Twenty-eight percent of firms reported that they were at their limit** in meeting demand over the last year. Firms that complete more than 500 projects a year were more likely to report they were at their limit.
3.4.1	**Half of all trade allies (50%) said they anticipated demand in the next year to be greater than the current year,** almost half (43%) reported that they expected it to stay the same, and only a few anticipated that demand would decrease (7%). Note that we conducted some interviews in 2023 and some in 2024.
3.4.2	**Most firms (73%) are extremely interested in increasing their project volume** over the next year. Many firms that reported they were at their limit still reported that they are interested in increasing project volume.
3.4.3	The most common **barriers to taking on more projects** were labor constraints, supply chain issues, and demand (mostly reported by firms with low demand that want to increase project volume).
3.4.4	Despite some firms reporting they are unable to meet demand, a **majority of respondents (92%) noted that they are interested in Energy Trust's help with lead generation.** Other types of support that trade allies would like were more trainings (including on incentives), co-branding, and industry updates.

Memo

To: Energy Trust Board of Directors

From: Cody Kleinsmith, Evaluation Project Manager
Cameron Starr, Sr. Customer Service Strategy Manager
Ashley Prentice, Project Manager – Trade Ally Operations
Tom Beverly, Trade Ally Network Manager

cc:

Date: July 1st, 2024

Re: Staff Response to the 2023 Trade Ally Interviews Study

The 2023 Trade Ally Interviews study gathered a wide range of information from a representative sample of Energy Trust trade allies using qualitative interviews. The last trade ally research project performed in 2018 gathered information via an online survey. In this edition of the trade ally research, Energy Trust opted for a more discussion- and relationship-based format to engage with trade allies to better capture the nuance of their unique circumstances, attitudes and opinions. The 2023 study focused on four key areas: demographic and firmographic characteristics, compensation and benefits, professional and workforce development, and barriers and opportunities. A total of 148 trade allies participated in this research across different characteristics of interest including the sector they serve, length of time they've worked with Energy Trust, Business Oregon's Certification Office for Business Inclusion and Diversity (COBID) certification status and region(s) served.

The 2023 study found Energy Trust's Trade Ally Network is likely more diverse than in 2018. The rates of woman-owned and minority-owned trade allies have increased (12% to 24% and 6% to 18% respectively) from the 2018 study, though the different methods between the two studies mean they are not direct comparisons. The rate of trade allies able to serve customers in a language other than English has also increased, from 27% in 2018 to 51% in 2023, with Spanish still the most common non-English language supported. Diversifying the Trade Ally Network remains a priority for Energy Trust, and trade ally programming such as the Contractor Development Pathway, peer mentorship, expansion of Business Development Funds, and launch of a Small Business Trade Ally Resource Network will continue to support these goals. The study also found low awareness of COBID certification and its purpose. Energy Trust will continue to support COBID certification by not only spreading awareness but also assisting trade allies in getting certified. Energy Trust will also continue to provide a self-identification pathway for trade allies that are not engaged in public contracting. Residential contractors, for example, are often less likely to be certified as a result.

A common theme of the responses was the toll that Energy Trust's administrative rules and processes have on trade allies. The study also found a low rate of union enrollment (12%) with an especially low rate among residential-focused trade allies. Energy Trust's regulatory framework and cost-effectiveness rules that determine incentive amounts can be challenging for trade allies with higher labor costs, including many union-enrolled firms. Energy Trust is committed to assisting union-enrolled firms with joining the Trade Ally Network and finding specific offers and programs that work for them. In a recent example, a trade ally on the South Coast who faced these cost barriers to working with Energy Trust was able to collaborate with Energy Trust staff and found that the direct-install lighting offer's incentive structure could work for their business.

Trade allies, especially residential-focused trade allies, also expressed concerns and hesitancy with working on projects that have wage-reporting requirements, such as those that fall under the Davis-Bacon Act, a federal law that requires local prevailing wages be paid and reported on federally funded construction contracts. More paperwork and administrative burden led to some firms, often smaller firms, avoiding contracts subject to those requirements. As Energy Trust begins working with more federal programs – such as Solar for All, which will have wage reporting requirements – we will explore ways to reduce the burden of additional administrative and reporting requirements for trade allies. Streamlining forms and administrative processes will continue to be a key focus area for Energy Trust's existing processes as well to support trade allies in taking on more work and accelerating the acquisition of energy efficiency and renewable energy resources.

Trade allies had a wide variety of ideas about opportunities to work with Energy Trust in service of our goals. Trainings that Energy Trust could offer were top of mind for many trade allies. This aligns with Energy Trust's existing efforts, such as the Contractor Development Pathway, and also highlights some opportunities that Energy Trust will develop. At future Trade Ally Forums, Energy Trust will offer a project lifecycle training to help trade allies understand each step in the process of working with Energy Trust, from customer sales to incentive application and administration to project close out. The forums will also highlight technical training opportunities, marketing and cobranding opportunities, and other resources for trade allies that Energy Trust will develop and offer.

This study was successful both in terms of engaging with trade allies and developing effective learning outcomes. Due to the success of this study, future trade ally research projects will continue to be conducted in a similar manner using qualitative interviews and a relationship focused approach. To allow for Energy Trust to implement and learn from findings of this study, the next iteration of this research should be conducted in roughly three years.

2 Introduction

This section introduces the study background, including research objectives, and presents the sample design and methodology for the research.

2.1 Study Background and Research Objectives

Energy Trust of Oregon is an independent nonprofit organization dedicated to delivering energy efficiency and renewable power benefits to utility customers. Energy Trust's Trade Ally Network is made up of over 1,600 independent contractors that help deliver incentives to their customers. Enrolled contractors receive support from Energy Trust including training, business development fund access, and referrals to customers. Energy Trust's stated goal is to bring affordable clean energy to all. To help realize this goal, Energy Trust is working to expand its network and is actively seeking to diversify it by enrolling businesses owned by people of color, women, veterans, and those certified by Oregon's Certification Office for Business Inclusion and Diversity (COBID).[2]

In the past, Energy Trust has collected information and solicited feedback from its Trade Ally Network through an online survey effort. This survey was last distributed in 2018. Energy Trust has placed greater emphasis on fostering a more collaborative and discussion-oriented relationship with its trade allies. With this in mind, for this research study, Energy Trust invested in a more personal interview format to engage Trade Ally Network members at a deeper level, and hired Evergreen Economics and BrightLine Group (the Evergreen team) to conduct this research.

The four main research topics the study addressed are listed below:

1. Demographic and firmographic characteristics of trade ally firms;
2. Compensation and benefits;
3. Professional workforce development practices, tools, and courses; and
4. Barriers and opportunities.

Within each research topic, there are several research questions Energy Trust sought to answer through the trade ally interviews. A full list of research questions is listed in Appendix A: Research Questions. During the kickoff phase of this research, the Evergreen team and Energy Trust met to discuss priorities and nuance surrounding the questions to ensure that the discussions with trade allies would provide rich information to support Energy Trust's goals.

[2] Retrieved from https://www.energytrust.org/about/what-we-do/trade-ally-network/

2.2 Sample Design

During the research kickoff meeting, we discussed Energy Trust's needs so that we could prioritize key segments and ensure we allocated resources efficiently to maximize the value of the research. After the call, we finalized a detailed sample plan using the dataset of active trade allies. For this research, we defined active trade allies as those that have completed one or more projects since 2022.[3] A total of 746 active trade allies were captured in the program data. To achieve a 90/10 confidence and precision target across sectors and for other characteristics of interest, we estimated that we needed to complete a total of 165 to 175 interviews. Given the amount of overlap in characteristics within the population, we were able to hit our targets with 148 interviews.

In Table 6, we detail the number of active, sampled, targeted, and interviewed trade allies by their defining characteristics. While we ended up meeting all targets, we focused primarily on meeting the sector targets. The targeted characteristics were important for cross-cutting comparison of firms by different characteristics, such as when firms enrolled in the network, whether they were COBID-certified, and whether they had an office with a Portland address. On average, we achieved a 43 percent response rate.[4]

[3] Provided by Energy Trust in September 2023.
[4] Note that we stopped recruitment for groups once we reached the targeted number of interviews.

Table 6: Summary of Sample and Response Rates

Sector	Active Trade Allies[5]	Sampled	Target	Completed	Response Rate
Serves Residential Sector	599	215	62	68	32%
Serves Commercial Sector	307	163	56	82	50%
Serves Industrial Sector	78	78	37	45	58%
Serves Renewable Sector	60	61	33	37	56%
Targeted Characteristics	**Active Trade Allies**	**Sampled**	**Target**	**Completed**	**Response Rate**
Later Trade Allies (2013 to present)	341	167	57	69	41%
COBID-Certified or Self-Identified	68	67	35	36	61%
Trade Allies with No Portland Office	445	195	60	77	39%
Overall	**746**	**342**	**140 – 180**	**148**	**43%**

2.3 Methodology

In this section, we provide an overview of the recruitment effort employed for the study and the approach we used for documenting responses.

We offered a $100 gift card incentive for trade ally participation. Interviews were conducted over the phone in English, with the option to schedule with a Spanish-speaking interviewer if preferred. No trade allies responded that they would prefer to do the interview in Spanish, but the option was available, and we included a Spanish summary of the interview effort and our request to interview trade allies in all recruitment materials to ensure access.

During the research planning phase, we designed the interviews to take 30 minutes to complete. However, with the addition of questions to support Oregon Department of Energy (ODOE) efforts for firms that serve residential customers, we found that many residential interviews took longer, between 45 minutes and one hour to complete. There was a significant range in interview duration due to participant availability, response length, and applicable follow up questions. In some cases, if the respondent noted that they had limited time, we shortened the interview to focus on the key questions. In others, respondents provided extensive feedback and took longer to get through all questions. On average, interviews took between 30 to 40 minutes to complete,

[5] For this research, we defined active trade allies as those that have completed one or more projects since 2022.

with at least 33 interviews taking longer than 45 minutes and at least 14 taking fewer than 25 minutes.[6]

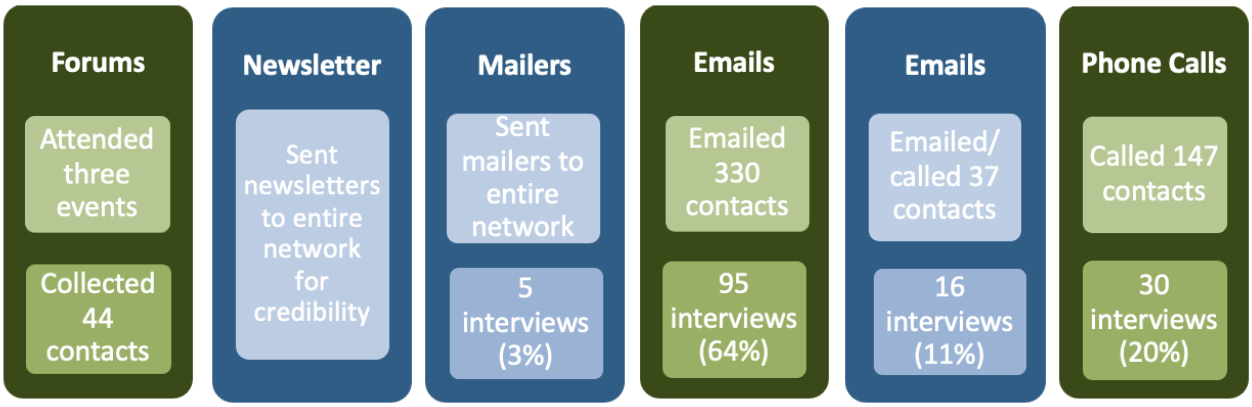
2.3.1 Recruitment

To recruit contacts, we developed a multi-modal approach. Our recruitment approach leveraged Energy Trust's existing relationships through the Insider Newsletter, and personal emails and phone calls from the Program Management Contractor (PMC) account managers. The Evergreen team also attended in-person Trade Ally Forums and conducted more traditional recruitment methods such as email, phone, and mailers.

Figure 1 displays the different modes used by the teams, with the Evergreen team's activities in green and Energy Trust's in blue. Overall, this recruitment approach was successful, with most interviews (64%) coming from email recruitment, and others coming through phone (20%), Energy Trust emails (11%) and Energy Trust mailers (3%). Of the 342 contacts in our sample, only 22 declined to participate by stating they were not interested or were too busy.

Note that it is unclear how much of an indirect "bump" Energy Trust's emails and mailers had on the overall recruitment rate, as the Evergreen team's email and phone call outreach occurred after Energy Trust's; it is highly likely that numerous participants were more interested in participating once we reached out directly because they were made aware of the study from Energy Trust. Overall, the recruitment success required teamwork and coordination across the Evergreen and Energy Trust teams.

Figure 1: Recruitment Strategies by Evergreen Team and Energy Trust



[6] We only recorded duration for 128 of 148 interviews for internal tracking purposes.

Next, we provide detail for each recruitment step, including findings. The steps covered are listed in chronological order, beginning with Trade Ally Forums in October 2023 through phone call recruitment ending in March 2024.

Trade Ally Forums

As part of Energy Trust's effort to be more collaborative and conversational than previous survey efforts, Evergreen staff attended three Trade Ally Forums in Portland (October 19, 2023), Grants Pass (October 26, 2023), and Bend (October 27, 2023) to meet trade allies in person. The forums provide an overview of upcoming incentive information, program updates, technical training, and an opportunity to network with industry equipment vendors. Because the forums were occurring at the start of the data collection effort, we leveraged the opportunity to meet trade allies in person.

Evergreen staff attended the three different locations because of the variation in firm types that typically attend each gathering and to provide equal opportunity to engage with rural and urban trade allies—by sending representatives to each forum, we were able to collect sample information from different groups. One Evergreen staff member attended each event with Evergreen and Energy Trust co-branded materials and set up a booth with information for attendees.

We included a one-page description of the research as well as a sign-up sheet for trade allies to provide a contact number, firm information, and best time to call. To encourage attendees to stop by the booth, we entered everyone that signed up to be contacted into a drawing for a gift card. Energy Trust staff also lent Energy Trust's logo for the information sheet and introduced the Evergreen team and the research during opening remarks of the forums.

Trade allies that our team talked to and received contact information from during the in-person trade ally forums were considerably more likely to complete an interview. Regularly sampled trade allies (n=294) had a response rate of 40 percent, and Trade Ally Forum attendees (n=44) had a 59 percent response rate.

Energy Trust Insider Newsletter and Mailers

The Evergreen team developed copy for the monthly Trade Ally Newsletter to describe the study and lend credibility to our recruitment efforts. The team also helped develop a postcard mailer to be sent to trade ally firms with physical addresses. These materials are located in Appendix B: Data Collection Materials.

While we only received five eligible inbound contacts directly from the mailer and newsletter outreach, we found that many contacts were familiar with the study when we recruited them, and we attribute some of the successes of these efforts to that awareness.

Evergreen Team Email Recruitment

After attending the Trade Ally Forums, the Evergreen team sent emails to invite sampled firms to participate in the research. Due to the groundwork laid by the Energy Trust team and the recognition from the Trade Ally Forums, we scheduled 64 percent of all interviews through just email outreach. Once we emailed all contacts a total of three times, we collaborated with Energy Trust program leads to engage with nonresponsive contacts.

Energy Trust Emails and Phone Calls

Energy Trust program team leaders and Program Management Contractor (PMC) account managers have valuable relationships with members of the Trade Ally Network. To leverage these relationships, we sent 208 unresponsive contacts to the Energy Trust team for follow-up. In total, Energy Trust staff sent emails to or called 37 contacts to encourage them to participate in the study. Of those, 16 firms scheduled an interview (11% of all interviews).

Evergreen Team Phone Recruitment

Finally, phone recruitment allowed us to reach contacts who do not regularly check email or for whom we had outdated contact information; phone recruitment also made it easier to convince those who reported they were short on time to participate. Many firms that were recruited through phone calls mentioned they had not seen the email and asked us to resend it or provided a new email address to send it to. Others, upon talking through the research and explaining why Energy Trust is interested in hearing from them, were willing to stay on the call and conduct the interview. Overall, about 20 percent of all scheduled interviews were from phone recruitment.

To be responsive to contacts that cited time as a barrier to participating in this research, we offered a 20-minute version of the interview. Notably, contacts that selected the 20-minute version often stayed longer after the initial 20 minutes to complete the full interview, indicating that they enjoyed giving feedback and felt the time was valuable.

2.3.2 Documenting Responses

The Evergreen team documented responses in an Excel workbook, with each set of responses from each respondent as columns and with each question as a row. We sought to document verbatim responses and then summarized them when applicable (i.e., to “yes” or “no” for a question intended to solicit a yes or no response). The respondent characteristics were also included for each response column, allowing us to analyze across the sampling dimensions.

2.3.3 Statistical Significance

The findings shared in this report are statistically significant at the 90/10 confidence interval, unless otherwise noted. Any confidence interval estimated from a small sample has the potential to overstate confidence (i.e., estimating unrealistically tight error bounds) if the sample

measurements are similar by random chance (if none of the natural outliers made it into the sample).

Statistically significant differences between groups are visualized in tables throughout this section using shading to help the reader identify which statistics were compared. In Table 7, we report on trade allies that responded "Yes" to a question, and show an example of statistically significant differences across a given firm characteristic.

In this case, firms that fall under Category 1 are statistically significantly different than firms that fall under Category 3. In situations where there are two categories within a topic that are statistically significantly different, we denote with matching symbols to track which are being compared. In the example, firms that fall under Category 1 and firms that fall under Category 3 are linked with the asterisk subscript (*) and firms that fall under Category 2 and firms that fall under Category 3 were also statistically different from one another, so we denote it with a dagger subscript (†) to show that it is a different combination. Throughout the study findings section, there may be multiple groups that are statistically significantly different from another. To help identify those, we use a combination of shading and symbols.

Table 7: Example for Statistical Significance Reporting

Firm Characteristics	Category	N	% Responded Yes
Firm Characteristic	Category 1	62	47%*
	Category 2	30	43%†
	Category 3	25	16%*†
	Category 4	17	35%
	Category 5	6	50%
	Category 6	3	0%

*†The differences between corresponding groups are statistically significant at the 90 percent confidence interval.

3 Findings

This section reports on findings from the interviews, organized by research topic. Detailed research questions are located in Appendix A: Research Questions. We analyzed all variables listed in Table 8 for each question and reported on differences in this section if they were statistically significant at the 90 percent confidence interval.

Table 8: Variables for Analysis

Category	Source	Options
COBID Enrollment	Program Data	• Enrolled • Not Enrolled
Firm Size	Self-Report	• Very Small (1 – 4 employees) • Small (5 – 10 employees) • Medium (11 – 39 employees) • Large (40 – 119 employees) • Very Large (More than 120 employees)
Number of Projects Annually	Self-Report	• Less than 40 projects annually • Between 41 – 200 projects • Between 201 – 500 projects • More than 500 projects
Percentage of Projects with Energy Trust Incentives	Self-Report	• Less than 20% of projects use incentives • Between 21 – 50% of projects • Between 51 – 75% of projects • More than 76% of projects
Portland Office	Program Data	• Office location listed in Portland • Office location not in Portland
Primary Service Area	Self-Report	• Entire State • Portland • Willamette Valley • Southern and Central Oregon • Eastern Oregon • Coastal Oregon
Sectors Served	Program Data	• Serves commercial customers • Serves industrial customers • Serves multifamily customers • Serves residential customers
Years Involved with Energy Trust	Self-Report	• Less than 4 years with Energy Trust • Between 4 and 9 years • Between 10 and 15 years • More than 15 years

Program Data versus Self-Reported Data

Note that in Table 8, some variables for analysis were pulled from program data while others are self-reports from the interviews. Service area, for example, was reported by the interviewee when we asked, "What areas of the state do you primarily serve?" Many firms may serve multiple areas, or "go to where the work is," but asking about their primary service area helps to categorize the firms by geography more specifically.

Generally, if the program data were available and reliable, we used program data; otherwise, we used self-report data from the interviews.

Often, we saw discrepancies between COBID enrollment in the program data and whether the respondent knew if their firm was COBID enrolled (Table 9). Only 35 and 23 percent of firms reported a COBID status that was consistent with what the evaluation team saw in the program data (% enrolled and % not enrolled, respectively); many respondents simply were unaware of their firm's COBID status.

Table 9: Self Report versus Program Data – COBID Enrollment

	Self-Reported		
Program Data	Enrolled in COBID	Not Enrolled in COBID	Don't Know
Enrolled in COBID (n=37)	**35%**	14%	51%
Not Enrolled in COBID (n=108)	5%	**23%**	72%

This discrepancy is likely due to several factors. First, interviewed contacts were not always owners of the firm, and therefore may not have been aware of their firm's COBID enrollment status. Second, COBID eligibility is fluid and can change. For example, a certified small business could grow and lose their COBID certification. Finally, program data may not be complete for all certified firms. Throughout the history of the program to May 2023, self-attestation was a way for firms to convey to Energy Trust that they are COBID certified without submitting their certification number if they did not have it on hand. In those cases, firms would need to email Energy Trust to attest that they are COBID certified. Until May 2023, if a firm did not have its certification number available, it would have been marked in the program data as a non-COBID firm, even if it was technically qualified.

Another discrepancy we saw between the program data and the self-reported answers was the sectors served. Sectors served by firms can change often depending on what customers they serve. In general, trade allies reported more sectors than were listed in the program data (38% reported more, 15% reported less). It is likely that some firms complete projects for certain sectors

without incentives from Energy Trust programs, either due to lack of awareness or, importantly, because they are not completing energy efficiency or renewable projects for those customers.

For findings to be actionable, we used the program data when running analyses on COBID enrollment and sectors served throughout this report.

Sample Size Discrepancies

This findings section will report on counts and percentages of characteristics and responses to questions throughout. Though we completed 148 interviews in total, not all of those we interviewed responded to every question. The most common reason why some questions were not answered by all respondents was that many questions were only for firms that said they serve residential customers (n=106 respondents said they serve residential customers). Another reason was that the interviewee did not have time to complete the full interview within the allotted 30 minutes. While we do not have specific data on which questions were skipped due to time constraints versus questions that the respondents refused to answer, our team noted that most skipped questions were due to time and not to a refusal to answer.

3.1 Demographic and Firmographic Characteristics

This section reports on findings from questions related to demographic and firmographic characteristics of firms and their owners, as well as implications for hiring.

3.1.1 COBID Enrollment

The Certification Office for Business Inclusion and Diversity (COBID) certifies firms through the Business Oregon office. The primary goal of certification is to level the playing field for providing certified firms a fair opportunity to compete for government contracts regardless of owner ethnicity, gender, disability, or firm size.[7]

COBID enrollment is a key metric by which Energy Trust currently tracks demographic and firmographic characteristics of the firms involved in its Trade Ally Network. Approximately half of the COBID-certified firms we interviewed were women business enterprises (WBEs) or emerging small businesses (ESBs) (Table 10). About half of interviewed firms were certified under more than one designation (41%), and veteran business enterprises (VBEs) were the least common.[8]

[7] Retrieved from https://www.oregon.gov/biz/programs/cobid/pages/default.aspx
[8] The most common pairing of firms that had more than one designation mostly included WBEs (n=11). The most common pairings were WBEs and ESBs (n=5), and WBEs and MBEs (n=5).

Table 10: COBID Certification Types Interviewed

COBID Enrollment Type	Count	Percentage
Women Business Enterprise	17	46%
Emerging Small Business	16	43%
Minority Business Enterprise	15	41%
Disadvantaged Business Enterprise	8	22%
Veteran Business Enterprise	3	8%
More than One Designation	15	41%
Any COBID Certification	**37**	**100%**

COBID Awareness and Understanding

When it comes to awareness of COBID in general, however, only 39 percent reported that they knew what COBID certification was. Predictably, interviewees from firms that were certified as enrolled in COBID in the program data were more likely to be aware of COBID certifications than those that were not enrolled (56% vs 32%, respectively). There were some geographic differences, such as firms that serve the entire state versus other areas, and firms with Portland offices (Table 11).

For detail on how to interpret statistically significant differences, please reference Section 2.3.3.

Table 11: COBID Awareness (n varies)

Firm Characteristics	Category	N	% Aware of COBID
All Trade Allies Interviewed		**145**	**39%**
COBID Certified	Not Enrolled	106	32%*
	Enrolled	36	56%*
Primary Service Area	Entire State	62	47%*
	Portland	30	43%†
	Willamette Valley	25	16%*†
	Southern and Central Oregon	17	35%
	Eastern Oregon	6	50%
	Coastal Oregon	3	0%

Firm Characteristics	Category	N	% Aware of COBID
Office Location	Portland Office	67	49%*
	No Portland Office	75	28%*

*†The differences between corresponding groups are statistically significant at the 90 percent confidence interval.

Of the 148 interviews completed, 53 were with owners or founders of the firms. Owners were slightly more likely to be aware of what COBID certification is, but not significantly (Table 12).

Table 12: COBID Awareness by Company Role

Company Role	N	% Aware of COBID
Owner	53	45%
Non-Owner	92	35%
Total	**145**	**39%**

When we asked those we interviewed about what they understood about COBID certification, most respondents who were aware of certification were able to provide some form of a description that confirmed their awareness. The most common response (n=13) we heard was that COBID designations can make it easier to win contracts, but they did not mention the goal of the certification, which is to provide all firms fair opportunities by leveling the playing field. Respondents instead tended to focus on the outcomes of COBID enrollment, illustrated by one respondent who said, "for some government contractors, we have to check a few boxes to be more competitive."

Only three interviewees acknowledged the core tenet of COBID certification. One respondent summarized the program as "trying to help in the equity crisis in the state and help disadvantaged areas of the state."

Three of the firms we interviewed were frustrated with COBID certification. Two firms responded that it was unfair to their firms to compete against firms with certifications just because they are not women-owned or some other COBID designation. The third reported that they appreciate the opportunities provided by the certification, but there are a lot of problems with the program. Specifically, this respondent criticized the amount of time it took to complete COBID paperwork and how challenging communication with Business Oregon was throughout the process.

On administrative burdens, only two firms responded that they did not re-enroll for COBID certification because it was too much of an administrative burden; they also mentioned that the certification was only beneficial for firms that serve commercial customers.

3.1.2 Non-English Language Support

We also asked about language, which is another metric to track demographic and firmographic characteristics. About half (49%) of all interviewed firms reported that they only had English-speaking employees, and over a third (38%) responded that they had English and Spanish-speaking employees to support customers. Only 12 percent of firms had employees that spoke a language other than English or Spanish. Of the 18 respondents that said their firm can support English and another language, 15 of them also included Spanish. Almost half of trade ally firms can therefore support Spanish-speaking customers.[9]

We also found that firms that serve residential customers were more likely to be able to serve customers in both English and Spanish compared to firms that do not serve residential customers. One interviewed firm that serves commercial customers supported this and mentioned they do not need to hire for other languages because the commercial customers they serve mostly speak English. They responded, "[we have] no practical need because we're in the commercial sector, and with the size of our projects, [we] haven't run across any non-English speakers." Statistically significant differences between geographies served, customers served, amount of Energy Trust incentives used, and firm size are denoted in Table 13.

Table 13: Languages Supported (n varies)

Firm Characteristics		N	English Only	English and Spanish	English and Another Language
All Trade Allies Interviewed		**146**	**49%**	**38%**	**12%**
Primary Service Area	Entire State	62	48%*	32%*	19%*
	Portland	31	35%*	48%*	16%†
	Willamette Valley	25	48%*	48%*	0%*†
	Southern and Central Oregon	17	75%*	25%*	0%*†
	Eastern Oregon	6	50%*	50%*	0%*†

[9] Thirty-eight percent of firms reported English and Spanish (n=56) and most of the 12 percent of firms that said English and another language also spoke Spanish (n=15). In total, 71 respondents said their firm can support Spanish speakers (49% of all respondents)

Firm Characteristics		N	English Only	English and Spanish	English and Another Language
	Coastal Oregon	3	100%*	0%*	0%*†
Residential Customers	Serves Residential	67	45%	49%*	6%
	Does Not Serve Residential	76	54%	28%*	18%
Energy Trust Incentive Use	Less than 20% of Projects Use Incentives	19	68%*	16%*†	16%
	Between 21 – 50%	48	42%	48%*	10%
	Between 51 – 75%	24	33%*	46%†	21%
	More than 76% of Projects Use Incentives	45	62%	29%	9%
Firm Size	Very Small Company	31	67%*	32%	0%*
	Small Company	40	53%	33%	15%*
	Medium Company	39	37%*	46%	21%*
	Large Company	19	37%	58%	5%
	Very Large Company	15	53%	27%	20%*

*† The differences between corresponding groups are statistically significant at the 90 percent confidence interval.

Support in Other Languages

Most firms (85%, n=76) reported that they do not encounter challenges serving customers due to language barriers. Of those that reported challenges (n=11), only three responded that they use a translator to serve those customers, and the others did not specify how they overcome the challenges.

We heard from some interviewed trade allies that there was usually a way to address the language barrier, such as:

- Someone in the customer's family speaks English;
- Customers speak enough English that they can get by without technical jargon; or
- They had access to translation apps.

One specific need that came up in a few different interviews was for non-English marketing materials. One interviewed trade ally noted that a lot of the Energy Trust documentation they send their customers is in English. Even though their firm has the ability to serve Spanish speakers, they do not have access to Energy Trust materials in Spanish.

Hiring to Support Other Languages

We also asked owners of firms (n=52) if they plan to hire employees to support communication in additional languages. Approximately one in five respondents said they are interested in hiring to support more languages (21%). Of those, three mentioned that hiring in general is more important than hiring to support languages. Two quotes that capture the sentiments of this group include: "if someone that spoke another language would apply, that would be a bonus," and "yes, but we want to make sure we give equal opportunities to folks based on skill."

A smaller group of respondents prioritized non-English language skills when hiring. One firm said they were specifically looking to hire someone to speak French because they are interested in expanding into Spokane and Seattle, which have high percentages of French speakers. Another firm was primarily Spanish-speaking and mentioned that they seek to only hire Spanish speakers due to their company mission to support minority and Hispanic workers. They noted that hiring diverse workers was not a challenge for them due to their network connections, indicating that firms with hiring challenges could benefit from tapping into other community networks.

Other languages supported by trade allies are listed in Table 14.

Table 14: Non-English Languages Supported (n=142)

Languages Supported [10]	N
Spanish	69
Italian	5
French	5
Russian	3
Chinese/Mandarin	2
Afghani	1
South Sudan	1
Portuguese	1
Korean	1
Urdu/Hindi	1

[10] We acknowledge that some entries reported here are not languages and/or are not specific enough to determine what population they would serve. However, we report on what interviewees said in the interviews.

Languages Supported [10]	N
Filipino	1
Tribal Language	1
Ukrainian	1

3.1.3 Race and Gender of Owners

During the interviews, the evaluation team asked company owners to describe their race and gender for categorization purposes. If the firm was owned by two people of different races, we categorized them as "Multiple races." Most trade ally company owners identified as Caucasian (82%, Table 15) and male (76%, Table 16).

Table 15: Self-Reported Race of Owners

Primary Service Area	N	Caucasian	Asian	Hispanic or Latino	Middle Eastern	African American	Native American	Multiple Races
All Owners	**43**	**82%**	**7%**	**2%**	**2%**	**2%**	**2%**	**2%**
Entire State	16	81%	13%	-	-	-	6%	-
Portland	10	70%	-	10%	10%	-	-	10%
Willamette Valley	6	83%	-	-	-	17%	-	-
Southern and Central Oregon	6	83%	17%	-	-	-	-	-
Eastern Oregon	2	100%	-	-	-	-	-	-
Coastal Oregon	3	100%	-	-	-	-	-	-

Table 16: Self-Reported Gender of Owners

Primary Service Area	N	Male	Female
All Owners	**46**	**76%**	**24%**
Entire State	16	75%	25%
Portland	10	70%	30%
Willamette Valley	6	-	100%
Southern and Central Oregon	7	86%	14%
Eastern Oregon	2	50%	50%
Coastal Oregon	3	67%	33%

We also asked non-owners if they knew how their firm owner identified. Of those that felt comfortable answering about their firm owners' race and gender (n=71, n=69, respectively), most reported their firm owners to be Caucasian (87%) and male (80%).

Owners we spoke with were sometimes uncomfortable with answering these questions, and 15 percent of them declined to respond. Non-owners were even more uncomfortable answering on behalf of the owner of the firm and declined to answer 38 percent of the time.

During the interview effort, the Evergreen team approached Energy Trust about the hesitancy to respond to this question. Tracking the race and gender of owners is important to Energy Trust to understand the demographic makeup of their Trade Ally Network firm owners; therefore, we continued to ask these questions with modifications. After discussing the issue with Energy Trust, we included a longer introduction to the race and gender questions that explained why we were asking and what Energy Trust plans to do with the information. We also gave participants a more explicit opt-out option if they did not feel comfortable answering. After this change, we found that respondents were less likely to decline to respond to these questions (Table 17). While these differences are not statistically significant, it is valuable to think about framing when approaching trade allies about topics that may be sensitive.

Table 17: Decline to Respond to Race and Gender Questions

Company Role	Before or After Question Change	N	% Declined to Respond
Owners	Before	23	22%
	After	30	10%
Non-Owners	Before	38	32%
	After	56	23%

Diversity in Hiring

We asked firms that serve residential customers whether they have had challenges retaining or hiring diverse employees, and 102 interviewees (of 104 that serve residential customers) responded. Approximately one in five respondents said there have been challenges (20%). There were no statistically significant differences between different types of firms. Of the firms that reported challenges (n=20), most reported that a lack of diverse applicants was a barrier (70%). Other reasons included that their company is too small to focus on diversity (20%), and that hiring in general is challenging (10%).

Two illustrative quotes are provided below:

- "The engineering industry in general is not a very diverse pool."

- "I focus on hiring the person and have several different ethnicities come through the firm. If you do a good job, that's all that counts and nothing else matters. If you are a good person and I can trust them, that's all that matters. I like to keep it simple."

Some specific challenges that trade ally firms reported were:

- A lack of knowledge about where to hire more diverse workers;
- Concern about not knowing how to accommodate other genders and races; and
- Worry about new, more diverse workers feeling welcome in the environment.

3.2 Compensation and Benefits

Hiring workers will be important for growing the energy efficiency sector in Oregon. We started this round of questions by asking respondents whether they faced any challenges in hiring, then sought detail on what benefits they offer to entice employees to stay. This section reports on findings from questions related to hiring challenges, compensation and benefits, and union enrollment.

3.2.1 Hiring Challenges

Less than half of all respondents (44%) reported that they faced some internal bottlenecks with projects and workflow due to challenges in hiring employees. Trade allies that serve Coastal Oregon and Eastern Oregon were more likely to report impacts due to hiring challenges (Table 18).

Table 18: Internal Bottlenecks with Projects Due to Hiring Challenges (n varies)

Firm Characteristics	Category	N	% Reported Challenges
All Trade Allies		**132**	**44%**
Primary Service Area	Entire State	55	40%*
	Southern and Central Oregon	15	40%
	Willamette Valley	23	43%
	Portland	29	41%
	Eastern Oregon	5	80%*
	Coastal Oregon	3	100%

* The differences between groups are statistically significant at the 90 percent confidence interval.

Of the respondents that said they faced impacts of hiring challenges (n=58), many responded that all positions were impacted (41%). Of those, there were significant differences in firms by COBID enrollment and by sectors served (Table 19).

Table 19: All Positions Impacted Due to Hiring Challenges (n varies)

Firm Characteristics	Category	N	% Reported All Positions Impacted
All Trade Allies with Hiring Challenges		**58**	**41%**
COBID Certified	Not Enrolled	20	65%*
	Enrolled	38	29%*
Sector Served	Industrial	18	17%†
	No Industrial Customers	40	52%†
	Residential	30	63%±
	No Residential Customers	28	18%±

*†± The differences between groups are statistically significant at the 90 percent confidence interval.

About a quarter of respondents (26%) mentioned technicians or installers, and other common responses included operations (including office managers, project managers, and admin), electricians, and sales. Table 20 shows the prevalence of all responses.

Table 20: Positions Impacted Due to Hiring Challenges (n=58)

Position	% of Respondents
All Positions Impacted	41%
Technicians/Installers	26%
Operations	12%
Electricians	10%
Sales	10%
Service	7%
Analysts	3%
Design	3%
Marketing	3%
Warehouse	2%

Of all respondents that reported hiring challenges (n=15), firms that install HVAC equipment most frequently (60%) reported the need for technicians or installers.[11] A common thread was that there were not enough qualified or experienced technicians or installers to hire. One respondent said, "Many have not worked in HVAC in the past and we would like to alleviate some of that." When pressed on how this barrier could be alleviated, they responded that they may require training due to their lack of industry knowledge.

Another common response was difficulty in hiring electricians. One interviewed trade ally from a solar PV installation firm reported that electricians were in high demand and mentioned that it is hard to compete with union shops because electricians will want the benefit of higher wages. They said, "[we] pay [our] electricians well but it's hard to compete with union shops for electricians." This likely indicates a preference for subcontracting electrical work, rather than hiring electricians due to the competitive wages provided by electrician firms.

Union Employees

Twelve percent of firms reported that their employees were enrolled in a union. Firms that serve commercial or industrial customers were more likely to be enrolled compared to firms that do not serve commercial or industrial customers (Table 21).

Table 21: Union Employees

Firm Characteristics	Category	N	% with Unionized Employees
All Trade Allies		**139**	**12%**
Sector Served	Commercial	78	19%*
	No Commercial Customers	59	2%*
	Residential	65	5%†
	No Residential Customers	72	18%†
	Industrial	44	22%±
	No Industrial Customers	93	6%±

*†± The differences between corresponding groups are statistically significant at the 90 percent confidence interval.

[11] Others included one solar firm, one electrical firm, one glass/windows firm, one air compressor firm, and two that did not specify their industry.

The firms that reported that the company employees were enrolled in a union (n=16) mostly worked in the electrical (8), HVAC (6), lighting (5), or solar (4) industries. Note that many firms reported working in multiple industries. Furthermore, nine reported they were enrolled in their local International Brotherhood of Electrical Workers (IBEW) chapter. The other seven did not know or did not specify the union.

3.2.2 Benefits

We asked respondents about benefits provided to employees of their company. Many respondents said they receive the "typical benefits" or "all benefits," but when pressed, listed only a few of the options.[12]

Of the 136 interviewees that responded to questions about benefits offered, only eight reported that they only received a wage. The most commonly offered benefits are listed below:

- Healthcare (98)
- Paid time off (79)
- Retirement (76)
- Paid training (31)
- Sick days (31)
- Company vehicles (30)

Some offerings that were reported by less than 10 respondents included flexible schedules (9), life insurance (6), gym benefit (4), remote work options (4), heath savings accounts (3), commission (3), company phones (1), store discounts (1), commuter reimbursement (1), and employee assistance program (1).

We also asked respondents what they believe is the most important reason that people stay at their firm; we report on the responses by whether they were the owner of their firm or not. Of the 104 responses, culture, wages, and flexibility were identified by both owners and non-owners as the most important reasons for staying at their firms (Table 22).

[12] If collection of specific benefits is valuable to Energy Trust, this question should be modified to ask yes or no for each benefit of interest.

Table 22: Most Important Reason Employees Stay with Firm, by Owners and Non-Owners (n varies, multiple responses allowed)

Reason	Non-Owners (n=70)	Owners (n=34)
Culture	66%	68%
Wages	42%	53%
Flexibility	21%	21%
Stability	4%	12%
Bonus/Profits	4%	-
Advancement	4%	-
Work/Life Balance	3%	-

Clients with Wage Reporting Requirements

We asked trade allies whether they work with clients that have wage reporting requirements (i.e., through the Davis-Bacon and Related Acts). Clients that require wage reporting often perform work on federally funded or assisted contracts of public buildings or public works and often have different requirements for contractors.[13]

More than half of respondents (59%, n=135) reported working with clients that have wage reporting requirements. There were many statistically significant differences by primary service area, sector served, and firm size (Table 23).

For this analysis, we added descriptive notes to help the reader understand where statistically significant differences lie.

Table 23: Working with Wage Reporting Clients (n varies)

Firm Characteristics	Category	N	% Work with Wage Reporting Clients	Descriptive Notes
All Trade Allies		**135**	**59%**	
Primary Service Area	Entire State	59	69%*	• Eastern Oregon is different than all groups
	Southern and Central Oregon	14	71%±	
	Willamette Valley	23	35%*†	

[13] For more information on Davis-Bacon and Related Acts, please see the Department of Labor website.

Firm Characteristics	Category	N	% Work with Wage Reporting Clients	Descriptive Notes
	Portland	29	45%*†	except Coastal Oregon • Entire state is different than Willamette Valley and Portland
	Eastern Oregon	5	100%*†±	
	Coastal Oregon	3	33%	
Sector Served	Commercial	76	71%*	
	No Commercial Customers	56	43%*	
	Residential	60	48%†	
	No Residential Customers	72	68%†	
Firm Size	Very Small	27	42%*	• Extra large firms are different than all others • Large firms are different than very small firms and small firms
	Small	38	47%†	
	Medium	38	61%±	
	Large	17	82%*†	
	Extra Large	13	92%*†±	

*†± The differences between corresponding groups are statistically significant at the 90 percent confidence interval.

We asked respondents who worked with clients with wage reporting requirements (n=80) what differences there are in working with these clients versus others. A quarter (25%) of respondents said there were no differences. Of the respondents that did say there was a difference, the most common difference was that prevailing wage clients required more administrative work such as paperwork (37%). Other differences mentioned are listed in Table 24.

Table 24: Differences with Working with Wage Reporting Clients (n=80)

Difference	Example	Percentage of Responses
No Difference		**25%**
More Paperwork	"[A lot of] documentation and invoicing. We have to show hours worked and show proof wage was paid. It causes extra time and steps."	37%
More Expensive	"A lot more overhead cost for the company"	11%
More Time	"With extra qualifications, it does take more time and money. So that's challenging but we factor it into bidding, administration, and labor."	9%
The Jobs Pay More	"Our electricians like getting paid a little bit more on those jobs."	5%
Projects Have Higher Quality Standards	"Higher expectations, quality assurance standards"	5%
Types of Clients	"A lot of government and municipality work"	4%
More Transparency	"We do have to be open with our specs."	3%
Other	"Payments can be delayed…they tend to hold onto payment for up to 90 days, so I don't do a lot of that for that reason."	3%

We also asked all trade allies about challenges serving clients that require wage reporting, and 79 people responded, including 12 interviewees that said they do not serve these clients.

While about half (49%) of respondents said that there were no challenges, some reported that the differences mentioned in serving these clients presented challenges. In particular, paperwork (21%), time (12%), and cost (5%) were cited. A small group (8%) mentioned that project fit was a challenge (Table 25).

Table 25: Project Fit Challenges (n=6)

Trade Ally Firms that Serve Clients with Wage Reporting Requirements (n=4)	Trade Ally Firms that Do Not Serve Clients with Wage Reporting Requirements (n=2)
"[The challenge is that those projects] typically get awarded to larger and more established firms."	"This is not an avenue that we go down. **Wage reporting itself is not a barrier,** those projects are just not projects that are in our wheelhouse."
"[These projects] tend to be highly competitive. We don't tend to pursue them as much because we are so busy with much more profitable projects."	"Not really the type of work we do."

According to some smaller firms, the administrative and time burden from working with clients with wage reporting requirements created a barrier to working on these projects because they do not have the capacity. One firm responded that they would have to hire more people to take on these projects, and another mentioned that they had to hire union workers specifically for the projects, which was challenging. One respondent mentioned that there are issues with how solar installers are classified, so they end up getting paid a lot less than market rate.

3.3 Professional Workforce Development Practices and Tools

This section reports on the training resources utilized by trade allies, gaps in trainings, and the potential for Energy Trust support. We started by asking about the training resources that trade allies use, making a distinction between in-house or internal resources offered by the firm and resources from external organizations that the firm utilizes. Next, we asked about perceived gaps in training and what types of resources are missing. We then looked into the potential for Energy Trust support and what types of resources trade allies are interested in. Finally, we cover the types of work that trade allies are interested in and would need training for, anticipating increased federal funding from the Inflation Reduction Act (IRA).

3.3.1 Training Resources

The majority of trade allies reported offering training resources to their employees (95%). The most common types of internal training resources offered by firms are on-the-job training (45%), manufacturer product training (18%), and continuing education training (12%, Table 26). Firms tend to use external resources for specific technical training such as manufacturer product training (41%) and installation training (12%).

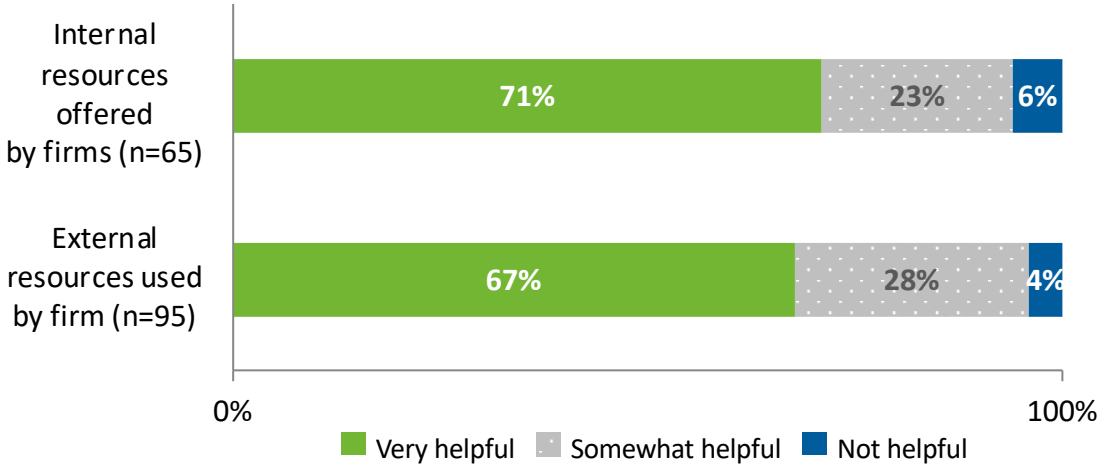
Table 26: Training Resources

Resource	Internal Resources Offered by Firm (n=139)	External Resources Used by Firm (n=148)
On-the-Job Training	45%	1%
Manufacturer Product Training	18%	41%
Continuing Education Training	12%	7%
Installation Training	10%	12%
Apprenticeship	5%	3%
Sales Training	4%	3%
Certification Program	2%	8%
Other	13%[14]	31%[15]
None	17%	16%

We then asked respondents who had participated in these trainings how helpful they were (Figure 2)—specifically, how helpful internal resources are for career development and how helpful external resources are generally. Respondents reported that in-house resources offered by their firms were just as helpful as external resources (71% vs. 67%).

[14] Resources included in 'other internal resources offered by the firm' include unspecified in-house trainings, industry trainings, safety trainings, licensing trainings, incentives trainings, and staff meetings.
[15] Resources included in 'other external resources used by the firm' include unspecified trainings, licensing classes, safety trainings, conferences, and trainings from other organizations. A complete list of these organizations is listed on the next page.

Figure 2: Usefulness of Training Resources Available (n varies)



Of the respondents who reported that the resources are either somewhat helpful or not helpful, the most common reason for this rating is that the trainings are not specialized enough to be particularly useful. As respondents put it, the trainings are either "not technical enough" or are simply "useful if needed" and "depends on [your] role at the company."

Respondents reported using training resources from the following external organizations:

- Energy Trust of Oregon (28)
- Utilities (14)
- ENERGY STAR (3)
- American Architectural Manufacturers Association (AAMA)[16] (2)
- Bonneville Power Administration (2)
- Occupational Safety and Health Administration (2)
- Department of Energy (1)
- Other[17] (12)

[16] Note that respondents told us that they used training resources from "AAMA." During analysis, we post-coded the response and assumed they were referring to the American Architectural Manufacturers Association.
[17] The following organizations were mentioned by one respondent: Air Conditioning Contractors of America (ACCA), Association of Energy Engineers (AEE), BuildingGreen, CLEAResult, Compressed Air and Gas Institute (CAGI), Construction Contractors Board (CCB), Electric Vehicle Infrastructure Training Program (EVITP), James Hardie, North American Technician Excellence (NATE), Oregon Solar Lobby, Resource Innovation Institute (RII), and Solar Energy International (SEI).

In addition to training resources that trade allies use, we also asked respondents about training resources that they have heard about but are not using. Most respondents said they were aware of specific trainings from different organizations, such as Energy Trust, ENERGY STAR, the Occupational Safety and Health Administration, and the Construction Contractor Board. The types of trainings mentioned include the following:

- Specific trainings from different organizations (23)
    - Licensing, seminars, safety trainings, etc.
- Manufacturer product training (6)
- Certification programs (2)
- Installation trainings (1)
- Sales training (1)

Of the 19 respondents who had heard of additional resources but were not using them and provided reasons why, time and scheduling was reported as the most common barrier to participation (n=10). Trade allies reported that they were either too busy for additional trainings, that they were not made aware of the trainings in time to schedule them, and that it was challenging to find the balance between sending employees to training sessions and ensuring that they are taking on enough projects to sustain operations (from a financial standpoint). One quote that summarized this group's sentiment is captured below:

- "[It is a challenge to allocate] time to pull employees from projects and put them on days of training without pay and income to the company."

Similarly, respondents reported that the cost of the trainings (as opposed to lost opportunity of not working on paying projects) was a barrier to participating in additional trainings (n=8). Three trade allies also mentioned that some resources are not accessible, either due to their location or because they were not offered in Spanish.

The portion of respondents who said that the resources are not useful or that they have no need for the trainings is relatively small (n=3), implying that while these firms are interested in participating in these trainings, they face other barriers.

3.3.2 Gaps in Training

In addition to asking about existing training resources, we also asked trade allies about training resources that may be missing at their firm.

Skill Gaps in Training

Close to half of respondents (45%, n=112) said they think there are gaps in training offered by their firm. Interestingly, owners are more likely than non-owners to report that there are gaps in

training (56% vs. 38%). This difference is not statistically significant but may be because owners have a more comprehensive understanding of the trainings offered at their firm and their firm's limitations in what types of projects they are able to complete.

Additionally, companies that have been involved with Energy Trust for more than 15 years were less likely to report that there were gaps in trainings compared to companies that have been involved for less than four years (Table 27).

Table 27: Reported Gaps in Training

Firm Characteristics	Category	N	% Reported Gaps
All Trade Allies		**112**	**45%**
Energy Trust Involvement	Less than 4 Years	21	71%*
	Between 4 – 9 Years	28	43%
	Between 10 – 15 Years	29	45%
	More than 15 Years	28	32%*

* The differences are statistically significant at the 95 percent confidence interval.

Respondents reported most commonly experiencing training gaps in specific technical or industry-specific knowledge (17), creating standardized onboarding and training plans (5), and incentive training (3).

- Technical / industry-specific knowledge (17)
- Onboarding / training plan (5)
- Incentive training (3)
- Energy efficiency knowledge (2)
- Administrative tasks (2)
- Safety training (2)
- Product training (2)

Career Advancement Gaps

The 15 respondents who reported not having enough resources were asked about the types of training resources they would like to see. The most requested resource was technical training (n=4), with respondents citing that these trainings can be expensive to offer themselves and that they prefer hands-on work to online trainings. Additionally, respondents expressed interest in administrative trainings such as project management, bookkeeping, and information on how to complete incentive paperwork (n=3), along with marketing training for help expanding their

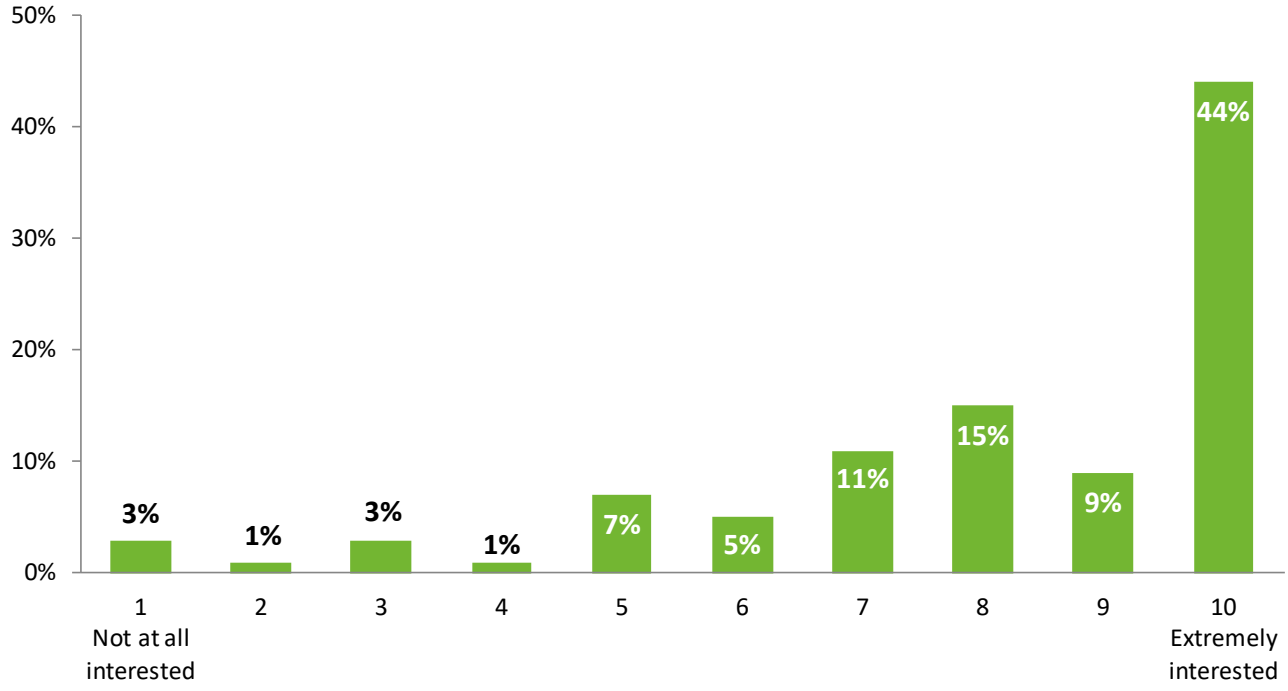
customer base and enhancing web design (n=2). Teambuilding support was also requested to improve communication skills and create a cohesive team (n=2).

Those who reported not having enough resources stated that they lacked trainings for both technical and soft skills. The interest in soft skill trainings suggests a recognition of the importance of administrative and interpersonal skills as individuals progress into managerial roles, where the emphasis shifts from technical proficiency to effective leadership and communication.

3.3.3 Potential for Energy Trust Support for Training

Energy Trust offers various resources to its Trade Ally Network. We asked in the survey how interested respondents would be in professional development resources. Approximately half of the respondents (44%) said they were "extremely interested" in Energy Trust offering professional development resources to members of its Trade Ally Network (Figure 3).

Figure 3: Interest in Training Resources from Energy Trust (n=148)



We found some geographic differences in the proportion of firms that were extremely interested in training resources from Energy Trust; these are denoted as statistically significant in Table 28. We also found statistically significant differences in this level of interest based on how long the firms were engaged with Energy Trust.

Table 28: Interest in Resources from Energy Trust

Firm Characteristics	Category	N	% Extremely Interested[18]
All Trade Allies		**148**	**54%**
Primary Service Area	Entire State	63	40%*
	Portland	31	71%*
	Willamette Valley	24	46%†
	Southern and Central Oregon	18	83%†
	Eastern Oregon	6	50%
	Coastal Oregon	3	33%
Years with Energy Trust	Less than 4 Years	25	76%*
	Between 4 and 9 Years	42	57%
	Between 10 and 15 Years	35	37%*
	More than 15 Years	38	53%

*† The differences between the groups are statistically significant at the 90 percent confidence interval.

Trade allies mostly requested resources from Energy Trust related to business operations compared to any technical or industry-specific skills. Respondents reported being most interested in resources that would keep them informed with industry news and opportunities, administrative trainings, and information about Energy Trust-specific offerings and programs. All responses were categorized as:

- Industry information and potential opportunities (19)
- Administrative / managerial / project management resources (16)
- Energy Trust-specific offerings and programs (12)
- Incentive programs (12)
- Industry best practices (12)
- Technical skills (10)
- Marketing / sales (7)
- Code changes (7)
- Soft skills (5)

[18] 'Extremely interested' includes respondents who indicated an interest level of 9 or 10.

- Funding / financing (4)
- Networking events to meet other trade allies (3)

Responses from trade allies that did not want any additional support from Energy Trust (n=11) were categorized into three groups: their firm does not need any support (n=5), the perception that Energy Trust does not have enough experience or expertise in their area to provide training that would benefit them (n=4), and if Energy Trust paid them for their time at trainings, they would be more interested (n=3).

One respondent illustrated their sentiments regarding the trainings by saying, "[our] employees don't have time to do more training and we already hire experienced staff. If Energy Trust paid us for our time attending their trainings, it would be a 10 [very interested.]"

3.3.4 IRA Funding Implications

The State of Oregon is expecting an influx of federal funding to support residential energy efficiency from the Inflation Reduction Act (IRA). We asked firms that serve the residential sector whether they would be interested in work expected to be in high demand once IRA funding becomes widely available, and if so, if they would need training to become skilled in these types of work. The specific areas we asked about included the following:

1. Energy modeling
2. Weatherization
3. Installing efficient HVAC equipment
4. Assisting customers applying for incentives
5. Educating customers about energy efficiency options

Most respondents (93%) were interested in at least one of these areas of work, and many (63%) responded that they would need additional training to complete the work (Table 29).

Table 29: Interest and Need for Training for New Areas of Work (n=80)

Work Type	Interested	Need Training
Assisting Customers Applying for Incentives	90%	49%
Educating Customers about Energy Efficiency Options	80%	55%
Installing Efficient HVAC Equipment	54%	24%
Energy Modeling	46%	36%
Weatherization	30%	16%
Total	**93%**	**63%**

3.4 Barriers and Opportunities for Trade Allies

This section covers findings related to trade ally firms' capacity to meet demand, their interest in increasing project volume, barriers to business, and solutions to barriers in the form of Energy Trust lead generation and support.

3.4.1 Capacity to Meet Demand

Trade allies were asked about their ability to meet demand for their services over the last year. Twenty-four percent of firms responded that they had unused capacity, 22 percent reported that they were perfectly meeting demand, and 28 percent reported that they were at their limit (unable to support demand). Statistically significant differences between firms based on how many projects they complete annually and whether they serve residential customers or not are visualized in Table 30.[19]

Table 30: Capacity to Meet Demand

Firm Characteristics	Category	N	% with Unused Capacity	% Somewhere in Between	% Perfectly Meeting Demand	% at Their Limit
All Trade Allies		**148**	**24%**	**22%**	**22%**	**28%**
Number of Projects Annually	Less than 40 Projects	38	37%*	26%	8%*†	24%
	Between 41 – 200 Projects	44	30%†	20%	27%*	16%*
	Between 201 – 500 Projects	36	8%*†	25%	36%†	31%
	More than 500 Projects	24	17%	8%	17%	50%*
Sector Served	Serves Residential Customers	68	13%*	25%	26%	31%
	No Residential Customers	77	31%*	19%	18%	26%

*†The differences between the groups are statistically significant at the 90 percent confidence interval.

[19] Non-significant differences between groups, including firms serving/not serving commercial and industrial customers, are not included in the table.

Future Capacity Projections

Half of all interviewed trade allies (50%, n=141) said they anticipate demand next year to increase, about half reported that they anticipate demand will stay the same (44%), and only a few anticipate demand to decrease (6%). There were no statistically significant differences across groups. Of the 64 firms that anticipate demand increasing, about a third (34%) are in the HVAC industry. Other industries for which trade allies anticipate demand increasing include solar (22%), lighting (20%), and electrical (19%). Table 31 shows the percentage of the 64 firms in a given industry; many firms were engaged in multiple industries.

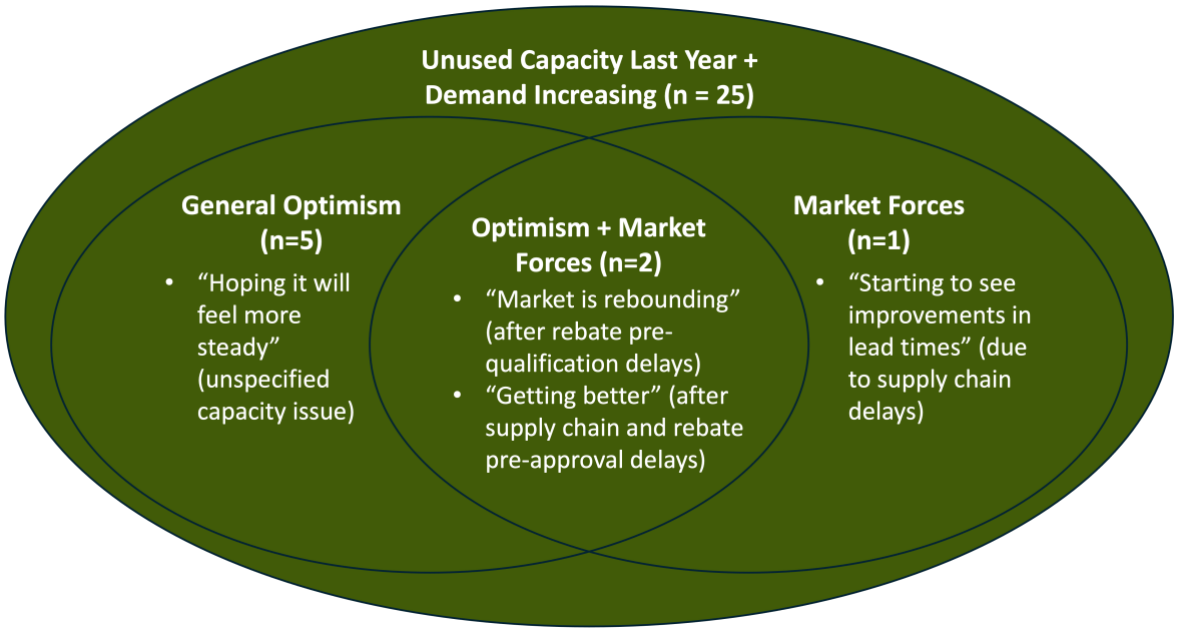
Table 31: Trade Allies that Anticipate Demand Increasing, by Industry

Industry	N	%
HVAC	22	34%
Solar	14	22%
Lighting	13	20%
Electrical	12	19%
Weatherization	10	16%
Other[20]	7	11%
Verification/Incentives Processing	5	8%
Windows and Doors	5	8%
EV Chargers	4	6%
Energy Storage	3	5%

Twenty-five interviewed trade allies reported they had both unused capacity over the last year and anticipate demand to increase in the next year. We categorized those responses as 'general optimism', 'market forces', and 'optimism plus market forces' (Figure 4).

[20] 'Other' includes irrigation, pumps, refrigeration, ventilation, roofing, and plumbing.

Figure 4: Comments on Demand Increasing Among Trade Allies with Unused Capacity



Thirteen interviewed trade allies said they were at their limit last year but anticipate demand increasing over the next year. Of these firms, nine reported that they either plan to hire to alleviate some of the demand pressure, or that they recognize the need to hire. One respondent discussed the tradeoff between needing to hire and not having capacity to train someone new with the demand pressures.

They said, "[We're] at our limit. The biggest issue has been hiring and finding people who are qualified and ready to work. [We] don't have the time to teach someone something new. We need to find someone who already knows how to do it."

3.4.2 Future Opportunities

All interviewed trade allies were asked about how interested they are in increasing their volume of projects over the next year. Only a small percentage (8%) of interviewed trade allies responded that they were "not at all interested."[21]

Smaller firms were more likely to report that they are not interested, while large firms were more likely to report that they are "extremely interested" (Table 32).

[21] Numeric responses were coded as: 1-3 = "not at all interested", 4-6 = "a little interested", 7-8 = "moderately interested", and 9-10 = "extremely interested".

Table 32: Interest in Increasing Volume of Projects

Firm Characteristics	Category	N	% Not at All Interested	% Extremely Interested
All Trade Allies		**148**	**8%**	**73%**
Firm Size	Very Small	31	23%*†	42%*
	Small	41	10%*†	80%
	Medium	40	0%*†	75%
	Large	19	5%	89%*
	Very Large	15	0%*†	87%

*† The differences between the groups are statistically significant at the 90 percent confidence interval.

The high overall rate of respondents that were "extremely interested" (73%) and the low rate of firms "not at all interested" (8%) in increasing the volume of projects seems to potentially contradict the fact that almost a third (28%, n=148) of trade allies were at their capacity limit last year.

Of those 41 firms that reported they were at their limit, 27 (66%) are "extremely interested" in increasing their volume of projects over the next year. Based on a review of responses, this seems to reflect 1) a growth mindset of always looking for more work despite labor or market realities, and 2) an expectation of being able to hire more to support increased volume.

Among these interviewed trade allies who were at their limit but looking to increase project volume (n=27), many spoke to their work ethic, growth mindset, and a core value that businesses should always aim to increase project volume. This occasionally led to statements that seemed to contradict responses related to operating at capacity (Table 33). For example, one trade ally noted that "if there was more demand, [we'd] have a problem" but responded that they were "extremely interested" in increasing project volume over the next year.

Table 33: Responses of Select Trade Allies at Capacity Who Want to Increase Project Volume

Capacity to Meet Demand over Last Year	Interest in Increasing Volume of Projects over Next Year
"If there was more demand they'd have a problem."	"Extremely interested."
"At limit."	"Company always wants more business."

Capacity to Meet Demand over Last Year	Interest in Increasing Volume of Projects over Next Year
"Always at limit. We can subcontract if we get too busy."	"I can never turn down a project."
"At their limit."	"Always looking for projects."
"At their limit."	"Always interested, leads are great, growth is great."

Even if respondents did not say they *always* want to increase project volume, 15 trade allies expressed some sentiment of a growth mindset. Eight trade allies explicitly said some version of "we *always* want to increase the number of projects." For example, one respondent said, "Everything benefits from increased productivity, personal gain, do better for family, pay employees better." Another said, "Focus on growing exponentially, our goal is to grow as fast as possible and expand our staff and tech force." The positive responses to increasing project volume despite operating at capacity appear to be tied to values of growth, whether explicit or implicit.

In some cases, a growth mindset seems to have masked the realities and difficulties of labor or market conditions, but 13 of the 27 trade allies recognized that they would have to hire more to support their desire for increased project volume. When asked about increasing project volume, one trade ally said "very interested, with a higher volume of projects can hire additional staff, turn around designs and projects faster and more efficient. As a small business, I am the bottleneck; need a certain amount of volume to have the cash to keep employees." Another trade ally noted that they, "always want more business. [The] challenge is finding experienced and quality employees to work on the team."

These quotes suggest that many of these trade allies have a desire for increasing project volume as long as they can hire more qualified employees, and they recognize the challenges of doing so. Additionally, the ability to hire may be somewhat contingent upon the ability to bring in more projects, as firms suggested reluctance in ramping up from a staffing perspective without sufficient contracts ("putting the cart before the horse").

3.4.3 Barriers

Trade allies looking to increase project volume were asked about barriers to taking on more projects, and trade allies who were not looking to increase project volume were asked about barriers to meeting demand over the last year. Interestingly, there were similar types of reported barriers for both groups (Table 34). The most common barrier was labor, which was reported by 37 percent of firms that want to increase project volume and 53 percent of firms that do not. There was a large difference in the reported barrier rate for costs; 11 percent of firms that want to

increase project volume reported that costs were a barrier, compared to 21 percent of firms that do not want to increase project volume.

Table 34: Reported Barriers by Trade Allies that Do/Do Not Want Increased Project Volume

Reported Barrier	Want to Increase Projects (n=129)	Do Not Want to increase Projects (n=19)
Labor	37%	53%
Supply	20%	26%
Demand	18%	16%
Costs	11%	21%
Marketing	5%	0%
Interest Rates	3%	0%
Other	14%	5%

The similar barriers may reflect that the question posed to trade allies looking to increase project volume asked about barriers more generally, while the question posed to trade allies not looking to increase project volume asked them to speak to their direct experience (and focused on barriers experienced over the past year). For example, one trade ally listed supply as a barrier but commented "There was a lot of supply chain issues - especially during covid, but [it's] far better now."

It is also worth noting that the subset of trade allies who were at their capacity limit last year but who want to increase project volume are included in the group of 129 firms that want to increase projects, and they likely reported similar barriers as the firms that were at their capacity limit last year but that do not want to increase project volume.

Ultimately, the most important barriers are intertwined—if demand ***increases*** and supply chain issues ***decrease***, the risk associated with staffing ("labor") may become less important or impactful. Conversely, if firms experience shortages in skilled labor, they may be unable to meet demand.

Travel Costs

In another question related to barriers, trade allies were asked if travel costs are factored into bid pricing and if that leads to any advantage for local firms. The majority of interviewed trade allies (84%, n=130) said that they factor travel costs into bid pricing. Many trade allies mentioned that their firm charges a travel fee on the project, pays a per diem to their employee, and/or covers lodging for employees. Several firms have a set threshold for when they charge a travel fee,

including if a project is further than a certain mileage radius or if their workers have to stay overnight.

A majority of interviewed trade allies (67%, n=121) said that local firms have an advantage in terms of winning bids because they do not have to factor in travel costs (which are ultimately passed on to the client in the form of a higher cost project). The difference between all trade allies and ones that primarily serve coastal Oregon was statistically significant. However, please note that we only had two respondents from coastal Oregon. No other groups had statistically significant differences, including whether firms served different sectors (Table 35).

Table 35: Belief that Local Firms have an Advantage in Winning Bids

Firm Characteristics	Category	N	% Local Firms Have an Advantage
All Trade Allies		**121**	**67%**
Primary Service Area	Entire State	50	66%*
	Portland	27	78%*
	Willamette Valley	21	67%*
	Southern and Central Oregon	13	69%*
	Eastern Oregon	6	67%*
	Coastal Oregon	2	0%*

* The differences between the groups are statistically significant at the 90 percent confidence interval.

However, many trade allies elaborated on the nuances of local firm versus out-of-town firm advantages. Many trade allies mentioned that in more rural areas, there might be a lack of specialized firms and thus an out-of-town firm is best suited to conduct the project. One trade ally noted, “when we travel it’s because there are not a lot of HVAC companies around the customers.” Another trade ally put it simply and said, “the problem is there are no local firms.” Bid pricing was mentioned as a key factor in winning bids, and several trade allies noted that the project will go to the lowest bidder, which is not necessarily a local firm.

Incentive Changes

One final barrier mentioned in several interviews was changing incentive amounts. In particular, several companies in the windows and doors industry were upset that the Oregon Department of Energy (ODOE) changed the incentive amount for windows. One trade ally mentioned that they had previously worked extensively with Energy Trust incentives but now the incentives do not make sense for any of their customers. The trade ally said, “It isn’t doable based on the new incentives, [customers] don’t get enough back to pay the higher upfront cost.” Another trade ally

in the window installation business said that the only current projects involving incentives were lingering 2022 projects.

3.4.4 Potential for Energy Trust Support

Interviewed trade allies were asked several questions about support from Energy Trust. When asked about interest in lead generation support from Energy Trust, an overwhelming majority (92%) responded that they would appreciate Energy Trust's help with lead generation. Some respondents mentioned that they have received leads from Energy Trust in the past, or that they currently do and that they were or are helpful. One mentioned that they used to work with an Energy Trust account manager for multifamily leads and they were extremely helpful; however, those leads seemed to stop coming.

Only a small percentage (8%) of interviewed trade allies responded that they were not interested, with firms that do not serve industrial customers, smaller companies, and firms without a Portland office more likely to report they are not interested (Table 36).

Table 36: Interest in Lead Generation Support

Firm Characteristics	Category	N	% Not Interested
All Trade Allies		**143**	**8%**
Sector Served	Industrial	44	0%*
	No Industrial Customers	96	11%*
Firm Size	Very Small	31	19%*
	Small	39	10%†
	Medium	40	5%±
	Large	16	0%*†±
	Very Large	15	0%*†±
Office Location	Portland Office	65	2%*
	No Portland Office	75	13%*

*†± The differences between corresponding groups are statistically significant at the 90 percent confidence interval.

Of the 12 firms not interested in lead generation, four mentioned that they already had enough work or were particularly established in their community. Two firms mentioned it was not worth the time investment, one trade ally said that people who come to them directly are more likely to move forward, and the other said that it is too much of an investment to navigate the Energy Trust lead portal. Finally, one trade ally in the residential and commercial windows industry said, "Most

of the lead generation has been for big commercial projects which [we] don't really get involved in." There were several concerns among firms that were interested in lead generation and that currently receive leads from Energy Trust. These included:

- Concerns about the quality of leads received from Energy Trust and the time it takes to further qualify leads;
- A concern that the leads are sent to multiple companies and are not personalized for their firm; and
- A disconnect between what Energy Trust thinks the firm does versus what they actually do (e.g., one firm does not do large projects but continues to get leads for large projects).

Interviewed trade allies were asked for other suggestions for partnership opportunities with Energy Trust (outside of lead generation). Table 37 categorizes the most common responses of incentives trainings, other trainings, and co-branding.

Table 37: Suggested Energy Trust Partnership/Support Opportunities with Trade Allies (n=94)

Opportunity	Example	N	Percentage
Incentives	"Training on incentives. Would like an assigned, dedicated representative."	25	27%
Training	"trainings around code changes"	23	24%
Co-Branding	"marketing co-branding"	23	24%
Industry Updates	"White papers and technical conference proceedings"	15	16%
Partnering	"Have a Board of Contractors/partners to help make policy decisions"	14	15%
Open Generally	"We are big fans of ETO and the more engaged we can be, the better."	13	14%
Other	"More direct communication"	11	12%
Certification Help	"LEED certification help"	5	5%

Many trade allies mentioned that incentives and the intricacies of Energy Trust programs change so frequently that it would be helpful to have more incentives-based trainings. Trade allies who mentioned co-branding said that the Energy Trust brand would help them generate more leads. Finally, one trade ally had a creative suggestion of forming a group or board of contractor representatives (trade allies) that have a say when policy decisions are being made, although practical limitations would certainly be a consideration. This respondent felt that certain decisions had previously been made without much input from those in the field.

Appendix A: Research Questions

Table 38 provides Energy Trust's stated research goals and questions, as well as more detail added to the research questions based on discussion during the kick-off call with the team.

Table 38: Research Matrix

Research Topic	Research Question
What demographic and firmographic characteristics do trade ally firms have?	What languages do trade ally firms work in and serve customers with throughout the life of the project (sales, installation, follow up)?
	What are the race and gender of trade ally firm owner(s)?
	What is the level of awareness and enrollment in the Business Oregon Certification for Business Inclusion and Diversity (COBID) program among trade ally firms?
What compensation and benefits are employees of Trade Ally Network firms offered and engaged/enrolled in?	What rate of union enrollment do trade ally firms have? Which unions are they enrolled in, if any?
	What employee classifications or labor tiers do trade ally firms utilize to determine compensation packages for employees?
	What non-wage benefit packages do trade ally firms offer to their employees?
	What experience do trade ally firms have working under contracts with wage and wage reporting requirements (e.g., Davis-Bacon)? Does this differ by residential and non-residential serving firms?
What professional and workforce development practices, tools, and courses do trade ally firms use/offer?	What workforce development entities or organizations do trade allies work with/are members of?
	What training resources do trade ally firms offer to employees? Are there other resources available from third parties, such as training delivery partners or continuing education organizations?

Research Topic	Research Question
What barriers and opportunities do trade ally firms express that exist in helping to fulfill Energy Trust's mission?	What labor, supply chain, or other circumstances are constraining trade ally firms' abilities to complete projects?
	What level of interest do trade ally firms have in Energy Trust developing lead generation relationships with trade ally firms?
	What level of interest and ability do trade ally firms have to handle higher volumes of projects? What barriers exist to completing more?
What barriers and opportunities do trade ally firms express that exist in helping to fulfill Energy Trust's mission?	What level of interest do trade ally firms have in Energy Trust supporting professional development resources for their employees? What types of professional development support would trade ally firms be interested in?
	What partnership opportunities on capacity building initiatives do trade ally firms believe exist?
	What level of interest do trade ally firms have in standardized professional development practices offered throughout the Trade Ally Network?

Appendix B: Data Collection Materials

This section contains in-depth interview guides, recruitment materials, and an FAQ guide.

In-Depth Interview Guide

This section contains the in-depth interview guide.

Caller Introduction

All calls began with an introduction by the interviewer and a brief recap of the research objectives (Energy Trust is investing in workforce development and training. They want to learn about its trade allies in a more personal way, specifically about training resources, barriers and opportunities for trade allies, and more information on the firms themselves to understand where and how to invest), reminders of anonymity (with the option to share feedback if they would like), and the $100 incentive for completing the interview.

Interviewee Background

1. First, I want to learn about you and your firm. Can you tell me a little bit about your role at [firm] and what [firm] does?
    a. How many years have you been with [firm]?
    b. How many employees are with [firm]?
    c. What areas of the state does [firm] serve?
        i. (probe on: how far is the firm typically willing to travel for a job)
    d. How long has [firm] been involved with Energy Trust?
    e. What sectors does [firm] serve? (residential, commercial, industrial, agricultural)
        i. [IF residential] What types of energy efficiency work does [firm] do?
            1. (probe on: electrical, plumbing, HVAC, weatherization)
2. About how many projects a year does [firm] complete in Oregon?
    a. About how many of those involved Energy Trust incentives?
    b. [IF multiple sectors or regions] How does this differ by sector or region?

Workforce Development Tools

Next, we want to learn about training resources and development opportunities you may have at [firm].

3. What training resources does [firm] offer employees?
    a. [IF there are resources] Have you yourself used those resources? Which ones?
        i. [IF they have used them] How helpful are those resources for career advancement?
        ii. [IF they haven't] Why not?

4. Are there any external training or workforce development resources that [firm] uses or provides for employees, such as trainings or workshops provided by another company?
    a. [IF yes] What are they?
    b. [IF yes] Have you yourself engaged with them?
        i. [IF they have used them] How useful are those resources?
        ii. [IF they haven't] Why not?
5. Outside of what [firm] provides internally and externally, are there any other resources for training or workforce development you are aware of?
    a. [IF yes] What are they?
    b. [IF yes] Have you yourself engaged with them?
        i. [IF they have used them] How useful are those resources?
    c. [IF yes] Out of curiosity, what do you think is keeping [firm] from leveraging these additional opportunities?
6. Do you see any gaps in trainings provided at [firm]?
    a. [IF yes] Like what?
7. Do you think there are enough training resources available for career advancement within [firm]?
    a. [IF no] What would you like to see?
8. On a scale of 1 to 10, with 1 being not interested at all and 10 being extremely interested, how interested would you be in Energy Trust offering professional development resources to members of its Trade Ally Network like you?
    a. [IF 5 - 10] What types of developmental support would you and others in the network be interested in?
    b. [IF 1 – 4] What led you to give it that score?

Barriers and Opportunities

Next, we want to talk more about the energy efficiency projects [firm] works on in Oregon.

9. How would you rate [firm]'s capacity to meet demand for your services over the last year? [IF NEEDED] Would you say you have lots of unused capacity, were you at your limit, or were you somewhere in between?
    a. How does [firm] anticipate this changing in the next year? [IF NEEDED] Speeding up, slowing down, or staying the same?
    b. On a scale of 1 to 10, with 1 being not interested at all and 10 being extremely interested, how interested is [firm] in increasing the volume of projects in Oregon over the next year?
        i. What factors lead you to give that score?
        ii. [IF looking to increase] What barriers are there to take on more projects?
            1. [probe on labor, supply chain, demand]
        iii. [IF NOT looking to increase] What barriers have there been over the last year or so to meeting demand for your services?

1. [probe on labor, supply chain, demand]

10. Thinking about traveling out of town for projects, how does [firm] deal with the associated costs? Are the costs factored in to bid pricing?
    a. Do local firms have an advantage in terms of winning bids, since they don't have to factor in travel costs?
11. Are you familiar with the federal home energy rebates passed as a part of the Inflation Reduction Act?
    a. [IF yes] Does [firm] plan to engage with the federal rebates when they are available?
        i. Why or why not?
        ii. [probe on paperwork requirements, alignment with customer needs, electrification barriers such as needing panel upgrades]
    b. Does [firm] have experience connecting homeowners with incentive programs and rebates for projects other than Energy Trust energy efficiency projects?
        i. [If yes] which ones?
12. Oregon is experiencing an influx of federal funding to support residential energy efficiency. Would [firm] be interested in carrying out any of the following types of work? A simple yes or no answer for these are fine.
    a. Energy modeling
    b. Weatherization
    c. Installing efficient HVAC equipment
    d. Assisting customers applying for incentives
    e. Educating customers about energy efficiency options
13. Along the same vein, would [firm] need training to carry out any of the following types of work? A simple yes or no answer for these are fine.
    a. Energy modeling
    b. Weatherization
    c. Installing efficient HVAC equipment
    d. Assisting customers applying for incentives
    e. Educating customers about energy efficiency options
14. Would you be interested in Energy Trust helping with lead generation?
    a. Why or why not?
15. Do you see any other partnership opportunities between Energy Trust and [firm] or other trade allies like yourself?

Compensation and Wages

With these next few questions, we are going to ask specifically about compensation and wages at [firm]. Energy Trust is interested in understanding operational cost differences across Oregon because they can impact overall costs to customers. A reminder that these responses will be kept anonymous, and you're free to skip any that you're not sure about.

16. Are you familiar with how compensation is determined at [firm] and wage reporting requirements?
    a. [IF no – skip to next Q19]
17. Do you encounter internal bottlenecks with your projects and workflows due to challenges hiring for certain positions?
    a. [IF yes] Which positions are most impacted?
18. Does [firm] work with clients that have wage and wage reporting requirements (e.g., Davis-Bacon)?
    a. [IF yes] What are some differences in working with clients with these requirements versus without these requirements?
        i. [probe on] Residential vs. non-residential projects
    b. [IF NO] Are you aware of opportunities with clients that do have wage and wage reporting requirements?
        i. [IF yes] Are there challenges with those types of projects that tend to keep [firm] from pursuing?
            1. [probe on] requirements
19. Is [firm] enrolled in a union?
    a. [IF yes] Which union(s)?
20. What non-wage benefit packages does [firm] offer employees?
    a. [probe on: health care, paid time off, sick days, 401k, company vehicles, trainings, flexible schedules]
21. We're interested in learning about employee retention at [firm]. Between wages and [insert other non-wage benefits mentioned], and anything else you can think of, which do you think are the most important reasons workers stay at [firm]?
    a. (probe on: advancement opportunities, work/life balance, more consistent hours, barriers due to childcare, transportation or other personal matters, career change)

Firmographic and Demographic Questions

Finally, to help us categorize all your responses, we need to ask a few demographic questions about [firm].

22. Are you familiar with the Certification Office for Business Inclusion and Diversity, or "COBID" program?
    a. [IF yes] What do you know about the COBID program?
    b. [IF yes] Do you know if [firm] is enrolled as a COBID firm?
        i. [IF yes] What type of COBID designation does [firm] have?
            1. (options are: women-owned, veteran-owned, minority-owned, emerging small business, disadvantaged business)
23. What languages does [firm] work in?
    a. [for each language] Is [firm] able to serve customers throughout the life cycle of the project from sales to installation to follow up in [mentioned languages]?

i. [probe on: challenges with handoffs across staff, teams]

b. [if only English] Has [firm] had issues serving other customers?

c. Does [firm] have plans to hire or train to support more languages in the future?
   i. Why or why not?

d. Does [firm] experience barriers or difficulties in hiring and retaining diverse employees?
   i. [IF yes] What barriers or difficulties does [firm] experience?
      1. [probe on: work authorization issues, lack of applicants, employee barriers like transportation, childcare, or other personal matters]

24. [IF Interviewee is not the owner] Do you know who [firm]'s owner is?
    a. [IF yes] Which best describes their race?
       i. Options:
    b. [IF yes] Which best describes their gender?
       i. Options:
25. [IF Interviewee is the owner] For categorization purposes, how would you describe your race? How would you describe your gender?
26. Finally, do you prefer a $100 virtual Amazon gift card or a physical $100 VISA gift card?
    a. [IF virtual] What is a good email address to send that to?
    b. [IF physical] What is a good address to send that to?

Recruitment Materials

This section lists all recruitment materials we used over the course of the recruitment period. A list of all materials, in the order that we deployed them, is below:

- Insider newsletter copy for Energy Trust to use
- Email recruitment from Evergreen
  - One version was for those who signed up at the Trade Ally Forums
  - One version was for those who were sampled
- Mailer copy for Energy Trust
- Email reminder from Evergreen
- Email text for Energy Trust field staff to send
- Phone scripts for Evergreen recruitment

Insider Newsletter Copy – Energy Trust

Below is the copy for the Insider Newsletter that Energy Trust sent out mid-November 2023. The purpose of this text is to inform trade ally firms about the research to help legitimize our recruitment efforts.

To	Trade ally email
Method	Insider Newsletter
From	Energy Trust Listserv
Text	Energy Trust recognizes the need for a strong workforce and is investing in workforce development and training. We've hired Evergreen Economics and Brightline Group (the Evergreen tam) to conduct interviews with trade allies to learn more. Your feedback will help us understand trade ally training and workforce needs and areas to direct our funding. Evergreen or Brightline will soon be reaching out to selected trade ally firms through email, phone calls, and direct mail to schedule 30 to 45 minute interviews in the next few weeks. The Evergreen team understands your time is valuable, and they will pay you $100 for your help with this research. If you have any questions about the research, please contact Cody Kleinsmith at Cody.Kleinsmith@energytrust.org.

First Email Recruitment (Signed up) – Evergreen Team

This email went out to anyone who signed up to be contacted during the in-person Trade Ally Forums.

To	Trade ally email contact who signed up at the Trade Ally Forums
Method	Email
From	Evergreen team, CC regional field staff
Text	Hi <<name>>, It was nice to meet you at the Trade Ally Forum in <CITY> last month. Thank you for taking an interest in this research! As a reminder, we are doing research to learn about the needs and opinions of industry professionals like yourself. We're conducting interviews that will take around 30 minutes of your time and ask you questions about characteristics of your company and your experience in the Trade Ally Network. **As a thank you for your time, we will offer you a $100 gift card when you complete the interview.**

	If you're still interested in taking part in an interview, please click on the link below to reserve your time. *Si prefiere que su entrevista sea en español, una entrevistadora que habla español le llamará para agendar la entrevista.* [link] Thank you! **Please reply to this email for help with any technical issues. If you'd like to confirm the legitimacy of our request, you can contact Cody Kleinsmith at Energy Trust at Cody.Kleinsmith@energytrust.org.**

First Email Recruitment (Sampled) – Evergreen Team

This email went out to any contacts that were sampled to be included in the research but did not sign up during the in-person Trade Ally Forums.

To	Trade ally email contact
Method	Email
From	Evergreen team, CC regional field staff
Text	Dear <<name>>, Energy Trust recognizes the need for a strong workforce and is investing in workforce development. They have hired us to learn more about the trade ally network so they can invest in ways that will help firms like yours! We'd like to hear from you and invite you to participate in a 30 to 45 minute interview. You may have heard about this research from the Insider Newsletter or a Trade Ally Forum. **As a thank you for your time, we will offer you a $100 gift card when you complete the interview.** If you're interested in taking part in an interview, please click on the link below to reserve your time. *Si prefiere que su entrevista sea en español, una entrevistadora que habla español le llamará para agendar la entrevista.*

	[link] Thank you! **Please reply to this email for help with any technical issues. If you'd like to confirm the legitimacy of our request, you can contact Cody Kleinsmith at Energy Trust at Cody.Kleinsmith@energytrust.org.**

Mailer Copy – Energy Trust

This text was for Energy Trust to send mailers to non-responsive, sampled contacts. Energy Trust may have taken liberty with the design and format of the copy.

To	Trade ally addresses
Method	Energy Trust mailers
From	Energy Trust
Text	Dear <<name>>, Energy Trust of Oregon would love to hear from you about your experience with the Trade Ally Network! We recognize the need for a strong workforce and are investing in workforce development and training. We've hired Evergreen Economics to help us learn the best ways to improve the network. We are running a study to understand the needs and opinions of trade allies in the network. We've hired Evergreen Economics and Brightline Group (the Evergreen team) to conduct interviews with trade allies to learn more. **The Evergreen team is offering a $100 gift card to complete an interview with them.** The interview will take around 30 to 45 minutes of your time and ask you questions about characteristics of your firm to learn about how to tailor services offered to trade ally firms. If you're interested in taking part in an interview, please email or call the Evergreen team to schedule a call. If you'd like to schedule a call online, please use the link listed below. Link to schedule: https://bit.ly/Energytrust *Si prefiere que su entrevista sea en español, envíenos un correo electrónico a tradeallyinterview@evergreenecon.com y una entrevistadora que habla español le llamará para agendar la entrevista.*

	If you have any questions, please contact Cody.Kleinsmith@energytrust.org or Evergreen Economics at tradeallyinterview@evergreenecon.com or 971-930-8684. Thank you!

Email Reminder – Evergreen Team

Two weeks after the initial email, the Evergreen team followed up with non-responsive contacts using this script. This script provided a different value statement on why they should participate. Using multiple appeals could have helped with a response.

To	Trade ally emails, non-responsive
Method	Email
From	Evergreen team
Text	Dear <<name>>, We are reaching out again because we have not heard back from you. We really need your help. Energy Trust wants to learn more about their trade allies; specifically, about training resources, barriers, and opportunities for trade allies. These interviews are meant to help Energy Trust with investing in workforce development and training. We're inviting you to participate in a 30-minute phone call about your trade ally firm. **We are offering a $100 gift card for your participation in an interview.** Your help with this research will help improve the program for you and other trade ally firms in Energy Trust's network. If you're interested in taking part in an interview, please click on the link below to reserve your time. You may also reply directly to this email. *Si prefiere que su entrevista sea en español, una entrevistadora que habla español le llamará para agendar la entrevista.* [link] Thank you!

	Please reply to this email for help with any technical issues. If you'd like to confirm the legitimacy of our request, you can contact Cody Kleinsmith at Energy Trust at Cody.Kleinsmith@energytrust.org.

Email Text – Energy Trust Field Staff

One week after the follow up email from Evergreen, Energy Trust field staff sent non-responsive contacts an email to help establish the research as legitimate and make a more personal appeal if they have a relationship with the contact. This script could have been customized to the field staff member and their relationship.

To	Trade ally emails, non-responsive
Method	Email
From	Energy Trust field staff, cc Evergreen team member
Text	Dear <<name>>, I'm following up on an email you received about an opportunity to take part in an interview and share your experiences in the Trade Ally Network. Evergreen Economics and Brightline Group are inviting you to participate in a 30-minute phone call about your trade ally firm. **They will send you a $100 gift card for your participation in an interview.** Your insights can help improve the network and increase professional development opportunities in the future. If you're interested in taking part in an interview, please click on the link below to reserve your time. [link] Thank you!

Phone Scripts – Evergreen Team

After all other recruitment methods are exhausted, we called all other non-responsive contacts to attempt to schedule them for an interview using this script. Staff members were prepared to conduct the interview on the spot if the contact wanted to do it at the time of this call.

To	Trade ally emails, non-responsive
Method	Phone call

From	Evergreen team OR subcontracted Spanish recruitment firm
Text	Hello, this is [caller name] from Evergreen Economics/Brightline Group calling on behalf of Energy Trust of Oregon. Could I speak with [contact name] please? [If not customer] When would be a better time to call back to reach them? I'm calling to follow-up on an email you received from us inviting you to take part in a phone interview as part of an Energy Trust Trade Ally Network study. We're offering a $100 gift card for you to participate in a 30 to 45 minute phone interview. During the interview, we will ask you to tell us about different characteristics of your firm and your experience in the Trade Ally Network. Would you like to participate in our study? [If yes] Schedule interview and confirm phone number. [If no] Thank and terminate

FAQ Guide for Recruitment

This section includes anticipated questions from trade ally contacts so that the Evergreen team and Energy Trust staff assisting with recruitment were well prepared with answers.

1. **When will you be conducting these interviews?**
    a. We will begin contacting and scheduling interviews with selected trade ally firms in November.
2. **Who are you looking to interview?**
    a. We are reaching out to enrolled trade ally firms that have completed at least one Energy Trust-supported project in the last year. We need to speak to someone who has a company-wide (or at least a regional) perspective on things such as staffing, compensation, workforce development, and/or barriers to completing projects. We only need to speak with one person per company, unless there are geographical differences within a franchise, for example.
3. **How will you pay me the $100?**
    a. We can either mail you a physical VISA gift card or email you a virtual Amazon gift card after you complete the interview.
4. **Can I take the interview in Spanish?**
    a. Yes, if you prefer to take the interview in Spanish, we will schedule you with one of our Spanish-speaking interviewers.
5. **What will Energy Trust do with the information from the interviews?**

a. Evergreen will compile all responses from the interviews to provide recommendations for how Energy Trust can better support the Trade Ally Network. All responses will be anonymous and only reported on in the aggregate. If you have specific feedback and would like Energy Trust staff to follow up, we can pass along the message.

6. **How will you interview me?**
    a. We will schedule a 30 to 45 minutes phone call with you and will call you at your preferred phone number.
7. **Who can I contact with more questions?**
    a. Please contact Cody Kleinsmith (Cody.Kleinsmith@energytrust.org) at Energy Trust or Kayla Kirksey (kirksey@evergreenecon.com) at Evergreen Economics with more questions.
8. **Will this research be published?**
    a. Yes, this research will be available on Energy Trust's website in Spring of 2024

ILLUME
an E Source Company

August 22, 2025

report

Energy Trust of Oregon Independent Restaurant Study Report

Prepared for:
Energy Trust of Oregon

Prepared by:
ILLUME Advising, LLC
An E Source Company

Acknowledgments

ILLUME Advising LLC, an E Source Company (ILLUME), is a forward-thinking consulting company at the rare intersection of insight and execution. Founded in 2013, the company has quickly grown to include a deep bench of quantitative and qualitative research experts. ILLUME uses cutting edge research strategies to help build a resilient energy ecosystem to enrich lives, improve global health, and ensure a more secure and sustainable future.

For this effort, we would like to acknowledge, first and foremost, Energy Trust of Oregon, and the support of our Research Advisor, Beria Consulting, for their guidance and expertise throughout this research process. We would also like to recognize the study Advisory Committee members who were integral for advising and assisting in research development and execution:

Jose Garcia, Executive Director of New Horizons and CEO of Hispanic Business Alianza, Hermiston

Oscar Gustavo Gordillo, Small Business Advisor and Community Member, Beaverton

Angelina Martinez, Community Member, Salem

Leesha Posey, Community Advisor, Portland

Julio C Valera, President, JulioKnows LLC, Silver Falls

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Executive Summary

Independent restaurants keep our communities connected, yet they've long been underserved. This study, led by Energy Trust and ILLUME Advising, is a starting point to listen, learn, and help the whole industry better support these vital businesses.

Energy Trust of Oregon (hereby referred to as Energy Trust) set out to conduct a study to understand the needs of independent restaurants. Better understanding this market and their needs is of particular interest to Energy Trust, as independent restaurants:

1) Have high energy use intensities within the commercial market, and specifically compared with other small business[1]. This is due to the intensive nature of the equipment necessary to run a commercial kitchen, as well as the age of much of the equipment used in these businesses.

2) Have higher levels of racial minority ownership as compared to businesses overall (34% versus 18%)[2], a critical market to serve in Energy Trust's efforts to advance their equity goals.

3) Are a less researched and understood group compared with commercial businesses in other sectors, leading to limited literature and resources available in the public domain. This lack of deep understanding has resulted in many programs and institutions that do not directly address these customers' needs.

Energy Trust recognized that this segment has been underserved by traditional energy efficiency programs and the supply chain. They have unique equipment needs and, much like small businesses, require program designs and implementation strategies to address participation barriers unique to this market, such as lower amounts of upfront capital, high volatility of business ownership, and lower expected savings, which can be less cost-effective than serving larger commercial customers.

Energy Trust and stakeholders enlisted ILLUME Advising to conduct this study to learn more about this unique market, identify opportunities to better serve them, and understand how they interact within the restaurant supply chain. Energy Trust also looked for this research to support the industry more broadly in serving independent restaurants, recognizing there has been little research on this segment. This study serves as a launching point for this discussion.

Who are these restaurants?

We talked to restaurants we define as "independent restaurants" as well as restaurants who had ethnically diverse cuisines.

Independent restaurants are defined as restaurants that are 1) non-franchised, 2) independently owned & operated, and 3) dine-in.

The study excluded food carts, home-based food service, or temporary stalls as they will have different needs than those who operate out of a permanent commercial space.

Restaurants with ethnically specific cuisines and ownership were of specific interest, as these kitchens were hypothesized to have different equipment needs than other kitchens and owners face unique participation barriers.

[1]NEEA Commercial Buildings Assessment, 2019
[2]National Restaurant Association Data Brief, April 2025 https://restaurant.org/research-and-media/u-s-restaurant-owner-demographics

Research Objectives and Methods

Energy Trust wanted to understand the extent to which independent restaurants faced unique equipment needs, barriers, and purchasing decisions with the intent of using this insight to more equitably and effectively serve this group.

This research, as initially designed, had **three main objectives**:

1

Understand the characteristics of independent restaurants and their operations, including how these operations impacted their decision making and constraints.

2

Understand the equipment sourcing and supply chain for cookline (including ventilation) and refrigeration equipment—where these restaurants make purchases, how they decide what to buy, and how suppliers influence those decisions.

3

Identify gaps in efficient equipment and efficiency services, including the availability of efficient options, barriers to adoption, and opportunities for Energy Trust to address these challenges.

Learning from the Source

To answer these objectives, the research team conducted site visits and interviews with restaurants, interviews with service contractors[3], and attended a manufacturers conference to more deeply understand this segment.

This research was designed to be flexible to accommodate emerging needs and questions throughout the process. During the research execution, the research team continually assessed which questions were still relevant to the team and which actors were most critical to receive feedback from. This process is further described in Chapter 1, Detailed Research Methods.

23 Site Visits and Interviews

14 in Portland
6 in Willamette
3 Eastern Oregon

5 Contractor Interviews

3 who service all equipment types
2 who service only refrigeration/HVAC

Observational Research & Interviews

Informal discussions with food service industry professionals
Attended The North American Food Equipment Manufacturer's Conference

[3]In this context, "service contractors" or "contractors" refers to service providers who work with commercial restaurant equipment. While the contractors we interviewed offered a variety of services, some focused on servicing hot or cold equipment, and others handled both. Others also offered HVAC services or worked with institutional or industrial refrigeration. Nonetheless, all shared the common role of servicing restaurant equipment, and some also sold equipment.

Key Findings and Opportunities for Energy Trust

Objective 1

Understand How Independent Restaurants Operate

In exploring how these restaurants operate and how that affects their engagement with energy efficiency programs, three key themes emerged: 1) relationships are key, 2) margins are tight, and 3) messaging is critical.

From the perspective of these owners and the contractors that serve them, energy-efficient equipment can be expensive, difficult to source, hard to maintain, and not perform to their standards. While not always true, these perceptions and constraints will be challenging for Energy Trust to overcome.

Key Findings

For these restaurants, strong relationships are central—with customers, staff, trusted contractors, and other local businesses. Many rely on industry networks for business decisions. Owners from specific cultural communities often have strong ties to community organizations, while rural owners struggle to build these connections due to distance and isolation.

Most owners operate on tight margins and focus on managing core costs like labor and food, leaving utility costs a lower priority despite overall concern about operating expenses.

Equipment costs are viewed differently from other operating costs as large, one-time investments. The disruption and unpredictability of replacements creates anxiety, leading owners to extend equipment life to space out major purchases.

Most use old and non-ENERGY STAR® certified equipment, often inherited from taking over previous businesses, with average ages ranging from 3 to 30 years.

Independent restaurants have limited bandwidth. Owners are commonly wearing multiple hats in their business and working long hours, making time constraints an issue for participation.

Restaurant owners do not prioritize energy efficiency in equipment decisions, and often assume anything new is more efficient, leading to uninformed purchases.

Owners find some efficiency guidance difficult to adopt. Many felt unable to reduce HVAC costs, unwilling to join smart thermostat programs, or unable to adjust set points due to concerns about customer comfort or equipment performance.

Equipment replacement is largely driven by equipment failure or inoperability, often due to age, poor durability, or lack of maintenance. While repairs are attempted, high costs frequently make replacement the more practical option.

Independent restaurants are particularly sensitive to equipment failures, as they are completely reliant on this equipment for their operations. Any energy efficient equipment offered by Energy Trust needs to reliable and well tested.

Owners want programs to be easier to engage with. They recommended simplifying applications (such as turnkey or midstream models), offering personalized audit-based recommendations, providing online cost-comparison tools, and expanding financing options with more flexible qualifications than traditional financing.

Messages about reliability and cost savings resonate more than "energy savings," which doesn't connect with how owners think about expenses. Framing efficiency in terms of direct operational impact is more effective for this audience.

Opportunities for Energy Trust

To cater to this segment, look towards program models that **reduce customer burden**, such as trade ally programs, midstream programs, or other turnkey services that do a majority of installation and rebate processing.

In marketing, **focus on reliability and operational costs** as well as energy savings. Provide clear messaging that contractors can use to easily promote upgrades to owners. Owners respond more to messaging that speaks directly to their bottom line.

Work through existing networks to build trust, like small business associations, cultural organizations, and restaurant and lodging associations, and use channels that already reach these owners, such as community newsletters, Hispanic radio, and cultural publications.

Objective 2

Understand Equipment Sourcing and Supply Chains

Related to the reasons discussed in Objective 1, independent restaurants have major constraints on their purchasing decisions and equipment sourcing due to tight margins and need for quick replacement turnaround times. They prefer equipment that they perceive as high performing, durable, and easy to maintain—although that equipment was not always within their budget. Additionally, Contractors emerged as a key supply chain actor that Energy Trust does not currently engage with during program outreach.

Key Findings

Equipment replacement is highly constrained. Most restaurants operate in rented spaces where they can't make permanent modifications. New equipment must fit existing footprints and be compatible with what's already in place. Choices are further limited by what's immediately available.

Contractors are a trusted but underutilized part of the supply chain. Restaurant owners often turn to them early in the decision-making process for advice on equipment replacement or repair, yet Energy Trust lacks targeted engagement with those serving this segment. Many contractors they work with are local, smaller-scale providers who offer end-to-end support, reflecting the close personal connections these independent restaurants rely on.

Contractors are not opposed to energy-efficient equipment, but many need more information on how to service and promote it. Some noted while they are familiar with efficient models, those models can be harder to service than "lower tech" alternatives.

Contractors have low awareness of Energy Trust offerings for this segment. Although Energy Trust engages some vendors and contractors, staff believe awareness is low among those catering to this segment of food service equipment and rebate programs. While the study included only a small number of contractor interviews, most were more familiar with residential or HVAC programs than with food service-specific offerings. The fryer rebate was the only restaurant-related incentive they could name.

Opportunities for Energy Trust

Design programs to **support fast, efficient upgrades during equipment failure**. Since these restaurants typically replace equipment only when it breaks, responsive solutions—like pre-qualified equipment or contractor-led replacements—can meet their needs while improving efficiency, especially for high-intensity items like refrigeration.

Identify and engage contractors who are already trusted advisors to independent restaurants. Their close relationships position them to spot failing equipment early and guide owners toward efficient replacements, creating a natural entry point for Energy Trust to support timely, high-impact upgrades.

Leverage these contractors' trusted role by **training them to diagnose and service efficient equipment**. Prepare them not only with information on incentives, but also with practical knowledge so they feel confident maintaining and recommending high-efficiency models to restaurant owners.

Objective 3

Identify Gaps in Efficient Equipment and Efficiency Services

The study gathered information on the equipment used by independent restaurants and the efficient options currently available in the market. It also explored additional equipment opportunities for future product development, particularly for restaurants with ethnically specific cuisines.

Based on this assessment, the research did not identify gaps that could be addressed through new product development and/or cost-effectively developed for independent restaurants specifically. However, the research did find there was opportunities to expand service to this group through their existing offerings and potentially through expanding offerings.

Key Findings

ENERGY STAR is the only widely recognized signal of efficiency. Without it, most restaurant owners don't know which equipment is energy efficient, and manufacturers also rely on ENERGY STAR to communicate performance.

There is no common piece of specialty equipment. Some restaurants had specialty equipment such as rice cookers, wok burners, or pizza ovens, but most restaurants used the same standard cookline: a range, griddle, oven, and refrigeration equipment, such as prep fridges and larger two-door fridges.

There are no emerging equipment technologies that are well suited for this market. Instead, program innovation will come through existing market opportunities. Energy Trust should look to existing food service energy efficiency programs to understand their equipment gaps.

Energy Trust's current rebate offerings focus primarily on hot cooking equipment, with limited support for cold storage like refrigerators and freezers, despite their importance to restaurant operations. Contractors noted a desire for more refrigeration options on the rebate list and recalled broader offerings in the past. As Energy Trust's eligibility criteria depend heavily on ENERGY STAR® active list, some high-efficiency models—especially for cold storage—may be excluded, even though they qualify for rebates in other utility programs.

There appears to be limited knowledge amongst this segment of Energy Trust's non-foodservice offerings. Instead, program innovation will come through existing market opportunities. Energy Trust should look to existing food service energy efficiency programs to understand their equipment gaps.

Opportunities for Energy Trust

Reconsider equipment, like energy-efficient refrigeration, already on the market but no longer offered in Energy Trust programs. It could also be of interest to establish an equipment baseline, as the research team saw a trend of older, less-efficient refrigeration equipment, and this would allow the equipment to again be viable for the programs.

Water heaters and HVAC systems present key efficiency upgrade opportunities for restaurants. Energy Trust may benefit from better **promoting existing offers for these systems.** Water heaters have shorter lifespans and higher usage due to sanitation needs, while cooking fumes and heat increase demand for effective ventilation and cooling.

Look to other utility programs to **identify high-efficiency equipment not included on the ENERGY STAR list** that could be made eligible for rebates. While ENERGY STAR is a trusted signal for both restaurants and contractors, viable opportunities may exist beyond its criteria.

Conclusion

The independent restaurant segment is varied in equipment needs, business practices, and cultural backgrounds, but they are united in being industrious, community driven, and determined to thrive in a difficult industry. To adequately serve these independent restaurants, Energy Trust will need to work within the structures that already serve these businesses and build on existing trusted networks. Energy Trust will need to learn to speak these restaurant owner's language; not of kilowatt hours or therms, but of how these offerings directly impact a business' bottom line and customer service.

When looking at the equipment market, we know that manufacturers are not looking to these businesses as a motivation for product development. So, even as new energy efficient technologies are developed, they are not yet well suited for this market. Instead, Energy Trust should look to existing, well-tested technologies for opportunities for independent restaurants. Even so, education will be needed to help contractors and vendors understand how this equipment works and how it benefits these customers.

Finally, there is more work to be done. This study attempted to review the market on a broad rather than deep basis, but is not meant to be a complete characterization of the independent restaurant segment in Oregon. For instance, there are opportunities to dig deeper into the rural restaurant perspective as a majority of the interviewees were from the Portland metro area. Also, while the research team interviewed equipment service contractors, no vendors or equipment representatives were specifically interviewed as a part of this research. This means there's more to dig into to truly understand this segment and its supply chain. Identifying where to focus in a deeper way for future studies, such as preferences for program design, desired incentive levels, or marketing testing, would be helpful.

Memo

To: Energy Trust Board of Directors

From: Amanda Zuniga, Program Manager – Commercial
Patrick Urain, Senior Program Manager – Commercial
Leila Shokat, Project Manager – Evaluation

Date: September 10, 2025

Re: Staff Response to the Independent Restaurant Study Report

Energy Trust's Existing Buildings program has invested time and resources to understand small business needs and identify opportunities for deeper savings in these businesses. Energy Trust has seen success in reaching first-time small business participants through direct install offers and is conducting pilot activities to assess the feasibility of no-cost HVAC solutions for these customers. Alongside these efforts, Energy Trust's Evaluation team conducted the present market research project focused specifically on independent restaurants in Oregon. The goal of this study was to develop a comprehensive, sector-specific understanding of restaurant owners' decision-making, their equipment needs and the market opportunities that exist for Energy Trust to engage more with this sector.

Energy Trust contracted with a research advisor, Beira Consulting, to advise and help promote a community centered research design. Beira Consulting assisted Energy Trust in convening an advisory committee of community members, business owners and industry professionals who helped guide the research. Together, this team scoped the project and selected ILLUME Advising to conduct the research. The advisory committee was engaged during workplan development, throughout the study as key contacts for recruitment and in the interpretation of findings to identify opportunities for the program. Beira Consulting was engaged and involved throughout the project in reviewing data collection guides, guiding the research direction and participating in recruitment. We would recommend working with advisors for future research projects that seek to develop an in-depth understanding of a sector where Energy Trust has not had a strong presence in the past or research projects where there is not already a basis for trust in a research team.

The research team aimed to strike a balance between generalizability of results and the importance of specificity in understanding independent restaurants. By prioritizing the recruitment of restaurants that serve many different cuisines, this research delivers useful and specific results while representing a broad range of restaurant owners. One limitation is that there was limited recruitment in more rural areas of Oregon, where supply chains and equipment purchasing are quite different from Portland Metro or surrounding cities. The research team's networks in rural areas were not as extensive as expected, hampering recruitment in those areas. In research that seeks to understand rural customers, in-person recruitment with a trusted connection present is critical to get in the door.

With regard to findings on restaurant owners' equipment purchase decisions, research participants indicated that serviceability, ease of maintenance and reliability were motivating factors for them. The research also indicated that though operating costs are a key concern for restaurant owners, energy costs are not the main contributor to their operating costs, putting energy-related improvements lower on their priority list. This guidance, along with other findings from the report, will be a resource for Energy Trust marketing plan development, and will help the program develop messages and outreach strategies that focus on what is most important to restaurant owners.

The research also found that restaurant owners most often replace equipment only when it has failed or when repair becomes too expensive. The urgency of replacement makes equipment availability and upfront cost primary drivers of restaurant owners' decisions. This suggests that program designs that mitigate customer burden and administrative requirements, such as instant discount programs, are a key ingredient in driving adoption of energy efficient equipment in this sector. Energy Trust will pursue ways to make incentives more accessible for these customers.

Interviews with restaurant owners also helped identify that contractors or handymen who service restaurant equipment are an important and under-engaged market actor within this sector. While there is some overlap between these service contractors and Energy Trust's trade ally network, the distinction is that the primary role of service contractors is to service, rather than install, restaurant equipment. This makes them less visible to Energy Trust's current project tracking systems, which are focused on market actors involved in equipment purchase and installation.

The research team found that service contractors are important not only in assisting restaurant owners to repair equipment throughout its lifetime, but also in recommending replacement equipment when the time comes. The program will explore how the current trade ally model can support collaboration with service contractors like these, who may not install equipment regularly but are trusted sources of information for restaurant owners. Energy Trust will also work to build relationships with these contractors and provide training or information on how to service energy efficient equipment to support greater adoption of efficient technologies through existing trusted networks.

The report highlights that ENERGY STAR certified cookline equipment does not seem to be the norm in these restaurants. It also pointed out that there are barriers to fully understanding this prevalence; even with in-depth site visits by experienced staff, the majority of the cookline equipment could not be identified to the point of determining its level of energy efficiency. Site visit data from this study alone do not provide enough data to support development of new measures. However, site visits did allow the research team to assess overall equipment age, condition and the prevalence of different equipment types. These findings broadly indicated that there is opportunity to serve these restaurants through efficient standard cookline equipment if Energy Trust can make its existing offers more accessible to customers.

This research project was a new approach for Energy Trust to understand a small business sector to better meet their needs. The research was exploratory and the research team remained flexible to pursue questions as they arose. For example, we had not originally intended to interview service contractors, but their importance in the market was evident from preliminary interview findings and warranted further investigation. This kind of exploratory research is valuable for understanding markets that Energy Trust is not deeply connected in, and should be guided by people with expertise and relationships in that market.

Chapter 1: Introduction & Methods

Background

Over the years, Energy Trust of Oregon (hereby referred to as Energy Trust) invested in research to better understand the small business sector, with a particular interest in small business owners that are black, Indigenous, and people of color (BIPOC). These studies have been particularly important for advancing the organization's efforts toward inclusive service and engagement as articulated in Energy Trust's Diversity, Equity, and Inclusion (DEI) Plan, which calls for designing service offerings that would increase participation among underserved customer groups and trade ally businesses[4].

To continue to advance these efforts, Energy Trust set out to conduct a study to understand the needs of independent restaurants with a focus on culturally diverse restaurants. Better understanding of this market and their needs is of particular interest to Energy Trust as independent restaurants:

1. Have **high energy intensities** within the commercial market and specifically compared with other small business.[5] This is due to the intensive nature of the equipment necessary to run a commercial kitchen, as well as the presumed age of much of the equipment used in these businesses.
2. Have **higher levels of racial minority ownership** as compared to businesses overall (34% versus 18%) , a critical market to serve in Energy Trust's efforts to advance their equity goals.[6,7]
3. Are a **less researched and understood group** compared with commercial businesses in other sectors, leading to limited literature and resources available in the public domain. This lack of deep understanding has resulted in many programs and institutions that do not directly address these customers' needs.
4. Are **generally underserved** by energy efficiency programs and the supply chain given their needs for specialized equipment which may not be available in efficient options and other barriers unique to this market

To scope and conduct this research, Energy Trust gathered a team of researchers and advisors with differing perspectives and qualifications. Energy Trust engaged with Beira Consulting who served as a Research Advisor. The Research Advisor was responsible for overseeing and consulting on the research evolution and ensuring that equity and the needs of this population are at the forefront of the research. Energy Trust also worked with Beira Consulting to form an Advisory Committee to inform the research. The advisory committee was comprised of members of the community of interest, including business owners, restaurant advisors, community leaders, and supply chain representatives. The Advisory Committee helped to shape the research scope and RFP, as well as providing valuable resources and input throughout the research process. The Research Advisor and

[4] Energy Trust of Oregon Diversity, Equity, and Inclusion Plan, updated 2023 (https://www.energytrust.org/wp-content/uploads/2022/07/2022-DEI-Plan.pdf)
[5] NEEA Commercial Buildings Assessment, 2019
[6] National Restaurant Association Data Brief, April 2025 https://restaurant.org/research-and-media/u-s-restaurant-owner-demographics/
[7] Energy Trust Diversity, Equity, and Inclusion Plan, 2024

Advisory committee were essential to ensure that this research was customer-centered throughout the fielding process. Finally, Energy Trust engaged ILLUME Advising and their associated team to conduct the research based on their deep background in culturally responsive human insights research.

Target Market and Research Focus

This study targeted the following:

Independent restaurants, defined as restaurants that are 1) non-franchised, 2) independently owned and operated, and 3) dine-in. The study excluded food carts, home-based food service, or temporary stalls as they will have different equipment needs than those who operate out of a permanent commercial space.

Restaurants with ethnically specific cuisines and ownership, as these kitchens were hypothesized to have different equipment needs than other kitchens and owners face unique participation barriers.

Regionally diverse restaurants, attempting to target various geographies throughout Oregon recognizing access to equipment and supply chain options could vary by geography, particularly between rural and urban areas.

In addition, the study focused primarily on **cookline equipment** such as griddles, fryers, ranges, and refrigeration. While there is potential with other types of equipment affecting a building (e.g., HVAC), there is less understanding of cookline equipment needs than other energy systems that are more common to other small business types.

Research Goals

This research, as initially designed, had three main goals:

1. Understand the characteristics of independent restaurants and their operations, including how these operations impacted their decision making and constraints.
2. Understand equipment sourcing and supply chain for independent restaurants for cookline and refrigeration equipment, including how they considered their purchasing decision, where they sourced equipment from, and how those they sourced equipment from impacted their decision.
3. Identify gaps in efficient equipment and efficiency services in independent restaurants, including availability of efficient equipment, barriers to adoption of efficient options, and areas of opportunity for Energy Trust to address those gaps and barriers.

Energy Trust was particularly interested in understanding these issues from the perspective of business owners that offer ethnically specific cuisines. They sought to understand the extent to which these diverse groups of businesses faced unique equipment needs, barriers, and purchasing decisions with the intent of using this insight to more equitably and effectively serve this group.

Overarching Study Approach

From a research perspective, this study started with the understanding that **we don't know what we don't know, and we need to adapt as we go**. While there is research documenting the barriers

to engaging traditionally underserved populations (such as small businesses and those with limited English proficiency), there is little to no research around this specific subgroup. Further, the study needed to be culturally sensitive and designed to ensure safety for any restaurant owners that may not be trustful of organizations or research such as this. It was therefore important that the research maintained continued openness and flexibility to the approach, adapting to the learnings along the way.

With this, there were four fundamental components of this study:

1. **Collaborative Stakeholder Engagement.** Research goals and objectives were informed by a collaborative and community-centric approach. In designing the initial research, Energy Trust solicited and integrated considerable feedback from the advisory committee, their Research Advisor, and program teams (primarily Existing Building and Small Business program teams). It was important to maintain that collaboration and opportunities for input throughout the research itself. The research team (Energy Trust Evaluation Project Manager, ILLUME research staff, and Research Advisor) met with the advisory committee twice in the study period (during kick-off/planning and early reporting) and bi-weekly with the Existing Buildings program staff. The research team also maintained regular communication with select members of the advisory committee who represented Hispanic and Latino populations. Several of these advisory committee members became key contacts and played an active role in the research by engaging, recruiting, and interacting directly with restaurants.
2. **Restaurant Engagement Through Trusted Sources ("Key Contacts").** Recognizing the criticality of trust, the study design included a "key contact" model for recruiting restaurants. Key contacts were individuals who had relationships or connections with potentially eligible restaurants. The research team identified key contacts early in the study, leveraging networks identified by the research team and study stakeholders. Key contacts recruited restaurants in their network and, where successful, provided an incentive in appreciation of their efforts. These individuals were also provided resources to support their recruitment, including handouts and a detailed summary of the study and process (see Appendix A – Recruitment Materials). Key contacts included: a) members of the advisory committee, b) members of the research team (including the Research Advisor), c) organizational representatives, including Oregon Restaurant and Lodging Association (ORLA) and APANO, and d) Energy Trust's Small Business and Existing Buildings program team members.
3. **Culturally Sensitive Design and Staffing.** Based on experience with diverse populations, the research team and stakeholders recognized the need for this study to be mindful of the cultures and needs of those we are seeking to speak to. As noted, it was important for the restaurant owner to feel comfortable and respected throughout the process, particularly because any negative experiences or perceptions could affect their relationship with the key contacts. The research team included several native Spanish speakers who understood the Hispanic culture and fostered trust with key contacts as well as recruited restaurant owners. In addition, the research team reached out to organizations within Oregon to serve as key contacts and successfully partnered with APANO who helped initiate discussions and recruit participants within Asian and Pacific Islander communities. Finally, all materials were translated into three languages (Spanish, Mandrin Chinese, and Vietnamese), with additional

translations provided on an as-needed basis, most of which were reviewed by native speakers in those languages.

4. **Flexible Research Design to Account for Learnings and Maximize Value**. The initial study design provided by Energy Trust and stakeholders was thoughtful and detailed. However, the approach laid was relatively uncharted, and it was not clear what components would be most effective when implementing the research. Further, the study was, in part, designed on the hypothesis that independent restaurants are a heterogenous population and, based on cuisine and other factors, approach decision-making differently.
5. This hypothesis led to relatively high research targets. On initial scoping, the research team identified the need to phase the study to maximize flexibility to respond to research learnings along the way. We discuss some of the key pivot points later in this section.

Detailed Research Methods

The research team conducted four main data collection efforts in this study: 1) site visits within restaurants; 2) interviews with restaurant owners; 3) observational research and interviews at a national manufacturer's conference, and 4) interviews with members of the supply chain. The research team also gathered intelligence through members of the advisory committee and informal discussions with suppliers, industry experts, and Energy Trust program implementation staff.

Below summarizes the process for preparing for the research followed by each activity.

Research Preparation

In preparation for this study, the research team conducted a literature review, including reports provided by Energy Trust. As noted in the Background section, Energy Trust conducted a number of studies that resulted in internal reports, including (but not limited to): a) a small business study on black businesses in the Portland-metro area and b) research related to Latino/a/x/e businesses within Central Oregon. The team also sought and reviewed publicly available data and reports related to the restaurant industry in general, including national restaurant owner demographics, and restaurant-specific equipment needs and innovations.

The team also spent considerable time on the communication materials, integrating interested members of the advisory committee in the review process. The time spent for this effort was important to ensure the research was accessible and appeared credible to restaurant owners. Specifically, the research team:

- Held an initial meeting with Advisory Committee members to understand their areas of interest and solicit feedback on the approach.
- Interviewed Advisory Committee members interested in follow-up discussions and supporting the research as key contacts.

- Met with supply chain representatives (e.g., Oregon retailers) to introduce the study and identify opportunities to engage restaurant owners through their networks
- Formalized the research process, incentive structure, and list of independent restaurants to recruit.
- Recruited key contacts (see the next section) which included creating a recruitment script and Q&A for key contacts.

Energy Trust website (www.energytrust.org/restaurant-study/)

- Developed externally facing materials in collaboration with the Energy Trust Marketing team to support restaurant owner recruiting, including flyers, Energy Trust website content, and frequently asked questions. All materials were translated into Spanish, Mandrin Chinese, and Vietnamese.
- Drafted interview guides and materials.
- Built data collection tools to capture data while in the field.

The research team shared all materials with Energy Trust and the Research Advisor for review and feedback. The research team also shared the interview guide with members of the Advisory Committee for their feedback.

Restaurant Site Visits and Interviews

Site visits and interviews were central to this study. As noted above, the research was designed to foster safety and trust with restaurant owners. Therefore, the study worked closely with key contacts to engage with restaurant owners end-to-end, starting with recruiting, being present throughout data collection, and following up to thank the restaurant owner for their time and ensure there were no further questions; and, when requested, facilitated connections between restaurant owners and program staff. The research was completed between October 2024 and January 2025 across various locations in Oregon, including Salem, Eugene, Hermiston, Portland, and surrounding communities. Interviewees were given a $250 gift card as a thank you for their time to complete both the site visit and interview process.

For cuisines, this research focused on, but was not limited to, ethnically specific restaurants due to the study's hypothesis that these restaurants would have specialty equipment. Of the 23 restaurants interviews, 10 were Mexican restaurants, 6 Asian restaurants, such as Thai, Vietnamese, or Filipino, 3 were Italian restaurants, 2 were American or pub style restaurants, and 2 were dessert focused restaurants. Additionally, 10 of the 23 restaurant interviews were conducted in Spanish and the rest in English. However, two interviewees from the total sample discussed that they spoke Chinese or Vietnamese predominantly in their businesses.

Figure 1. Map of Participants in Study

The initial scope called for 60 completed site visits and interviews. In consultation with Energy Trust and the Research Advisor, the research team decided to limit the research to 23 site visits and 24 interviews.

The larger sample size assumed there would be notable differences by restaurant or cuisine, sufficiently so to warrant a larger sample to capture those differences. However, the research team found there was not substantively new or different information with additional visits or interviews after the 23 visits, had exhausted the available sample, and the value of additional site visits was deemed minimal for the relatively high cost to complete these activities. This decision was made in collaboration with the Energy Trust Research Program Manager and the Research Advisor. allowed the research team to allocate those funds to additional supply side research and interviews with industry experts.

Below summarizes how the research team approached recruiting, site visits, and interviews.

Recruitment

The recruitment process used various approaches, was high-touch, and coordinated with many actors. Below summarizes the process.

To conduct the site visits and interviews with these restaurants the research team first leveraged a **snowball sampling approach through Key Contacts.** These Key Contacts provided valuable contact information for restaurant owners and served as a trusted liaison to this study given their relationship. As noted earlier, Key Contacts included restaurant owners that were highly connected in the industry, community leaders, and vendors. This key contact model was essential in the

research process and strengthened the quality of the data that was collected during the site visits and interviews due to the relationships present. For example, one Key Contact had a strong relationship with Mexican restaurant business owners in Hermiston, OR who would have otherwise been hesitant to participate in research. This connection and relationship were essential to building trust with these business owners, showing the legitimacy of the research, and explaining why the data was being collected. Even with trusted key Contacts, some owners initially hesitated to participate, highlighting the importance of culturally sensitive communication (i.e., tailoring language, messaging, language preference) and repeated personal engagement. The research also found that impersonal recruitment methods, such as phone calls, were often not sufficient to engage busy restaurant owners.

With snowball sampling, there is a possibility of bias through the recruitment of similar businesses or restaurant owners with similar experiences. The research team weighed this drawback of this approach with the benefits of reaching a population that might be otherwise hesitant to participate in the research. Additionally, the additional recruitment methods outlined below were pursued to combat some of the bias inherent in snowball recruitment.

Second, the research team conducted **in person outreach.** The in-person, door to door outreach was conducted through two avenues: outreach in the Jade District of Portland in partnership with APANO and accompanied by a key contact; and outreach in Independence, OR with Spanish speaking restaurant owners, also accompanied by a key contact. These two avenues were chosen due to the relationships already present in the community, building on the trust that already existed.

Third, the research team worked with **Energy Trust's Existing Building and Small Business Direct Install lighting (SBDI) teams,** to recruit restaurants that previously participated in or targeted for an Energy Trust program.

While a past participant, these restaurant owners were of particular interest because while they had received some measures from the Energy Trust programs, they had yet to engage more deeply in energy efficiency through these programs. Given SBDI's focus on lighting, these restaurants still had significant opportunities aligned with the broader study goals.

Due to the quality and completeness of data, the research team opted to recruit customers from the SBDI list. From this data, we identified and randomly sampled restaurants in rural Oregon and restaurants with Asian menus as those were underrepresented in the study at that point. The data included an SBDI program contact, who sent the initial outreach and was referenced in the follow up outreach email, important for fostering trust in the research. This continuity of outreach also allowed the SBDI team to be informed of what restaurants were being contacted for this study, allowing for a coordination of outreach.

Finally, Energy Trust and the research team used **social media** to communicate about the study and recruit restaurant owners. The social media outreach included advertisements on LinkedIn, Facebook, and Instagram that lead to an interest form. Unfortunately, this approach was not successful as it led to several leads that were scams and that were not restaurant owners.

Site Visits

The research team conducted site visits that catalogued the energy using equipment present in these businesses. During these visits, the research team focused on gathering detailed data on key

cookline and refrigeration energy consumption equipment, including cold storage, cooking appliances, and kitchen ventilation.[8] For each item, the research team gathered details such as equipment type, quantity, age, condition, and manufacturer/model and took photos when possible. These photos were later used to verify equipment specifications and check for ENERGY STAR® certification. In many cases, photos were unusable due to worn or inaccessible nameplates, particularly on older or larger equipment. The research team gathered this information through a Qualtrics form, the printout of which can be found in Appendix C – Site Visit Guide

The research team conducted site visits at 23 restaurants. The site visits averaged an hour. Where possible, the research team conducted interviews throughout the visit. Doing so allowed for more organic discussion and minimized burden on the respondent.

The research team had several limitations during their data collection at the site visits:

1) Due to the age, location, or condition of the equipment, many times nameplates, or other documentation of the equipment specifications were not accessible or readable by the assessor. This was true of at least one piece of equipment at all businesses the research team visited.
2) As many of the equipment present was inherited from a previous restaurant owner, current restaurant owners did not always know the age of the equipment unless they had directly purchased it themselves. This impacted almost all restaurants (n=21) since restaurants were commonly in rented spaces, had purchased equipment wholesale from a previous owner, or had purchased used equipment, and therefore did not know the exact age.
3) The location of some HVAC equipment, such as rooftop units, made them difficult to access during the site visits. While HVAC equipment was not a focus of this study, the data collected on this equipment was further hampered by this limitation.

Restaurant Interviews

In addition to the site visits, the research team conducted interviews with 24 restaurant owners in person or over a video-conference call.[9] All restaurants who had a site visit were interviewed, with one additional interviewee who was unable to conduct a site visit. Where feasible, the interview was conducted in the language that the restaurant owner was most comfortable speaking in. A semi-structured interview guide was used to ensure consistency across interviews while allowing flexibility to explore participants' experiences in depth (see interview guide in Appendix B – Restaurant Interview Guide). These interviews covered concerns, needs, and constraints on these independent restaurants, as well as their purchasing decisions and knowledge and preferences for energy efficiency. The interviews were vital in providing additional information on why certain types of equipment were present in their restaurants, as well as what they considered important during equipment purchasing.

[8] Other equipment, such as HVAC and water heaters where not prioritized during the site visits, but data was gathered if time allowed and they were easily accessible to the on-site assessor.
[9] One restaurant owner who was interviewed attempted to conduct a virtual site visit, but the data collected during that visit was lost during data collection due to technical difficulties.

Lessons Learned from Restaurant Owner Research

While in-person fielding and outreach was successful, it was time intensive and required flexibility. Travel time between restaurant locations added considerable time to the fielding process, especially when appointments were spread out or when owners had limited availability (e.g., off-peak restaurant hours). This posed challenges for efficiency when attempting to maximize the number of visits per day. Coordinating visits often required multiple rounds of back-and-forth communication before a visit could be confirmed. This showcased the importance of a short turnaround between outreach and site visits to accommodate the busy, and sometimes unpredictable, schedules of restaurant owners.

Overall, participants were receptive to in-person visits. However, a few expressed some discomfort during the walk through their kitchen space. Researchers clarified that they were not evaluating cleanliness or food preparation practices, but simply learning more about the kitchen equipment helped build a bit more comfort and trust during the visit.

Supply Side Research

The research team sought to understand how the supply chain and purchasing decisions may differ for independent restaurants and how Energy Trust could best interject in this supply chain. To answer these questions the research team spoke with industry experts and conducted interviews and observational research with two key supply side actors: contractors and manufacturers. The research team did not conduct individual interviews with vendors or specific manufacturers as a part of this research process as 1) Energy Trust is already engaged with vendors through their current foodservice offering and 2) No brand or equipment type emerged in the site visit process that merited interviewing these manufacturers.

The supply side research was conducted after the conclusion of the restaurant site visits and interviews to incorporate learnings from the restaurant owner research within the supply side research.

Discussions with food service industry professionals. This study benefitted from food service industry expertise within the advisory committee and professional connections held by Beira Consulting (who served as the Research Advisor). The research team met with these individuals sporadically throughout the study period to better understand the food service market, their perception and experience with independent restaurants specifically. The discussions were also informative as the team established an observational research plan and interview questions in preparation for the North American Food Service Manufacturers (NAFEM) conference, discussed next. These discussions, while not called out explicitly within this report, shaped the direction of the research and findings overall.

Observational visits and interviews at the North American Food Manufacturer's (NAFEM) conference. To understand the needs of the supply chain, the research team attended the NAFEM conference in Atlanta, Georgia to understand if manufacturers were considering independent restaurants and efficiency in their technology development. Additionally, the research team collected information on the emerging technologies on the market, needs of manufacturers for equipment development, and overall presence of energy efficiency. At this conference the research team gathered contact information from the manufacturers of interest and discussed with the

manufacturer representatives their current equipment in development, development process, and interest in serving the independent restaurant segment.

This research effort originated from the learnings that there was no common piece of specialty equipment amongst these restaurants, there was little commonality amongst brands for this segment, and that for many of the pieces of equipment in these restaurants' cookline and refrigeration equipment, there were already efficient versions on the market, but with limited uptake. This finding caused the research team to explore other options for understanding the foodservice equipment industry, other than direct interviews with manufacturers, and lead to the decision to attend the conference. This conference attendance helped to understand the market at a macro level to understand how the industry understood this segment and efficiency as no key equipment type or manufacturer stood out during the site visit and interview process as key to interview in this research.

Service Contractor interviews. The research team interviewed five contractors who serviced cooking equipment, refrigeration and/or HVAC equipment for independent restaurants, hereby referred to as "contractors."[10] The service sector was chosen for interviews because they play a key role in restaurant owners' buying decisions and could offer additional insight into their decision-making processes. This research effort was shaped by the learning that trusted advisors were important to understand when working with this segment. It was gleaned from working with the Advisory Committee, the restaurant recruitment process, and information collected in restaurant interviews. During this process, the restaurants reported that many times they had some form of a trusted relationship where they got advice for business operations or equipment choices. For some of the restaurant owners, this was a contractor, peer business owner, or even a member of the Advisory Committee. The discovery of these trusted relationships shaped the decision to interview service contractors, as restaurant repeatedly reported having a trusted relationship with their service provider as they were seen as an expert and independent third-party. The interview guide for this effort can be found in Appendix E – Market Actor Interview Guide

The research team identified contractors to interview through two sources: 1) referrals from restaurant owners interviewed (who provided names of contractors they work with) and 2) extensive internet research to identify companies or individuals who serviced commercial restaurant equipment in Oregon. This approach was taken in recruitment to receive feedback from contractors that may be less familiar with Energy Trust offerings. The latter approach was less productive without a specific contact name or referrals; the research team attempted recruiting these contractors through general communications to these such as the companies' web forms, general contact emails (e.g., admin, info or service) and telephone cold calls. In the end, the research team spoke with a diverse group of contractors, two of whom had been in the business for 30 or more years.

[10] In this context, "service contractors" or "contractors" refers to service providers who work with commercial restaurant equipment. While the contractors we interviewed offered a variety of services, some focused on servicing hot or cold equipment, and others handled both. Others also offered HVAC services or worked with institutional or industrial refrigeration. Nonetheless, all shared the common role of servicing restaurant equipment, and some also sold equipment.

Of the contractors interviewed one was a trusted contractor from an interviewee, and two mentioned previously being registered contractors with Energy Trust. Table 1 Below (Table 1) lists the sizes, service types offered and focus on small independent restaurants for interviewed contractors.

Table 1. Characteristics of Interviewed Service Providers

SIZE (EMPLOYEES)	SERVICE TYPES	% OF BUSINESS SPENT ON INDEPENDENT RESTAURANTS PER YEAR
Large (150 employees, 75-80 technicians)	Large mechanical, plumbing, HVAC, cooking equipment, ice cream and shake machines, and sales	30%
Small (Family run)	Cooking equipment, cold storage equipment, and sales	25-30%
Small (10 employees, 5 techs)	HVAC and refrigeration cooking equipment	15-20%
Small	Refrigeration service only	40-50%
Small (One man shop)	Primarily HVAC and refrigeration, industrial sized agricultural refrigeration, and scientific lab	10-15%

Prioritization During Research Process

In the original scope of this research, the Energy Trust research team acknowledged that there were many things that they did not know about this segment, and this research was intentionally exploratory to shape the research as it was conducted to best serve the goal of understanding how to better serve this segment. This research was shaped throughout the data collection process to better address questions and learnings that emerged through this research. Through each of these data collection efforts, the research team gained information and insight into what was achievable and what gaps still existed.

In consultation with the Energy Trust Research Manager and the Research Advisor, the ILLUME research team shifted the priorities and activities of the research based on the data collected in the previous activities. Accordingly, this research is only the starting point for understanding this unique segment.

Learnings from the Research Process

Oftentimes the process of conducting research can be as insightful as the findings themselves. This study identified several important learnings which are applicable to program design, delivery, and future efforts:

Personal relationships are powerful. Engaging and leveraging key contacts to recruit customers that they had prior interactions with was a successful strategy for this research. This is, in large part, due to the trust that restaurant owners had in the key contacts, which the research team alone would not have brought.

It is important to engage independent restaurant owners where and when is most convenient for them. These owners are busy and time constrained. Their schedules are also unpredictable. The research team found some restaurant owners preferred a set schedule for meeting, whereas it was more effective to engage others through door-to-door recruiting. Regardless of their preferences, though, being with a trusted individual was key.

Establish regular checkpoints to elicit feedback from stakeholders. This study benefitted from an advisory committee who was integral for shaping the study. Committee members had varying areas of expertise. The research team met the advisory committee early in the study; however, they did not re-engage the whole group outside of individual coordination for study recruitment until the reporting stage. In this discussion, it became clear that they would have appreciated more regular updates, and the study would have likely further benefitted from their insights.

This type of exploratory research requires time and flexibility. It took several months for the pre-research work. Then even with the best laid plans, it took four months to build upon the key contact approach and complete interviews and site visits. The personal relationship and trust-building focus of the approach took time and required the research team to be flexible around the restaurant owners' needs. It is likely that program administrators will find the same challenges when looking to equitably serve customers that are not traditionally engaged, particularly through programs that intend to be delivered in partnership with or through community-based organizations.

Chapter 2: Who are these Independent Restaurants?

From previous research on small businesses and restaurants we know that independent restaurants are at a unique intersection of high needs, singular constraints, and untapped opportunity.

Previous research conducted by Energy Trust and other entities found that small businesses are extremely limited in their ability to engage with energy efficiency as the programs were not designed to serve their needs.[11] These owners are incredibly resource constrained for both financial capital and time. Additionally, many of the programs were not designed to understand deeply a restaurant owner's needs and concerns, rather serve a broad swath of the market.

This section summarizes the characteristics of independent restaurants included in our study, their primary day-to-day business concerns, and how utility costs factor into their operations.

Restaurant Characteristics

Independent restaurants that participated in the study were owned and operated by an individual who had usually had experience in the restaurant industry prior to owning that restaurant. These restaurant owners had worked in kitchens or behind the bar before being owners or had owned previous restaurants that had since closed. This previous experience impacts a restaurant owner's choices, perception of equipment, and networks, as compared to a novice restaurant owner.

A restaurant's space and location can also be a strong determinant of the equipment present in the restaurants and of their equipment decisions. Of the 23 restaurants included all but two rented their restaurant space. This means that these restaurants operate out of kitchens and spaces where their costs and choices are largely restricted by a building owner's preferences. Additionally, most of the restaurants had acquired their restaurant and equipment through the purchase of a previous restaurant that had since closed. This means that some, if not all, of the equipment currently present in the restaurant was acquired wholesale during the purchase. As a result, restaurant owners did not always know the age of the equipment or maintenance history.

Most restaurants included in the study were in an urban area, with 14 located in the Portland metro area. An additional six were in the Willamette Valley, and three were in Eastern Oregon. This is important to note as restaurants who are in rural locations were more limited on their network of suppliers and servicers which impacted their equipment decisions, as discussed further in the section below.

[11] Energy Trust Community Engagement Report

Meet [Name], Restaurant Owner in Beaverton, Oregon

From humble beginnings as a dishwasher to becoming the proud owner of a thriving restaurant, [Name] has spent decades in the restaurant industry, building both skill and passion along the way. Their Mexican restaurant in Beaverton, Oregon, is more than just a place to eat – it's a vibrant cultural hub where guests come together to enjoy family recipes, unique flavors, and the music and community that have always been at the heart of [Name]'s vision. Balancing passion with pragmatism, [Name] works tirelessly to create a space where both food and atmosphere reflect a deep commitment to quality.

Like most restaurant owners, [Name] has always been mindful of the costs that come with running a busy kitchen. But when it comes to energy efficiency, despite being mindful of turning off lights and equipment, when possible, it is not a primary factor when making equipment purchasing decisions. [NAME] described utility bills as comprising a relatively small portion of their overall operating costs—just 2–2.5%—whereas labor accounts for the majority at 40–50%.

Business Operations

Independent restaurant owners reported having limited time, limited capital, and external market pressures. This means that these owners are stressed, hardworking, and wear many hats in their business. When describing their role, most restaurant owners described juggling regular administrative duties with working front of house, such as waiting tables, and sometimes back of house in the kitchen, to keep the business running and adequately serve customers.

> *"We're a small company, so I'm HR. I'm operations. I'm a dishwasher. If I need to be."*
>
> *"[When discussing his role] overseeing all of the operations and making sure that everybody's schedules are filled...Legal, HR, payroll. A lot of the back-office stuff that people don't see. Granted I was just today over in the restaurant, busing tables and seating people as well."*

The restaurant owners we interviewed have many needs and priorities emerge suddenly through the course of the day. Restaurant owners described situations of getting emergency staffing coverage, experiencing power outages, or experiencing needing to perform emergency stop-gap maintenance on their equipment. Even throughout the site visits and interviews, many of the business owners had to take calls or hop on another requests.

For Energy Trust, it may be difficult to grab the attention of these customers, and these restaurant owners may not have the bandwidth to research efficient equipment or incentive programs.

Cost Concerns

Interviewed restaurants reported running their business on thin margins, having high overhead costs, and feeling like they cannot make an "unnecessary" investment when faced with an unexpected expense. When asked about their top expenses, nine of the business owners reported being the most concerned about labor expenses, followed by food costs (6), equipment costs (5), rent (5), and utilities (2).

Almost all restaurants reported that labor and food costs had increased in recent years due to inflation, while only two reported increases in their fixed costs, like rent. While rent had not increased in recent years, some restaurant owners expressed that their rent was still high compared to revenue, which was exacerbated by increasing food and labor costs.

When talking about their top concerns for the business, most owners discussed staffing difficulties or concerns for a slower economy. They felt like due to political changes or instability, that the economy might not be advantageous for their businesses.

While not as much of a day-to-day concern compared with other costs, restaurant owners reported that equipment can create more urgent issues. This is because they need to replace equipment quickly on failure no matter the cost, as described in this quote:

> *"I'm looking at replacing a freezer by the end of the year at one of our locations, so when equipment goes out it's a, you know, ten, $15,000 purchase. It becomes more urgent when that piece of equipment goes out. So,* ***if we miss an employee or somebody quits we can cover for that while we try to figure it out and it doesn't hit the bottom line as hard as if we were to buy a piece of equipment****…And like I said, if a HVAC unit goes out or a fan belt goes out on our exhaust system like that needs to be fixed right now.. So, there's some urgent issues that take priority over everything else."*

Due to a restaurant's thin margins, all the restaurant owners reported making equipment investments primarily when the equipment is at failure or too costly to repair.

> *"I mean, they already they're still there and they're still working… We don't really need to upgrade something."*
>
> *"I don't like to change things out that aren't killing us"*
>
> *"The only time I will need an upgrade is when you know equipment finally breaks down or surrender itself to be regarded as unusable"*
>
> *"When something dies or breaks or is becomes too costly to repair, that's when we would replace it"*

These equipment replacement costs are also large investments, compared to daily food or goods costs, and unexpected, compared to costs like rent. This means that the restaurants will be hesitant to make an investment in equipment that is not urgent, due to the possibility that another piece of equipment may also fail soon after. Owners described being worried about how long they have on the lifetime of equipment and making equipment last as long as possible to space out the time between equipment investments.

Utility Costs and Perception of Control

Even though studies have shown that restaurants have the highest energy use intensity for small businesses, utility costs were not a main concern for most interviewed restaurants. This could be due to two factors: 1) even with higher-than-average energy costs, these costs were minimal compared to high overhead and variable costs, like rent and labor, and 2) restaurants consider utility costs to be something that they have little to no control over.

Restaurant owners reported costs ranging from 1% - 20% of their total monthly costs, with most reporting that these were a "small amount". This means that programs that advertise reductions in energy costs may not be motivating for this customer as it is not their most pressing concern:

> *" I have to prioritize what's important. And lots of times for something like that [small] amount doesn't make the list.* ***It's on the bottom of my list*** *or in the back of the burner."*

While energy costs are a fraction of their operated expenses, most restaurant owners said their utility bills had gone up in recent years with several owners noting the rates increased with no change in service. For owners that reported rate increases, all reported that they did not feel like they had any control or influence over their costs. One restaurant owner reported that he was looking into changing his rate to one that varied based on peak pricing but felt like he did not have any influence over the peak times of energy usage from cooking or refrigeration at his restaurant due to needing to always use the equipment or during rush hours. Further, another restaurant owner in rural Eastern Oregon reported that they do not have options for energy providers due to their rural location:

> *"Utilities are challenging in Eastern Oregon because* **we don't have a lot of choices**. *So, I don't really worry about it because I can't do anything about it, or at least not much about it."*

Additionally, although utility costs were commonly regarded as small compared to other overhead costs, these costs did vary greatly based on the types of equipment present in the restaurant. For example, a dessert restaurant with south-facing windows experienced much higher energy costs, especially during the summer, due to outdated refrigeration equipment that had to work harder to function, compared to most of the restaurants with cooking equipment that we interviewed.

Finally, all restaurant owners said that they felt like they had little to no options for decreasing their consumption. For these independent restaurants, factors like maintaining consistent restaurant operations and customer comfort are paramount, and owners stated that these factors make it harder to follow common recommendations for reducing energy costs. Multiple restaurant owners discussed that they could not decrease their HVAC costs, did not want to participate in a smart thermostat program or could not make set point adjustments due to concerns that this would impact customer comfort or impact equipment performance. These restaurant owners also reported that it was already difficult to control the temperature of their businesses due to the heat produced from cooking equipment. The restaurants understand the relationship between the temperatures of their kitchen and the performance of their refrigeration equipment and therefore are not willing to endanger the continued operation of these important pieces of equipment for possible energy savings that may be forfeited by the equipment's decreased performance.

> *"So, [The utility will] suggest, hey, you can save this much energy if you increase your thermostat to 78°. And I'm just like, but at 78° it feels extremely uncomfortable in here, and that's not good for my customers. And then secondly, it makes it harder on the equipment because the hotter the equipment is, the less efficient they are."*

Most of the owners (13) reported that they had made some efforts towards decreasing their energy consumption, such as switching to LED lightbulbs, getting a smart thermostat, or trying to use EnergyStar appliances, but didn't feel like these changes had major impact on their overall energy costs. Some owners reported participating in a utility program, like the Small Business Direct Install program or a rebate program, but felt that any savings from reduced usage were erased by increased rates:

The perception that these restaurant owners do not have any influence over their energy costs, even as they impact their energy consumption, could make marketing about energy cost savings less of a driver for this segment.

> *"Since the lights were replaced [to LEDS] from the old our PGE bill went down a little bit cheaper than we normally used to pay, okay, but I guess it's another increase [in rates]. So, I think that's just gonna wash it out."*

This perception highlights the challenge of demonstrating value of energy savings equipment and programs, but it is worth reinforcing that energy efficiency still helps them reduce overall usage and therefore helps customers better control utility costs even when rates rise.

Community and Cultural Connections

Many of the restaurant owners interviewed discussed the importance of their community in their operations and livelihoods. These interviewed restaurants discussed that it is important to them to be a presence in their community not only through their restaurant establishment, but through supporting local efforts like fundraisers or collaborating with local organizations.

In addition to their geographic community, many of these restaurants mentioned the importance of connecting with their cultural community. They also saw their restaurants as a method of cultural promotion and connection, where people outside their culture could experience it for the first time through food.

> *NAME sees their restaurant as a "bridge" between communities, a place where everyone is welcomed and where customers can experience Mexican culture.*

To reach those who have been traditionally underserved by Energy Trust's programs, the program team will need to network not only with these more formalized networks, but also cultural organizations for this segment.

Related to valued business connections, white restaurant owners more commonly mentioned formalized business networks like the Oregon Restaurant and Lodging Association or a neighborhood business association, and non-white business owners mentioned networking with businesses in their cultural group, or through community groups like APANO and an unnamed Filipino cultural organization.

Chapter 3: How are They Making Decisions?

For most of these independent restaurants, their equipment is both their largest investment and what they rely on to make their food delicious, consistent, and safe for customers. Therefore, these restaurant owners will always be looking for the best deal on the most dependable piece of equipment within their budget. When they are making these equipment decisions, they are not always prioritizing factors beyond the price, such as energy consumption, due to the incredibly tight margins of the restaurant business. Additionally, the factors they do prioritize beyond price, such as availability, durability, and consistency of output, are not factors that they associate with energy efficient equipment.

This section describes what factors the independent restaurants interviewed considered in their previous equipment choices and where they are sourcing their equipment.

Equipment Selection Constraints

Meet [Name], Restaurant Owner in Beaverton, Oregon

Their current decision-making is guided by cost, equipment specifications, and consumer reviews—not necessarily efficiency. As they explained, "I focus more on being practical." Despite not prioritizing energy efficiency equipment, [Name] remains open to it, especially when the benefits are clearly presented. “I’m willing to consider new options if they make sense for the bottom line.,”

[NAME] explained. They also prefer to buy new equipment to avoid inherited maintenance issues, with [Name] stating, "It's better not to buy somebody else's Pitman Restaurant Equipment, Rose’s Equipment & Supply, and Webstaurant Store, because these vendors offer reliable products and strong warranty options, which are key factors in their purchasing decisions.

Affordability is Key

When asked about the main consideration when making equipment purchases, all restaurant owners reported that price was their number one or number two concern. These owners also discussed that brand reliability and equipment reliability and durability were important. Relatedly, restaurant owners talked about doing a cost benefit analysis of cost of maintenance versus price of the equipment, acknowledging that purchasing cheaper equipment was not always cheaper in the long run, but that they were not always able to make this investment for more reliable equipment. Brands mentioned were True, Turboair, Vulcan, and Wolf as top brands in the industry, but not always attainable:

> *"For me, as much as I would have loved to have a brand name quality built American made piece of equipment, I ended up having to go online and finding a cheaper version because it may not have the same bells and whistles and whatnot, but as long as it gets the job done for me and it's like 1/5 the price, then I'm willing to do that. I'd rather spend $10,000 buying five of those."*

One restaurant owner in rural Oregon discussed that she prioritizes reliability and ability to provide maintenance over price due to their isolation from many equipment vendors and maintenance staff, emphasizing the importance of tailoring energy efficiency programs in rural areas.

Timeliness of Delivery is Critical

As discussed previously, these interviewed restaurants are commonly making equipment replacements only on failure due to their limited amounts of upfront capital. Waiting for the equipment to fail means that these restaurant owners are making equipment decisions quickly, working with what is available in their local vendors or can be quickly delivered online through retailers like Amazon. Multiple restaurants discussed going into stores and buying whatever was in their price range and readily available due to the urgency of replacement.

> *"[Speaking about purchasing equipment at failure] If it is a real emergency, don't have time, cannot do the comparison, just go and grab it, because you need to run the business."*

As these restaurants depend on this equipment to provide adequate service to their customers, if a fryer goes down at 5pm on a Friday night, they must run out to quickly replace that night or the next day. This urgency does not allow for any considerations beyond price and availability.

Depending on the piece of equipment, it also can be difficult to source the specific replacement needed in a timely manner. One restaurant owner discussed going straight to the manufacturer when doing an exhaust fan repair as their local retailer could not deliver on time:

> *"I went through [CaptiveAir directly] primarily because they could get it to me within two weeks versus trying to buy it through a reseller if they said it was 6 to 8 weeks. And it's like, well, my exhaust fan's down, I can't last."*

This quote exemplifies how critical the delivery time is to these restaurant owners. Without an exhaust fan, they know the rest of their equipment cannot function properly and it risks their workers' safety. But they are unable to replace this piece of equipment before it fails due to a lack of capital. Timeliness and price work together to greatly constrain a restaurant's equipment choices, even if they have other preferences for buying new, brand, or durability.

Sometimes, these restaurant owners have some foresight to say that their equipment will fail due to a warning from a maintenance technician or due to the equipment needing multiple repairs.

With restaurants typically waiting until equipment fails to replace it, Energy Trust can work with them to more readily identify and upgrade this equipment early, before it fails. This could benefit the customer, by lessening the risk that equipment will go down unexpectedly, and Energy Trust, by having the opportunity to influence equipment decisions and guide upgrades strategically.

In this instance, restaurant owners discussed doing some comparison shopping between online and in-person retailers to determine what equipment to replace it with but would still not purchase the equipment until that other piece of equipment was at the end of its life. This presents an opportunity for programs to provide resources and education that help restaurant owners prepare in advance and be ready to take advantage of available incentives when the time for replacement comes.

Many restaurant owners attempt to extend the operational life of their malfunctioning equipment because they feel like they have no other options due to high replacement costs, logistical issues, or high maintenance costs. These restaurant owners will keep equipment functional, or semi-functional for as long as possible. Sometimes they do not have maintenance done on semi-functional equipment in the short term due to the high costs of replacement parts or labor, preferring to save that money to purchase a new piece of equipment in the long term.

One pizza restaurant described that their pizza oven's energy saving function does not currently work and they are using a workaround to keep it functional. They need to keep the oven on overnight as the oven otherwise would take over five hours to get up to operational temperature. He stated that the manufacturer is out of Italy, and they say it will take 6 weeks to fix, even though he has current five-year warranty on the equipment. So instead, the restaurant turns down the equipment to 450 degrees overnight so it can easily get back to operational temperature. The restaurant estimates that they are wasting $30 on natural gas each night just to make sure they can cook on time.

Equipment Preferences

New Equipment has Distinct Advantages

Another strong consideration for restaurant owners was being able to buy the equipment new. Most restaurant owners (n=18) stated that they preferred new equipment over used equipment when making purchases due to the warranty, ability to return, and possible maintenance contracts, and this preference was typically reflected in their purchasing behaviors.

> *"There's only a few things that I bought used and those few things, most of them have screwed me over."*
>
> *"It's worse if it causes problems later."*
>
> *"I normally try and get new ones and that way I know that and get the warranty just in case it doesn't work very well. If you buy a used one and it doesn't work, you're kind of stuck with it. So, as much as pricing is my first choice, I also tend to try to buy new."*

There was a perception amongst restaurant owners that if a piece of equipment was on the used market, there was most likely something that was malfunctioning on the equipment, and that was the reason it was being sold. One restaurant owner expressed that he would never buy refrigeration equipment used for this reason. As discussed above, as a majority of the restaurant owner inherited their kitchens when they purchased the business, some had experienced issues with these pieces of used equipment, making them prefer to make any replacements with warrantied equipment.

Only three restaurant owners expressed that they purchased predominantly used equipment, and this was due to cost constraints rather than an inherent preference for this type of equipment. When purchasing used equipment, owners discussed the importance of buying from brands they knew were reputable. Additionally, all three restaurant owners who bought used equipment knew how to do their own maintenance on the equipment, decreasing the lifetime cost of the equipment.

Durability and Ease of Repair Help with Longevity

While durability was a factor for most restaurant owners, it did not usually trump the constraints on price or the preferences for buying new. But, for restaurant owners that had more established restaurants and had been in operation for longer, durability was more of a consideration. This was partially due to their previous experiences with pieces of equipment failing or not lasting as long as promised, and partially because they usually had more capital. This slightly higher capital, or access to capital due to their business history, enables them to expand their decision making beyond factors of price or timeliness. Additionally, these businesses may have a different perception of their payback period due to their business history. For example, restaurants that have been in business for more than five years have the perception that their business is worth an investment with a longer time horizon for payback than a business that has been operational for only a year.

While brands rarely came up in conversation with restaurant owners, one contractor noted that regarding cold equipment customers, they may be brand loyal if they had a previous good experience with a particular brand. The research team also saw this in the data, with more consistency in brand around cold storage equipment than for cooking equipment. Contractors also expressed a stronger preference for certain brands or manufacturers. One contractor said they tend to prioritize some brands because they are an authorized dealer for them and get a factory discount. That means they can be more competitive with those brands while still providing more purchase, delivery, set-up and warranty-related services.

Service contractors often stressed the importance of buying equipment for which they could find replacement parts. In these contractors' experience, these tended to be US made products. They acknowledged that owners could bypass them and buy directly through the internet (using services like Webstaurant) which connects them with lower priced equipment that is often manufactured in other countries (examples given were China, India, Vietnam, Korea, Brazil). This equipment, the contractors pointed out, is often poorly made, has a shorter warranty period and expected lifespan, is often not UL tested, and replacement parts may be impossible to find.

Other Common Considerations for Replacement

Restaurants also consider how an equipment upgrade will impact their day-to-day business operations. Restaurant owners mentioned wanting to make equipment upgrades to keep up with service volume or to create efficiencies in the kitchen with delivery or footprint. This is reflective of a restaurant's top concerns of customer experience and operational efficiency. While operations and operational costs are important in this decision, no restaurant owners mentioned upgrading their equipment solely due to its energy consumption.

Additionally, there is a consideration for how upgrading your equipment will impact operations, even temporarily. Two restaurant owners discussed that they had delayed walk-in fridge or freezer upgrades even as the equipment was malfunctioning or the insulation had degraded due to logistical barriers in conjunction with the large upfront costs:

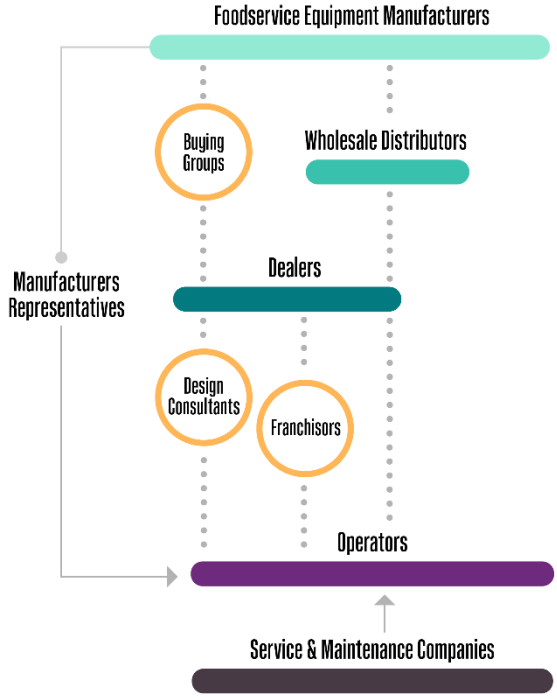
> *"[when discussing replacing a walk in] Is a logistical nightmare for replacement. What do you do with the product that's in the freezer when you are installing a new freezer?"*

These considerations are more common with larger pieces of equipment, such as walk-in fridges, freezers, or ranges, as any downtime can create issues for production.

Equipment Purchasing Sources

Most restaurant owners discussed shopping locally with a mix of online purchases and using online websites to compare prices. While restaurants had trusted relationships with local suppliers, and liked building this relationship, they also will shop around based on price as the bottom line is the primary driver of their equipment decisions. Figure 2. Equipment Purchasing Network shows the network of suppliers and distributors independent restaurants and operators work within.

Figure 2. Equipment Purchasing Network



Restaurant owners discussed liking local suppliers due to their ability to purchase in person to discuss equipment, get delivery, and installation.

> *"We call Pitman, and we buy something usually off the floor and, and they come out and they pick up the old one…and they install the new one for us."*
>
> *"They can guide you or they send somebody to help you to measure, measure the length or the volume cooler and they have some contractors to help you to set up everything for the kitchen."*
>
> *"You can get most of the pretty good advice from the Restaurant Depot…I asked them, and they answered my all the questions because they are from that kind of a background. So that's what I usually do if I need advice. Even when I'm not replacing anything; I try to connect with them."*

The two most mentioned in-person retailers were Roses (6) and Pitman's (6) out of Portland, followed by Bargreen Ellingson (3) across the state. Restaurant owners also discussed Restaurant Depot (2), Hongs (2), Curtis (2) and Valley Restaurant Supply (1). The in-person retailer of choice was highly dependent upon location of the restaurant, although restaurant owners in the Southern or Eastern parts of the state described driving out to Portland to shop at both Roses and Pitman's. For online purchases Webstaurant Store (5) is overwhelmingly the most popular retailer.

Several restaurant owners discussed having trusted relationships with maintenance staff, even asking them for guidance on equipment purchases, especially when they were trying to calculate the cost to maintain future equipment:

> *"And then I'll also talk with my techs and say, 'OK, is this 2500 dollars one gonna break in two years, and it's going to cost me actually $6500 in repairs?' and get their feel for the different manufacturers. That's a really good read that I have is like, 'How many times are you going out and is a True refrigerator breaking? Or how many times is a Bev-air breaking? What manufacturer are you going out servicing more so than not?' And so those are kind of how I deal with it"*
>
> *[PARAPHRASED] They typically rely on the advice of their independent repair contractor, who runs his own business and has been a trusted resource for NAME.*
>
> *[PARAPHRASED] NAME has a guy in Aumsville, [NAME], that he relies on for a lot serves as a restaurant consultant on all things cooking and cooling equipment.[NAME] advises on what brands and models are easiest to maintain and are the best value, which ones have parts that are easy to locate and which do not making it expensive to own even if they are cheaper up front.*

This consultation process helps the restaurant owner feel like they are making more informed decisions when purchasing from a local supplier or online, as they consider their maintenance staff to be an independent advisor, one who brings valuable insight from working within this industry and understanding which equipment tends to perform well or cause issues.

Energy Trust should leverage already existing trusted relationships, such as with their contractor or culturally specific vendor, to influence the purchasing decision of restaurant owners.

The study team heard this echoed in interviews with contractors. For both cooking equipment and cold equipment contractors discussed that they consult with customers on equipment replacement during equipment servicing. All contractors who service cooking equipment said restaurant owners typically call them in when a piece of equipment is failing. Cold equipment contractors are also usually called in for situations with failing equipment, but do more maintenance on equipment. In both situations, contractors will provide this consultation to a customer so they can understand when their equipment is expected to fail, if they are just performing maintenance, and their options for repairs, if they are servicing failing equipment. Contractors discussed situations where customers ask their opinions on replacement equipment when they decide that a repair is not worth the cost versus replacement, although they do not always follow their recommendations.

Cultural and Language Preferences on Sourcing

There is some preference from those who predominantly speak languages other than English to conduct business with people who also speak that language. Even so, restaurant owners stated that they didn't feel like language was a barrier for purchasing or participation, and they would move forward regardless in the pursuit of saving their business money. Instead, these preferences were about who they felt like they could more readily communicate with or trust for their recommendation.

Those restaurant owners who spoke Chinese commonly mentioned purchasing from Hong's in Portland due to the sales team's ability to speak their same language. Similarly, Spanish speakers discussed preference for working with technicians or other business contacts in Spanish.

Both groups discussed that while they would still work with retailers who only had sales staff who spoke English, that these other languages made them more comfortable working with their teams. Similarly, while recruiting for this research, the research team had much more success with Spanish speakers when recruiting and fielding with staff who spoke Spanish.

Upcoming Anticipated Restaurant Equipment Upgrades

During the interviews with restaurant owners, the research team asked them what equipment they anticipated needing to soon be replaced or upgraded. As previously discussed, most of these upgrades were due to the equipment not operating at peak capacity or failing in its primary functions. There was no common piece of equipment that restaurant owners discussed needing replacement, but they did most commonly have issues with their refrigerators and freezers not performing to proper cooling standards. The upcoming kitchen equipment needs varied widely on the age of the equipment and the focus of the restaurant. These anticipated upgrades included:

- Fridges and Freezers (4) - issues with improper cooling, seals, want display cases for customer interest
- Walk ins (2) - issues with sealing and insulation degrading
- Range (2) - malfunctioning burners, needs maintenance
- Hood (2)
- Fryer (1) - capacity issues
- Griddles (1) – manual for thermostatic
- Switching from gas to electric oven (1)
- Combi oven (1)
- Rapid Cook Oven to replace microwaves + pizza oven (1)
- Rice cooker (1)

Several restaurant owners expressed that they had recently upgraded their oldest piece of equipment, and therefore were anticipating not having near-term replacements, or that their equipment was relatively new and were hoping to not have to make replacements. The restaurants that most mentioned needing upgrades were restaurants where the owner purchased the restaurant equipment as a part of the restaurant purchase or inherited the equipment when they took over the restaurant.

When discussing preferences for replacement, most of the equipment replacements were like for like, such as replacing a range with a range that has the same number of burners, or replacing a freezer with a more recent model, but with the same capacity. Alternatively, one restaurant owner discussed wanting to replace two existing microwaves and one pizza oven with a Rapid Cook Oven type convection oven for efficiency of service, since he only used it for non-pizza cooking. But he discussed that he was not going to consider making this upgrade until all necessary repairs and majorly malfunctioning equipment was replaced to prioritize costs.

Non-Cookline Equipment Needs

Multiple restaurant owners discussed the need for higher cooling capabilities or wanting to replace their AC due to hotter summers, running temperatures of the cooking equipment, and customer demands for cooling. Additionally, several restaurant owners reported installing additional mini-split units to increase their cooling capacity. Similarly, water heating needs are key to independent restaurants as they have a greater need for a higher capacity, quicker recovery water heater than other small businesses. This is due to their needs for high volume sanitization while dishwashing.

Properly functioning HVAC and water heating are key to a well-functioning kitchen. Although most of the restaurant owners leased their space, they could be responsible for HVAC and water heating replacements based on their rental agreement:

> *When replacing his HVAC there was an issue that he leases, but is responsible for the HVAC replacement: "And so obviously I had to, I had to take a loan and, and take and, and do a $27,000 upgrades at my cost, but at the really at the owner of the building's benefit in the end, because that's not something you can take with you. So, I think that they should consider that, yeah, these smaller businesses having to replace their HVAC is, I would say very often the reason why a lot of places will decide not to renew their lease or close down altogether."*

While split incentive issues are common amongst small businesses who must rent out their space, this issue can be even greater for these restaurants. Proper ventilation, cooling, and water heating are of upmost importance to these independent restaurants due to its direct link to the ability to retain customers, through increasing comfortable temperatures within the dining area, and maintain proper restaurant operations, through keeping kitchens at a proper temperature for employee health and optimal equipment operations. While HVAC and water heating are not thought of as traditional food service measures, these pieces of equipment have a direct relationship to the operational efficiencies of a restaurant. In marketing for these measures, restaurants may respond to marketing that directly speaks to these impacts on their business operations, rather than general energy savings or cooling needs.

There is an opportunity for Energy Trust to better promote their existing HVAC and water heating incentives to these restaurants and their landlords to help alleviate the cost of replacement and issues of who shares that cost.

Marketing and Outreach Preferences

This research found that it was important to have: 1) personal engagement through trusted networks 2) culturally sensitive communication (i.e., tailoring language, messaging, language

preference) and 3) additional outreach via email. The research team found in recruitment for this research that building trust through networks, such as referrals or previous program participation was more successful than cold outreach. While this makes recruiting non-participants difficult, Energy Trust should build on previously established connections to continue to foster trust with these independent restaurant owners. Similarly, restaurant owners who were aware of Energy Trust programs found out about them through these higher touch outreach methods such as direct outreach through the Small Business Direct Install program, seeing them at industry events, such as ORLA events, or through a local retailer, like Rose's Equipment & Supply.

As previously discussed, restaurant owners preferred to have information in their native language, they stated that they would also pursue business opportunities regardless. Additionally, in doing outreach with Spanish speaking restaurant owners, the research team found success in having outreach and communications that were in their native language. This outreach approach helped to strengthen the research by making the restaurant owner more comfortable to express themselves and understand the complexities of some of the questions on efficiency and equipment types. Similarly, it could be most helpful for Energy Trust to use multiple languages and trusted pathways through native language speakers when doing relationship building, for example when going door to door with businesses, and when trying to convey complexities about the program.

Most restaurant owners mentioned email as the best way to get in touch with them. Although, recruitment was done primarily via email for this research, which may bias our results. Several mentioned disliking cold calls, thinking unknown phone calls were scam calls, but if Energy Trust left a message, they might listen to it. One restaurant owner discussed issues with digital literacy, making it hard to research programs on their own and hard to understand information sent via email.

The research team did find success in going into businesses and talking through the research to recruit participants in both Independence and Portland. It may be most successful to combine in-person and email outreach for this segment to build trust and to provide information for future reference.

Market Uncertainty Impacting Decision-Making

The interviews with restaurant owners were conducted between October 2024 and January 2025 and interviews with contractors were conducted between February 2025 and April 2025. During these interviews, the research team heard from several individuals that inflation or upcoming market changes could impact their purchasing decisions or their business operations.

One contractor mentioned directly that he felt like in the past couple of years restaurants have become even more constrained in their choices due to the *"hard times right now and the costs of materials and wages [going up]."* Four restaurant owners directly spoke about inflation and market changes impacting their businesses. Two restaurant owners directly mentioned that they thought the upcoming political change may negatively impact their business operations or their purchasing power. Two other restaurant owners mentioned inflation more generally could impact their business in the future, and brought up previous times of economic uncertainty, such as COVID-19, as times when food and labor costs increased. As it was not a goal of these interviews to understand the impacts of policies on decision making, the interviewers did not investigate further into which specific policies were concerning to these interviewed restaurant owners.

As we continue to see market uncertainty, there will be an even greater need for programs like Energy Trust's to interject earlier in the decision-making process to alleviate some of these market pressures. As restaurant owners are stressed due to outside forces, their bandwidth for making complicated decisions on equipment choices or long-term cost comparisons will decrease. Therefore, it will be critical that Energy Trust continues to offer information in a streamlined fashion and integrate this information into networks the restaurant owners are already utilizing, such as vendors and service providers.

Chapter 4: Equipment and Gap Analysis

This section provides a detailed overview of the equipment observed in the restaurants visited by the research team. It covers key categories including cold storage, hot cooking equipment, kitchen ventilation, HVAC systems, and water heaters. Each category includes available details on equipment type, brands, condition, if applicable, age, and, where possible, an indicator of whether the equipment is ENERGY STAR certified.

Overall, most of the equipment observed were older models. This is due to most of the restaurants reporting that their equipment was inherited when purchasing a restaurant and their equipment. Old equipment tends to be less energy-efficient, which could potentially consume more energy to perform the same tasks compared to newer, more energy-efficient models. This could lead to higher operational costs for the restaurants, especially in terms of electricity and water usage.

This data provides insight into the condition of and potential opportunities for Energy Trust as they are serving independent restaurants. Understanding and characterizing restaurants' use and need for cookline equipment was priority for this study to inform the gap analysis and future program and product needs. However, while on-site, the research team also collected information on other energy using equipment as able. Below highlights equipment observed within the following categories: 1) cold storage, 2) cooking equipment, 3) ventilation, 4) HVAC, 5) HVAC system controls, and 6) water heaters.

Cold Storage

The cold storage equipment observed across sites included freezers, prep fridges, refrigerators, specialized equipment, bar equipment, and others. Table 2 shows freezers and refrigerators are the most common types of equipment, with an average quantity of approximately 2.8 units per site, followed by prep fridges, with about 2.1 units per site.

Table 2. Cold Storage Equipment Characteristics by Type

EQUIPMENT TYPE	NUMBER OF SITES	AVG. QUANTITY PER SITE	AVG. AGE (YRS)	AVG. SEAL CONDITION*	COMMON BRANDS
Refrigerators	23	2.8	10	2.5	TRUE, Norlake
Freezers	22	2.8	11	2.6	TRUE, Frigidaire
Prep Fridges	18	2.1	7	2.5	TRUE, Turbo Air, Beverage-Air
Specialized Equipment**	16	1.3	9	2.6	Manitowoc, Ice-O-Matic
Bar Equipment	4	1.4	5	2.8	TRUE
Storage/Other***	2	1.7	4	3.0	TRUE, Turbo Air, Economy Refrigeration
Other/Accessory****	1	1.0		3.0	Perlick

*Seal condition is scored as follows: Poor = 1, Average = 2, Good = 3
**Specialized Equipment includes Ice makers, slushie/ice cream machines, and kegerators
***Storage/Other includes Glass cooler, holding cabinets.
****Other/Accessory includes Condenser

Most larger refrigeration equipment was on average 10-11 years old.[12] Smaller units—such as prep fridges, bar equipment, glass coolers and holding cabinets, tended to be newer, with average ages closer to four to seven years. Seal conditions were generally rated between "average" and "good," across all equipment types.

TRUE appeared to be the leading brand for most types of cold storage, including refrigerators, prep fridges, freezers, and bar equipment. For specialized equipment, such as ice makers, slushie or ice cream machines, and kegerators, Manitowoc and Ice-O-Matic were the most common brands. There was no brand consistency amongst other storage and accessory units (such as glass coolers, holding cabinets, and condensers).

When reviewing the cold storage equipment used by the restaurants, the team assessed ENERGY STAR certification status based on available nameplate photos and specifications sheets. Of the 109 pieces of equipment with adequate documentation, 17% (19 units) were verified as ENERGY STAR certified, including one unit without a specification sheet but with an ENERGY STAR sticker observed on the equipment; 18% (20 units) were confirmed not to be. For the remaining 64% of equipment, the team was unable to locate specification sheets, as shown in Table 3. It is important to note that commercial walk-in freezers are not eligible for ENERGY STAR certification.[13] The team identified eight such units, which were excluded from the table. Among the 19 pieces of cold storage that are ENERGY STAR Certified, True Refrigeration was the most common brand, accounting for 32% of the units. Turbo Air followed with 21%, and Hoshizaki made up 16%.

The remaining brands are Frigidaire, Atosa, Whirlpool, and Traulsen, each accounting for between 5% and 11% of the total, as shown in Table 4. A detailed list of model numbers and unit capacities for the identifiable equipment is included in Appendix D – Verified Equipment.

[12] According to the U.S. Department of Energy, refrigerators typically last an average of 12 years. See: U.S. Department of Energy. *Shopping for Appliances and Electronics*. https://www.energy.gov/energysaver/shopping-appliances-and-electronics?nrg_redirect=367177; Another estimate suggests that commercial refrigerators may have a service life of 10-15 years. See: Kitchenall. *How Long Do Commercial Refrigerators Last?* https://www.kitchenall.com/blog/how-long-do-commercial-refrigerators-last.html

[13] Walk-in Freezers are not qualified for ES Refrigerated buffet tables and preparation tables, walk-in coolers, blast chillers and freezers, horizontal open equipment, vertical open equipment, semi-vertical open equipment, remote condensing equipment, ice cream freezers, and equipment rated at the lowest application product temperature (LAPT, see 10 CFR Part 431, Subpart C, §431.62 and section 2.2 of Appendix B to Subpart C) are not eligible for ENERGY STAR under the Version 5.0 specification.
https://www.energystar.gov/products/commercial_food_service_equipment/commercial_refrigerators_freezers/key_product_criteria

Table 3 ENERGY STAR Status of Cold Storage Equipment

ENERGY STAR CERTIFIED	NUMBER OF EQUIPMENT	% TO TOTAL
Unidentifiable	70	64%
No	20	18%
Yes	19	17%
Total	**109**	**100%**

Table 4 Brands of Cold Storage Equipment Verified as ENERGY STAR Certified

BRAND	NUMBER OF EQUIPMENT	% TO TOTAL
True Refrigeration	6	32%
Turbo Air	4	21%
Hoshizaki	3	16%
Frigidaire	2	11%
Atosa	2	11%
Whirlpool	1	5%
Traulsen	1	5%
Total	**19**	**100%**

Cooking Equipment

The hot cooking equipment found across restaurant sites included a mix of ovens, grills and griddles, fryers and smokers, steamers and warmers, microwaves, cooktops, toasters and specialty appliances, and woks shown in Table 5. Ovens, grills and griddles, and cooktops and burners were the most common, with about 2.2 units per site on average, while other types like fryers and smokers, steamers, and microwaves were not as common, around 1 to 1.4 units per site.

Table 5. Hot Cooking Equipment Characteristics by Type

EQUIPMENT TYPE	NUMBER OF SITES	AVG. QUANTITY PER SITE	AVG. AGE (YRS)	AVG. CONDITION*	COMMON BRANDS
Ovens	12	1.5	11	2.8	Baker's Pride, Blodgett
Grills and Griddles	17	1.9	10	2.8	Stratus, Wolf
Fryers and Smokers	17	1.3	7	2.7	Pitco, Frymaster
Steamers and Warmers	12	1.4	10	2.7	Metro
Microwaves	9	1.0	4	2.9	Hamilton Beach, Sharp (Commercial), Panasonic
Toasters and Specialty Cooking Appliances	5	1.0	14	3.0	Black & Decker, Rinnai and others
Cooktops and Burners	21	2.2	9	2.8	Cook Rite
Woks	3	1.0	7	2.7	American Range and others

*Condition is scored as follows: Poor = 1, Average = 2, Good = 3

Most hot cooking equipment appeared to have been in use for a significant amount of time, with average ages ranging from 7 to 11 years. Microwaves had a shorter lifespan, averaging around 4 years, likely due to more frequent use and replacement, while toasters and other specialty appliances tended to last the longest, averaging 14 years. Overall, condition ratings were high, with most equipment rated between average and good.

Unlike the commonalities found amongst cold storage equipment, there was no consistency in brand amongst cooking equipment. Baker's Pride and Blodgett were frequently observed on ovens; Stratus and Wolf on grills and griddles; and Pitco and Frymaster on fryers and smokers. Cook Rite was commonly seen for cooktops and burners. For smaller equipment such as microwaves, toasters, specialty cooking appliances, and woks, a few units were observed during site visits, and no single brand clearly stood out. Among the nine sites where microwave information was collected, seven used residential-grade microwaves; only two sites had commercial-grade units, both from the brand Sharp, but with different models. A detailed model list is included in Appendix D – Verified Equipment. It is worth noting that ENERGY STAR does not certify microwaves, whether residential or commercial, so none of the units observed are ENERGY STAR[14].

The team faced difficulties in obtaining nameplate photos for hot cooking equipment during the site visit due to the equipment's placement, operational conditions, and, in some cases, the nameplates were worn or obscured by grease. Of the 89 pieces of hot cooking equipment with successfully collected photos, the team was able to identify model numbers and locate specification sheets for nine units. However, none of these were listed as ENERGY STAR certified, in part because some equipment types, such as microwaves, cooktops and burners, are not currently eligible for ENERGY STAR certification. Other equipment types, such as steamers and convection ovens, do have ENERGY STAR-certified models available on the market. A detailed model list of checked equipment is included in Appendix D – Verified Equipment.

Kitchen Ventilation

The number of kitchen ventilation systems is highly correlated with restaurant size. All the sites visited had at least one ventilation system, typically the main hood, with some locations utilizing two or three systems. These additional systems often include a secondary vent or a smaller vent above a secondary cooking area.

The age of the kitchen ventilation systems varied from 3 to 30 years old, with most of these systems being inherited by previous owners. In terms of brand, the most common kitchen ventilation systems observed were CaptiveAire and Ventroguard.

It was most common to see manually operated hoods. In cases where automation was present, it was typically limited to a basic automation on/off function. There was hesitation from many owners about automatic systems since sometimes they had either had experience with ones that wouldn't turn on when needed or wouldn't turn off.

[14] https://energystarhelp.zendesk.com/hc/en-us/articles/34537209557907-Are-there-ENERGY-STAR-certified-ovens-ranges-or-microwave-ovens?

The team was unable to gather photos of the kitchen ventilation equipment during the visits, restricting the ability to assess the efficiency or specifications of these systems. One thing to note is that ENERGY STAR currently does not certify commercial kitchen ventilation equipment[15].

HVAC

The HVAC system information collected by the research team was limited during the site visits. Several factors contributed to the limited HVAC data collection. In many cases, HVAC units were located on the roof or other hard-to-access areas, making it difficult for the research team to safely gather equipment nameplates, as well as some sites shared a building with other tenants, and it was unclear which HVAC systems were dedicated to the restaurant. Across the limited data collected, the average number of HVAC systems ranged from 1.7 to 2.0 per site.

As has been observed in kitchen ventilation systems, the HVAC systems in the restaurants were old (between 7 and 25 years). This indicates that many have been inherited from previous owners. The lack of information on restaurant ownership history beyond the current ownership made it difficult for the research team to determine replacement history beyond the current owner. While several brands were recorded, including Carrier, Darkin, Ruud, and Trane, each brand appeared in only one or two sites, so it is difficult to conclude that any brand is "common."

HVAC System Controls

Out of the 23 site visits, 22 locations have their HVAC system controlled by a thermostat. Among these, programmable thermostats were the most common type, followed by manual and other types. While programmable thermostats are designed to improve energy efficiency through scheduling temperature control, only five out of eight sites with programmable thermostats indicated using the scheduling feature as intended, as shown in Figure 3.

As the team noted during a site visit:

> *"There is a schedule for open/close when employees come in."*

In contrast, two sites with programmable thermostats reported using them manually:

> *"They tried to have one for the time they open but they usually end up manually adjusting."*
>
> *"They leave the AC on more during summer to keep the kitchen cool."*

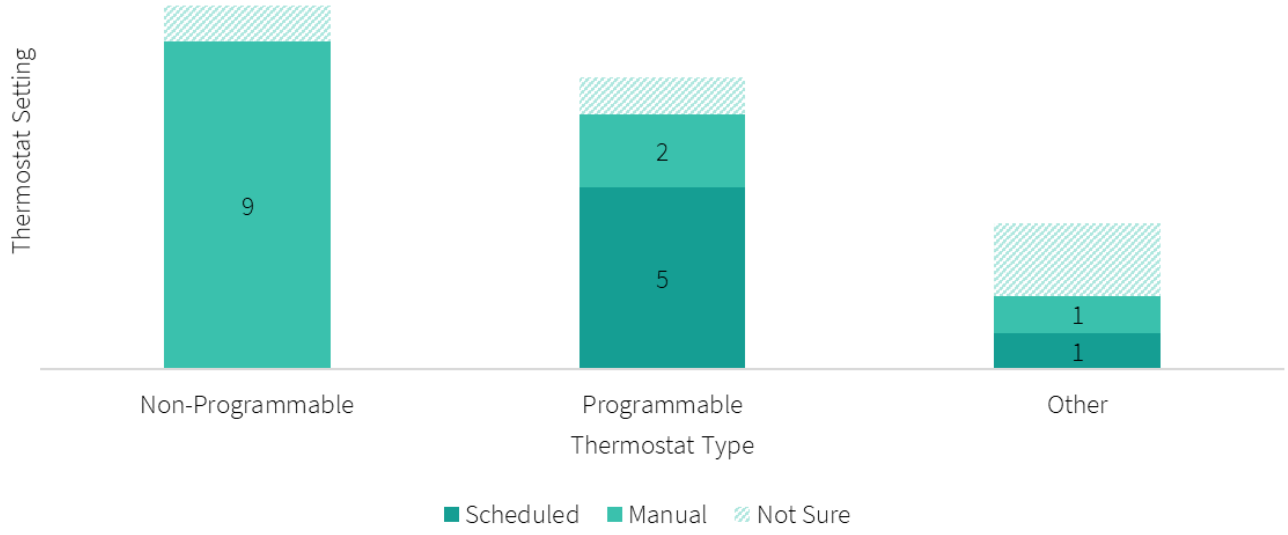
Honeywell emerged as the most frequently observed brand across all thermostat types, with 45% (10 out of 22) of the observed thermostats being Honeywell.

[15] ENERGY STAR certified commercial food service equipment list available online: https://www.energystar.gov/products/commercial_food_service_equipment

Heating and cooling setpoints varied slightly across all sites. Based on available data (10 out of 22 reported), the heating setpoint ranged from 65°F to 72°F, with an average of 69°F. For cooling, setpoints ranged from 70°F to 72°F, with an average of 70. Some restaurant owners emphasized the importance of maintaining a comfortable indoor temperature for both customers and kitchen staff, as many noted that adjusting settings manually was necessary to respond to daily conditions and customer volume. The research team noted during two site visits:

> *"They leave the AC on more during summer to keep the kitchen cool."*
>
> *"It is adjusted as needed and only serves the customer area."*

Figure 3. Thermostat Type and Setting



Water Heater

Information on water heaters was collected at 20 out of 23 sites with an even split between gas and electric systems, shown in Table 6. Both gas and electric water heaters showed very similar patterns, with an average of 1.2 units per site, and an average system age of 7 years – no clear preference observed between gas and electric water heaters among the sites. Rheem was the most frequently observed brand for both.

Table 6. Water Heater Characteristics by Fuel Type

FUEL TYPE	NUMBER OF SITES	AVERAGE NUMBER OF WATER HEATERS	AVG. AGE (YRS)	COMMON BRANDS
Gas	10	1.2	7.1	Rheem
Electric	10	1.2	7.3	

Compared to other equipment data collected during the site visits, water heaters had numerous photos of name plates. The research team reviewed 18 images; most were not ENERGY STAR certified. Of the 18 units observed, 39% (7 units) were unidentifiable due to missing nameplate photos, or the specification sheet couldn't be found. Over half, 55% (10 units), were confirmed as not ENERGY STAR certified. Only one unit has an ENERGY STAR sticker manufactured by Rinnai, although the team could not locate a model number or specification sheet, as shown in Table 7. The team identified two water heaters that had been recently replaced, neither of which was ENERGY STAR certified. A detailed model list is included in Appendix D – Verified Equipment.

Table 7. ENERGY STAR Status of Water Heater

ENERGY STAR CERTIFIED	NUMBER OF EQUIPMENT	% TO TOTAL
Unidentifiable	7	39%
No	10	55%
Yes	1	6%
Total	**18**	**100%**

Information on water heaters was collected at 20 out of 23 sites, with an even split between gas and electric systems. Both gas and electric water heaters showed very similar patterns, with an average of 1.2 units per site, and an average system age of 7 years – no clear preference observed between gas and electric water heaters among the sites. Rheem was the most frequently observed brand for both.

Energy Trust's Current Offerings

Energy Trust currently offers rebates for restaurant equipment that meets certain energy efficiency standards, primarily requiring most of the eligible products to be active on the ENERGY STAR® Certified Products List, (except for Commercial Vent Hood with Demand-Controlled Ventilation).[16,17] This section compares Energy Trust's current rebates with products eligible for rebates through other utility-funded programs to pinpoint possible gaps. It then correlates these insights with equipment observed during site visits. By cross-referencing these data sources, the analysis reveals opportunities to broaden Energy Trust's rebate eligibility, better align with market trends, and enhance support for restaurants in adopting energy-efficient equipment.

[16] Energy Trust's rebate offering qualified product list is available online at: https://www.energytrust.org/incentives/commercial-existing-buildings-foodservice/#incentivedetails

[17] The eligible Commercial Vent Hood with Demand-Controlled Ventilation must include a programmable controller with scheduling, occupancy, and heat sensing capabilities. Variable speed controls must be installed and operational on both the make-up air and exhaust fan motors. The make-up air must be tempered, and the total controlled motor horsepower must be at least 1.0 hp but not exceed the system's existing combined motor horsepower.

The analysis focuses on hot cooking and cold storage equipment, as these categories align closely with both Energy Trust's existing rebate offerings, and the types of equipment targeted by peer utility-funded programs that serve restaurants.

Energy Trust's current foodservice equipment rebates include core cooking equipment, such as ovens, fryers, griddles, and steam cookers, many available in both gas and electric models. The program also provides rebates for demand-controlled ventilation systems, dishwashers, and hot food cabinets, which are not as commonly offered by other energy efficiency programs. However, Energy Trust lacks rebates for most refrigeration and specialized cooking equipment, as shown in Table 8. The only refrigeration equipment currently eligible for a rebate are commercial ice makers and more advanced food service refrigeration measures, while many peer utilities have a broader offering for standard commercial refrigerators, freezers, and other cold storage equipment.

Table 8. Energy Trust's Foodservice Rebates[18]

EQUIPMENT TYPE	FUEL TYPE	INCENTIVE AMOUNT
Automatic Conveyor Broiler	-	$2,500–$3,500 each
Combination Oven (5–40 pan capacity)	Gas	$500 each
	Electric	$600–$3,000 each
Convection Oven (full-size)	Gas	$500 each
	Electric	$1,000 each
Griddle (single-sided)	Gas or Electric	$1,000 each
Fryer (High-Efficiency)	Gas	$1,500–$2,000 each
	Electric	$800–$1,000 each
Steam Cooker	Gas	$1,000 each
	Electric	$400–$2,000 each
Hot Food Cabinet (half-size)	Electric	$150 each
Double Rack Oven	Gas	$600–$900 each
Commercial Ice Maker	Electric	$180–$400 each
Commercial Dishwashers (Stationary & Conveyor)	Electric	$750–$1,200 each
Commercial Vent Hood with Demand-Controlled Ventilation	Electric	$900–$1,500 per controlled motor hp
Evaporator Fan Motor	Electric	$150–$180 per motor replaced
Doors on open Freezers or Refrigerated Cases	Gas	$160-$400 per linear ft of door
	Electric	$350 per linear ft of door
Advanced Controls on Walk-in Coolers/Freezers	-	$500–$1,200 each

[18] Energy Trust foodservice rebates are current as of August 12, 2025 and do not reflect any changes made to rebate amounts or eligible equipment since this date.

Gaps in Energy Trust Programs

The major difference between Energy Trust's foodservice rebates and other utility offerings were not in the general equipment types, but the availability of non-ENERGY STAR products for rebate. Many utilities offer point-of-sale rebates for commercial kitchen equipment to encourage energy efficiency in food service businesses. Like Energy Trust, rebates are commonly available for core cooking equipment, such as ovens, fryers, steamers, and griddles with both gas and electric models. Refrigeration equipment, such as refrigerators, freezers, ultra-low temperature freezers, and ice machines (the only refrigeration equipment currently incentivized by Energy Trust), is also frequently eligible for rebates through other utility-funded programs.

As Energy Trust's current foodservice rebates focus on ENERGY STAR qualified products, the research team looked at comparable utility-funded programs to understand what products they are rebating that are outside of this product list. Regarding eligible brands and models, the team compared ENERGY STAR® commercial kitchen equipment with rebate-eligible offerings from other utilities to assess brand and model diversity. To support this analysis, the team compiled a comprehensive list of energy-efficient equipment by drawing from the ENERGY STAR® database as well as rebate-qualified product lists from several utilities, including Sacramento Municipal Utility District (SMUD), Southern California Gas Company (SoCalGas), Southern California Edison (SCE), and the Los Angeles Department of Water and Power. A reviewed table of programs can be found in Appendix F – Peer Program Comparison. This analysis aims to understand the gaps where Energy Trust of Oregon (Energy Trust) may be missing opportunities by focusing exclusively on ENERGY STAR® certified equipment.

For several types of equipment, such as fryers, griddles, hot food holding cabinets, ovens, and steam cookers, Energy Trust offers rebates but limits eligibility to ENERGY STAR® models. While ENERGY STAR® covers a substantial number of brands and models in these categories, there are still many additional non-ENERGY STAR® brands and options supported by other utilities.

In other cases, such as cooktops, ENERGY STAR® certified equipment exists (Spring USA has 12 models), but Energy Trust currently does not offer rebates. For equipment categories like soup wells and toasters, there are no ENERGY STAR® certified models available, but other utilities offer a range of non-certified options.

In the Cold Storage category, Energy Trust currently offers rebates only for ice makers, while other utilities have much more expansive offerings. For example, for refrigerators and freezers, 11 of the utility-funded programs had coverage for some types of refrigerators or freezers. Additionally, ENERGY STAR® provides extensive coverage—69 brands and 1,426 models. Lastly, for chef bases, there are no ENERGY STAR® certified models available, and Energy Trust also does not provide rebates, although some utilities support a limited number of non-certified models and brands, as shown in Table 9.

Energy Trust should look to other utility-funded programs to understand what equipment outside the ENERGY STAR program could be added to the rebate list. While ENERGY STAR is a clear signal to both restaurants and contractors that a piece of equipment is energy efficient, there are viable opportunities outside this list.

Table 9. Comparison of Coverage and Common Energy Efficient Offerings

EQUIPMENT	ENERGY TRUST REBATE	ENERGY STAR COVERAGE*	PEER PROGRAM COVERAGE	TOP BRANDS WITH ENERGY EFFICIENT MODELS – ENERGY STAR AND NON-ENERGY STAR
Cooktops	No	Limited	N = 8	Spring USA, Cooktek, Venancio, Equipex, Montague, Vollrath
Fryers	Yes	Extensive	N = 12	Pitco, Frymaster, Vulcan, Henny Penny, Royal Range, Ultrafryer Systems, Giles Enterprises, Sapidus, Motion Tech, Admiral Craft
Griddles	Yes	Limited	N = 12	Taylor Company, AccuTemp, Imperial, Garland, Vulcan-Hart, Keating, Jade, Magikitchn, Wood Stone
Hot Food Holding Cabinet	Yes	Extensive	N = 8	Metro, FWE, Traulsen, Continental, Cres Cor, Cambro, Alto-Shaam, Royalton, Hatco, Moffat
Soup Wells	No	None	-	Cooktek, Vollrath
Ovens	Yes	Limited	N = 12	Southbend, Blodgett, UNOX, Convotherm, Vulcan, UNOX, Alto-Shaam, RATIONAL, Moffat, Royal
Steam Cookers	Yes	Limited	N = 12	AccuTemp, Sterling, Southbend, Groen, Market Forge, Cleveland
Toasters	No	None	N = 6	Antunes, Prince Castle, APW Wyott
Chef Bases	No	None	N = 2	Atosa, Migali, Adande
Refrigerators & Freezers	Limited	Extensive	N =11	TRUE, Beverage-Air, Turbo Air, IDW, Delfield, Continental Refrigerator, Kelvinator COMMERCIAL, Minus Forty, Avantco, AHT
Ice Machines	Yes	Extensive	N = 7	Manitowoc, Hoshizaki, Scotsman, Ice-O-Matic, Follett, Ice-O-Matic, Tazpi, Tittla, U-line, Hothope

*Extensive coverage includes greater than or equal to 400 models in ENERGY STAR, Limited is less than 400 models

The interviews with restaurant owners conducted by the research team revealed a common concern about upgrading large kitchen equipment: many are hesitant to pursue replacements due to the potential disruption to their business. Owners often hold on to aging equipment because replacing major appliances like ovens or refrigeration units can require temporarily shutting down operations.

In response to these concerns, the team explored additional opportunities for energy efficiency updates that focus on smaller or specialty equipment that has rebate offerings by peer utilities, shown in Table 10.

Table 10. Specialty Restaurant Rebate Offering by Other Programs

EQUIPMENT	PROGRAMS
Induction Cooktops	Mass Save
Infrared Broilers (e.g., Salamander, Upright, Char Broiler)	DTE
Pasta Cookers	
Underfired Broilers	National Grid
Vending Misers	
Refrigerated Chef Bases	
Hand Wrap Machines / On-demand Hand wrappers	PG&E, SoCalGas, SCE, SDG&E, National Grid

While other utility-funded programs do offer some of these smaller pieces of specialty equipment, as the research team found most of the equipment in these businesses to be a standard cookline, there may be limited uptake in these measures.

Other Considerations for Equipment Coverage

In conversations with Energy Trust, it was mentioned that this previously rebated equipment is no longer viable to them due to current equipment baselines and the cost effectiveness of these measures. While refrigeration equipment may not be viable with current baselines, there could be energy saving potential from early replacement due to the evidence from this study that these customers have an older than average age of this equipment. As this study was limited in the number of site visits and the geographic coverage of the state, further research is needed to verify the equipment baseline of refrigeration for this segment.

Reconsider equipment, like energy efficient refrigeration equipment, which is already on the market but no longer offered in Energy Trust programs. Specifically, if Energy Trust can verify the equipment baseline and modify their equipment baselines for these types of equipment, they could again be viable for the programs.

Chapter 5: Barriers and Opportunities for Efficient Product Adoption

As discussed previously in the report, most characteristics of these independent restaurant owners make energy efficiency, and particularly participating in energy efficient programs, difficult for this segment. We heard from both restaurant owners and from the contractors they work with, that as these restaurant owners have bigger constraints on their profitability than energy savings, energy efficiency rarely rises to the top. These restaurant owners have limited bandwidth and limited capital, which means that grabbing their attention and redirecting it towards energy efficiency will be challenging for Energy Trust. This makes it essential that any offering for this sector clearly demonstrates immediate and tangible value. For these restaurant owners, as illustrated by what one restaurant owner said below, any program or intervention must be clearly worth their time and effort, otherwise it is unlikely to gain traction even when it brings about long-term benefits.

Meet [Name], Restaurant Owner in Beaverton, Oregon

[NAME] has also been a recipient of an Energy Trust fryer rebate program, encouraged by a trusted business advisor, which marked an important step toward considering energy-saving solutions. However, their experience with this program has been mixed; while they appreciate the potential savings, they also found themselves frustrated by the paperwork and the slow pace of approval, which undermines their motivation to pursue more energy efficiency initiatives. **“If it takes too long or feels like a hassle, I’m not sure it’s worth it,” says [Name].**

With the multiple hats that restaurant owners wear, [NAME], is particularly keen on initiatives that are easy to navigate and come with trustworthy guidance. [Name] emphasized that relationships play a huge role in their decision-making process—whether it’s with employees, suppliers, or external partners. They value clear communication and expect energy companies to offer guidance that aligns with the realities of running a business—like understanding operational cycles and meeting owners where they are. As [Name] put it during our interview, **“[utility companies need to take] baby steps, but those baby steps need to be big,”** meaning actions should be clear, tailored, and impactful enough to feel worthwhile.

Owners talked about not considering the efficiency levels of equipment when making replacements, assuming that anything that they are replacing will be higher efficiency since they are replacing old, failing equipment. Additionally, restaurant owners discussed that they did not think that any increased equipment cost would be made up from increased efficiency of the equipment, especially due to increased utility rates.

From their perspective, any potential energy savings they may see on their utility bill would be washed out by these increasing rates, with little impact on their monthly bills. While there may be an opportunity to shift this thinking, understanding this perception and how it can limit their motivation for purchasing energy efficiency equipment is critical.

Mixed Experiences with Energy Efficient Equipment

Experiences with energy efficient equipment were split amongst restaurant owners. Some owners had good experiences with equipment like LEDs and mini splits, stating that the efficiency of the equipment did not impact performance, and there were other benefits of the equipment, such as decreased frequency of replacement for LEDs or ability to have controlled temperature zones, for mini splits. But when it came to restaurant cooking or refrigeration equipment, a couple of owners spoke about previous negative experiences with efficient fryer rebate offered by Energy Trust:

> *"I know that there's we've looked at like, efficient, efficient fryers, for example, to try and reduce the expense of natural gas going to that fryer. But then my experience with an efficient fryer is, how do I put this politely? They don't operate at a level necessary to keep to keep the temperature high enough... I rather buy or look at equipment that is going to last me longer, rather than try and save money by getting rebates on a cheaper or a more efficient, more efficient unit because I end up having to replace the efficient units quicker."*
>
> *"in 2015 we had a fire at our [NAME] location and as part of the rebuild we actually worked with the Energy Trust of Oregon to install some efficiency equipment. Those two specific pieces of equipment [fryer and ice maker] have now been replaced. Everything else that we installed is still operating, so those two pieces of equipment are no longer in our restaurant anymore.*

These quotes highlight two important issues: that restaurant owners value reliability over efficiency gains and that these previous negative experiences with energy efficient equipment impact greatly their interest in adoption of future energy efficient equipment. One restaurant owner stated that they do not think that energy efficient equipment is "practical," while another stated that they do not think it is "reliable."

While this may be more of a perception than a reality for this equipment, it is a perception that persists for this segment. When discussing this perception with members of the Advisory Committee, they discussed the need for customer education on combating these perceptions that energy efficient equipment as "unreliable" due to the different operational needs or behavioral changes that comes along with using an energy efficient piece of equipment.

As reliability is of upmost importance to these owners, this perception of energy efficient equipment may be hard to combat for Energy Trust and other program providers. It may be more effective to only promote tried and true equipment amongst this segment to help foster trust with energy efficiency and Energy Trust, rather than try to pilot new, unknown measures.

A few owners talked generally about wanting efficient equipment if they could afford it for the energy cost savings but didn't speak to any additional advantages of the equipment.

Restaurant owners did know the ENERGYSTAR branding and discussed interest in purchasing it if it was within their price range. This branding was the most recognizable way that restaurant owners and contractors knew that equipment was energy efficient and trusted ENERGYSTAR as high quality, verified equipment.

This was echoed at the national manufacturer's conference, where ENERGYSTAR was the most frequent way that manufacturers advertised that their products were energy efficient. This was due to its highly recognizable brand appeal, as well as well recognized standards in the industry.

Multiple of the restaurant owners discussed that they had recently upgraded their HVAC and cooling system with a heat pump, most commonly a mini split heat pump. This heat pump was to increase the cooling capacities of their existing system. As most of the restaurants were in rented spaces, they could not do upgrades due to needing owner approval and cost sharing or would prefer not to make major upgrades to the HVAC systems in a space they do not own. Yet these heat pumps were seen as a low-level investment in increasing the comfort of their customer facing space and making the kitchen more comfortable and workable for staff. Again, this speaks to the importance of highlighting the benefits beyond energy efficiency when attempting to market energy efficient products and technologies to customers.

Contractors also mentioned having mixed experiences with cookline equipment. While they recognized that energy efficiency is important, they noted that much of this equipment is more difficult to diagnose when there is an issue, due to the controls, sensors, or other technologies involved. The issue of serviceability is key for these contractors, as if they cannot service a piece of equipment, they feel they will lose that business in the future, and therefore may be less likely to recommend a piece of equipment that they would not know how to diagnose or service. Additionally, one contractor noted that he shied away from equipment that had electrical components or touchscreen panels as they were more technologically complex to fix. As energy efficient equipment becomes more complex, these contractors with a preference for "lower tech" equipment will get left behind.

> As Energy Trust works with contractors, they will have to train some contractors on how to properly diagnose and service these pieces of equipment, as serviceability was paramount in a contractor's equipment recommendation to a restaurant owner.

Space Constraints

As previously discussed, almost all the restaurants interviewed rented their restaurant space and were operational out of long-standing buildings. This means that they were working within a predetermined footprint, and many times working within small kitchen spaces. These space constraints can make specific equipment selection tailored not only to the equipment capabilities, but to the footprint available for the equipment.

As proper equipment sizing both in capacity of the panel and in actual footprint is important for equipment to run as intended, this constraint is particularly important for energy efficient equipment. For panel sizing, these restaurants may not have any power over their panel's capacity in their space if they are a renter.

Additionally, equipment footprint can create its own unique constraints: sometimes energy efficient equipment can operate within a smaller footprint, such as a combi oven replacing two separate pieces of equipment (steamer and oven); but, depending on the pieces of the equipment and the needs of the restaurant, energy efficient equipment may not fit within that predetermined space, for example, as they may need two energy efficient fryers to keep up with capacity instead of one.

Availability of Equipment and Urgency of Replacement

Several contractors noted that independent restaurant owners are generally underserved by the supply chain. Contractors felt that these owners were typically constrained by available capital and availability of new equipment as new equipment purchases were generally at the point of equipment failure and could be emergency situations. We heard this echoed in the restaurant owner interviews where several experienced issues in equipment supply chains for equipment and were constrained in their choices for whatever was available when their equipment failed.

A few restaurants directly mentioned previous issues with equipment supply chains. While these were not particular to only energy efficient equipment, when they talked about experiencing these issues, they went with whatever was available and in their price range, instead of waiting for the exact right piece of equipment. This was especially true of smaller pieces of equipment that could be picked up from a retailer and quickly installed, like a fryer or rice cooker.

The prevalence of replacing equipment at failure and urgency for replacement means that supply chain issues will have an even greater impact on a restaurant's equipment choices. For example, even if a restaurant owner is interested in energy efficiency, if they are constrained in their timeline and are experiencing delays with the supply chain for efficient equipment, they will choose the less efficient option to keep their restaurant operational.

Limited Product Development

An area the study sought to address was whether there were opportunities for product development based on independent restaurant needs. And more specifically, if independent restaurants that offered cultural cuisines had unique needs and equipment opportunities. The research identified a few key pieces of information that shaped the research and are important to consider in program design. First, while specialty equipment exists, the primary energy using and cookline equipment are not specialty, and in many cases have efficient options (which may or may not be included in programs due to cost-effectiveness). In addition, the study found that meeting the needs of independent restaurants is not the gateway to product development. Product development, testing, and marketing is costly, and therefore reserved for cases where mass sales opportunities exist. This is not to say that independent restaurants can't drive the innovation; rather, they have less market influence due to their lower buying power.

To understand these issues further, the research team attended the North American Food Equipment Manufacturer's conference, where they discussed with manufacturers products that were well suited for the independent restaurant segment, products they had in development for this segment, and how they considered efficiency in their development of equipment for this segment.

Based on expert interviews, restaurant equipment is primarily developed for chains. This is because many of these technologies developed by manufacturers are developed 1) for segments that have high market buy in and 2) are replicable technologies and environments. For energy efficient technologies, this means they only become available to independent restaurants once they have been well tested to have market viability and have wider scale adoption. This can also mean that they will always be slightly behind in the efficiency adoption curve. Energy efficiency gains usually are integrated into equipment made for specific environments in a chain restaurant, or outside the price ranges of these independent restaurants.

For example, the research team saw a cutting-edge grill that integrated increased reflectivity into the grill grates and ceramic plates that increased heat retention. These two technologies lead to a decrease in gas consumption without losing the cooking power desired from this equipment. While these new technologies are exciting, and should continue to be developed, the research and development costs preclude from manufacturers developing these new technologies at a cheaper price point. When talking to manufacturers they were hesitant about any business case for producing these new energy efficient technologies cost effectively without a very strong business case, and even then, did not think this could be currently economically viable, due to the high costs of R&D and the varied preferences and needs of the independent restaurant segment. This means that until the adoption of these technologies becomes more widespread, they will not be at the price point for most of the small, independent restaurants.

Additionally, there was some product development for after-market technologies with efficiency claims that could be suitable for restaurants with smaller budgets and footprints, including controls, add-ons to fryers, and soak tanks. But many of the manufacturers' claims had not been tested by trusted certification agencies. Additionally, these add-on or after-market technologies may impact the warranties of the existing equipment, and therefore not viable for these restaurants that depend on these warranties for equipment servicing and replacement. Therefore, the research team cannot recommend them to Energy Trust programs as viable technologies to add to the incentive programs without further research.

Finally, through the attendance at the manufacturers conference and the interviews with contractors, it emerged that there is no single technology or equipment that is emerging for this market. This lesson was important to shape any additional research that was to be conducted with manufacturers or on the equipment market. Through this learning, the research team decided to not conduct additional manufacturer interviews for this research to keep the findings focused on the trust and relationship building that is necessary to adequately engage with this segment.

Previous Experience with Energy Trust

Restaurant owners are particularly squeezed by both their thin margins and by being underserved by the restaurant equipment market. When considering energy efficiency opportunities and program designs, Energy Trust should consider what is under the organization's control to support these customers who face limited time, limited capital, and limited options. Restaurants and contractors discussed mixed previous experiences with Energy Trust. Both restaurants and contractors had a low awareness of rebates for this segment and felt like there were not many rebates on offer that catered to this segment.

Customer Experiences with Energy Trust

Although their utility and Energy Trust serve different roles, this distinction seemed to be unclear or irrelevant to restaurant owners due to the mental association between the two. As a result, when describing interactions with their utility or with Energy Trust, it wasn't always clear that they viewed them as different entities or the same. While most of the negative experiences were with utilities, Energy Trust is associated with energy and therefore their utility in the mind of most of these restaurant owners. Due to this association, Energy Trust may need to work to build trust and brand recognition with this segment.

Additionally, most restaurants didn't know of programs that were currently available to them and didn't feel like there were good resources, or they didn't have the time to investigate them. The most frequently mentioned Energy Trust program was the fryer rebate, which restaurant owners discussed having positive experiences with getting a rebate, but negative experiences of equipment performance. Except for Energy Trust's fryer rebate, all customers who discussed making recently upgrades, including HVAC or water heating, did not mention Energy Trust rebates. One restaurant owner discussed that they thought that Energy Trust had some rebates, but did not feel like those rebates were appliable to his restaurant:

> *"Some of the equipment that they do have rebates on is out of the scope of a small business, more suited for large business, like steam ovens or special ducted hood systems."*

This low awareness of rebates and perception that the Energy Trust program does not cater to independent restaurants will be a barrier to combat as Energy Trust changes their strategy and offering for this segment.

Contractor Experiences with Energy Trust

Three out of the five service contractors we spoke to had previous experience with Energy Trust programs. The other two contractors were refrigeration and HVAC focused and either did not know about Energy Trust programs or assumed the incentives offered were only for HVAC or hot equipment. The contractors who were familiar with Energy Trust reported that they suggest owners check with Energy Trust before buying to see if it will give them a rebate for the equipment they want. This wording suggests contractors and customers will first select the equipment they want then check Energy Trust for a rebate, not look to Energy Trust for rebate-eligible equipment, and then decide:

> *"Especially the independent [restaurant] customers, I don't think the Energy Trust comes in their vocabulary or in the conversation. They don't really mention any efficiency. Sometimes I bring it up and say 'hey, maybe … we see if this qualifies for the Energy Trust and you might get a rebate…' But if when we are at the first stage of a customer, it's not really on their vocabulary." – HVAC, Refrigeration and Cooking equipment Contractor*
>
> *"Energy efficiency more comes up if they're looking for some kind of credit. I think there is an assumption made that nowadays everything is as efficient as it can be… (They are) not understanding about EnergyStar and regulatory rules that things have to be at least a certain percentage of efficiency… I don't know if it's gotten harder or easier, I just know that (applying for credits from ETO) is not as common now as it used to be." – HVAC, Refrigeration and Cooking equipment Contractor*

These contractors noted that they felt like there was not as much applicable equipment coming from the Energy Trust program as there was previously, especially for refrigeration equipment. They also were not aware of rebates that are available for cooking equipment stating:

> *"I have not heard much about ETO credits lately. There was a time when it was all we heard. I know about rebates for electric cars, but I don't hear about rebates for fryers or griddles."*[19]

Servicers and contractors who also sold equipment noted that while they appreciated the rebates from Energy Trust to move sales, these programs could be more difficult than they were worth, especially with the perceived lower incentive values on equipment that they sell and service:

> *"There was a time when it was a little bit of a driving force because of the amount of the credit and how much it would save them. It seems like there hasn't been as much funding lately, and in order to get a credit … it's a lot of paperwork, a lot of questions." – HVAC, Refrigeration and Cooking equipment Contractor*

These service contractors will need continuous engagement to remind them and update them on what Energy Trust currently offers. This points to an opportunity for the Energy Trust programs to more readily inform these service contractors of their offerings for this segment, including food service, HVAC, and water heating measures, as these contractors are the "first stage" in that decision making process.

Suggestions for Energy Trust from Restaurants and Contractors

All restaurant owners discussed being interested in Energy Trust and in more information on possible incentives in the future, even those who had previous negative experiences with the rebated products. When asked how Energy Trust could better support their business, the following ideas were raised by multiple restaurant owners:

- Make the application process easier to limit time and paperwork (such as a turnkey solution or midstream model)
- Provide personalized recommendations from an audit of their business
- Provide online resources for comparing costs to standard efficiency
- Provide financing options that have different qualifications than traditional financing

> *"A lot of those things you have to jump through a lot of hoops just to make it happen and I lots of times I don't have the time."*
>
> *"I don't know what to do [regarding how to lower energy costs], but if the utility company were to give us ideas, I would listen to their recommendations."*

[19] Note that Energy Trust of Oregon does not offer direct rebates for electric vehicles. The contractor could be conflating rebate programs from the federal government, their utility, or an external provider, which is common in interviews about rebate programs.

While some of these have been considered by Energy Trust in the past or might be a part of Energy Trust's current offerings, these restaurants are interested in having offerings that are catered specifically to the needs of their business. When asked how Energy Trust could make programs easier to participate in from a contractor perspective, contractors had three main suggestions: increase awareness of available incentives, increase equipment availability, especially for refrigeration, and make the rebate process more intuitive in the sales process.

To cater to this segment, Energy Trust needs to look towards program models that reduce customer burden, such as trade ally programs, midstream programs, or other turnkey services that do most of the installation and rebate processing.

Contractors mentioned increasing awareness for both customers, so these customers would bring up the credits or programs in conversation for purchasing equipment, and contractors, so they could better sell this equipment. Their recommendations for awareness included:

- Local television and radio advertisements, especially to reach rural areas (2)
- In-person visits to contractor businesses (2): *"[We used to have] people visit from ETO at least once a month talking to us about it, to help us understand it better, getting the word out. If I don't hear about it, I can't talk about it."*

Recruiting these service providers to promote Energy Trust by showing them how it can help their bottom line or help them keep customers (for those who don't sell equipment) could be a way to get more owners thinking about efficiency, reliability and how incentives can lower up-front costs.

Contractors also wanted increased options for rebate, as they didn't always understand why some equipment would be available for a rebate, and some would not. One contractor mentioned that they just wanted more flexibility on what could qualify and that if a contractor could prove it would save the customer energy, it should qualify for some sort of incentive. Some contractors had more specific examples of desired equipment and services:

- **Parallel (also known as rack) systems instead of single systems for refrigeration**: This contractor is a refrigeration specialist. They said that this is incentivized in new construction, and should be incentivized in retrofits as well
- **Maintenance:** Maintenance that increases the longevity and efficiency of the equipment could be incentivized or subsidized.

Contractors did not have specific makes or models that they wanted Energy Trust to incentivize that they were not currently.

Finally, contractors said they would appreciate resources that would enable sales or marketing, such as:

- A comparison tool for an efficient model versus a not efficient model
- A short script for how to sell efficiency and Energy Trust programs
- Energy Trust advertise the benefits of regular maintenance, in the hopes that this would lead to increased service work for their company

- Seminar for contractors on available cooking equipment and the advantages of energy efficient options

The contractors discussed that these types of tools would help them be more effective at discussing Energy Trust programs, help them to develop their sales strategy, and widen their outreach. Additionally, as these contractors mentioned they still have some unfamiliarity with energy efficient cooking equipment, especially with diagnosing issues with that equipment, it could be helpful for Energy Trust to interject with trainings not just on their incentive levels, but on how to determine issues with this equipment when something goes wrong. This may make contractors less hesitant to recommend this equipment as they are more familiar with its repair and maintenance procedures.

Chapter 6: Conclusion and Future Considerations

The energy efficiency market is currently experiencing pressures unlike it ever has before. The "low hanging fruit savings", such as lighting, have been decreased by increased codes and standards, meaning the savings must be gotten from projects with more complex equipment and more customer involvement. Within these constraints, including cost-effectiveness pressures, program administrators may be inclined to serve customers that have been historically easy to derive savings from and continue to underserve groups like independent restaurants. In these times of pressure, Energy Trust recognizes that it is important to commit to serving all customers. Energy Trust conducted this study to understand the extent to which these independent restaurants faced unique equipment needs, barriers, and purchasing decisions with the intent of using this insight to more equitably and effectively serve this group.

This study found that to adequately address the needs of this segment, the programs will require a program design that prioritizes ease of access and includes hands-on program engagement through trusted relationships. As keeping their businesses running is these restaurants top priority, equipment decisions occur when the equipment is at failure, creating stress and limited bandwidth for decision making. Additionally, due to the tight margins of the restaurant industry, the Energy Trust programs should consider program models that decrease the need for high upfront capital. By ensuring easy access to rebates through point-of-sale rebate models, such as midstream programs, Energy Trust can alleviate the need to complete time-consuming paperwork, make complex decisions, or front the higher cost of equipment before the rebate clears.

Additionally, many of the restaurant owners rely on the guidance of other business owners, community members, and equipment servicers to help make decisions when upgrading their equipment. These trusted partners help to educate new restaurant owners about the durability, operational efficiency, and reliability of equipment, and help seasoned restaurant owners understand what is emerging on the market. To leverage these trusted partner relationships, Energy Trust should more widely advertise and educate these partners about the opportunities for independent restaurants. This broader market awareness will allow for Energy Trust rebates to be actively a part of the conversation during equipment decision making and purchasing, and not as an afterthought.

While Energy Trust can work to improve its rebate offerings and program design for independent restaurants, serving this market through energy efficient offerings continues to be a challenge. Much of the energy efficient product development in foodservice manufacturers is occurring where these manufacturers see market opportunity, buying power, and replicability, namely chains. As Energy Trust considers what equipment to add to its currently existing programs, it is important to note that these pieces of equipment cannot be added without consideration to how they will be delivered. For these customers, the right-sized and marketed program model seems to be just as, if not more important than the exact right set of measures in the program offering.

Finally, there is more work to be done. This study attempted to review the market on a broad instead of deep basis but is not meant to be a complete characterization of the independent restaurant segment in Oregon. This means there's more to dig into to truly understand this segment and its supply chain. As Energy Trust modifies its programs to serve independent restaurants, more research on program design, desired incentive levels, or marketing testing, would be helpful.

Appendix A – Recruitment Materials

Below are examples of the recruitment materials used in the recruitment of restaurants for site visits and interviews in English, Spanish, Mandrin Chinese, and Vietnamese.

ILLUME

Why Energy Trust Is Doing This Restaurant Study

The goal of this study is to understand how Energy Trust can best provide small business owners like you with incentives that help you save money and energy in your restaurant. You know the most about how your restaurant operates and uses energy, and we want organizations like Energy Trust to be able to offer better programs and incentives that make sense for businesses like yours.

What You Will Experience When We Visit Your Restaurant

Our research team will visit your restaurant to gather information on the equipment in your kitchen and restaurant space. We will collect information such as the age and type of equipment, and how it is used. We will also ask questions about the building and general maintenance questions. This should take approximately one hour. We will work to schedule at the most convenient time for you, including during off-business hours if you would like.

If there are questions you do not know the answers to, that is fine. We are excited to learn about your restaurant's equipment, and you are the expert in your restaurant!

Equipment We Are Interested In

The next page lists the information we will collect during the visit. This list summarizes the focus points of this survey, and there may be a few questions that are not listed here that will be asked. For example, we may ask about the temperature thermostats are set at or about general maintenance.

If you approve, we may take photos of equipment nameplates. We will use the pictures to look up the specific piece of equipment if the model number is unclear. We will not share photos outside of the research team without your permission.

What We Won't Ask

- We will **not** ask about your employees
- We will **not** ask to talk to your customers
- We will **not** ask questions regarding licensing and permits
- We will **not** take pictures of employees or food
- We will **not** share information identifying you or your restaurant outside of the research team. All information will be anonymous

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Building Space

- Square Footage
  a. Customer space (square feet)
  b. Kitchen space (square feet)
  c. Other (e.g., office and storage)
- Lighting
  a. Quantity
  b. Were the lights replaced since you acquired the building?
- HVAC and Domestic Hot Water Equipment
  a. Water Heater
  b. HVAC System
  c. Cooling and heating equipment that specifically serves the restaurant and kitchen space (e.g. mini-splits, portable air conditioner, space heater, etc.)
  d. Thermostats
  e. Kitchen Ventilation (Hoods)

Kitchen Equipment

1.1.1.1 Hot/Cooking Equipment

- For all cooking and hot/cold storage equipment we will attempt to capture the following information:
  a. Nameplate information
  b. Usage patterns (e.g. daily or weekly use)
- Equipment we are looking for
  a. Ovens
  b. Standard
  c. Combination (Steam +Convection)
  d. Pizza
  e. Convection
  f. Broiler
  g. Griddle
  h. Wok
  i. Fryers
  j. Hot Food Cabinet
  k. Steamers
  l. Rice cookers
  m. Ranges
  n. Microwaves

Figure 1: Example Nameplate

1.1.1.2 Cold/Storage Equipment

- Equipment we are looking for
  a. Stand-alone refrigerator
  a. Chest Freezer
  b. Walk-in cooler/freezer
  c. Ice maker
  d. Display Cases
- Stocking practice information
  a. When stocking cold equipment such as walk-in freezers, fridges are there procedures to reduce energy use?
  b. Are there times when the refrigerator or freezer is not hitting desired temperatures?

Back and Front of Restaurant Equipment

- Dishwashers
  a. Nameplate information
  b. Type (commercial or domestic)
- Other Notable Plug Loads (Ex. TVs)

email: restaurant@illumeadvising.com **phone**: (503) 894-6618 **website**: energytrust.org/restaurantstudy

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Por qué Energy Trust está realizando este estudio en restaurantes

El objetivo de este estudio es saber cómo Energy Trust puede ofrecer mejores incentivos a los propietarios de pequeñas empresas como usted que les permitan ahorrar dinero y energía en su restaurante. Usted conoce mejor el funcionamiento y el consumo de energía en su restaurante, y queremos que organizaciones como Energy Trust puedan ofrecer mejores programas e incentivos que se adapten a empresas como la suya.

Lo que sucederá cuando visitemos su restaurante

Nuestro equipo de investigación visitará su restaurante para recopilar información sobre los equipos que se encuentran en la cocina y los espacios del restaurante. Recopilaremos información como la antigüedad y el tipo de equipos, y cómo se utilizan. También haremos preguntas sobre el edificio y el mantenimiento general. La visita debería tardar aproximadamente una hora. Nos esforzaremos por programar la visita en el momento que sea más conveniente para usted, incluso fuera del horario comercial, si así lo desea.

Si no sabe la respuesta a alguna pregunta, no hay problema. Nos emociona conocer los equipos de su restaurante, y usted es el experto en su negocio.

Equipos que nos interesan

En la siguiente página se detalla la información que recopilaremos durante la visita. La lista resume los puntos clave de esta encuesta, aunque es posible que hagamos algunas preguntas que no están incluidas aquí. Por ejemplo, podríamos preguntar sobre la temperatura a la que están configurados los termostatos o sobre el mantenimiento general.

Tomaremos fotos de las placas de identificación de los equipos, si usted lo permite. Usaremos las imágenes para buscar el equipo específico en caso de que el número de modelo no esté claro. No compartiremos las fotos con personas que no pertenezcan al equipo de investigación sin su autorización.

Lo que no preguntaremos

- No haremos preguntas sobre sus empleados
- No solicitaremos hablar con sus clientes
- No haremos preguntas sobre licencias y permisos
- No tomaremos fotos de empleados ni comida
- No compartiremos información que lo identifique a usted ni a su restaurante con personas que no pertenezcan al equipo de investigación. Toda la información será anónima

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Espacio del edificio

- Metros cuadrados
  a. Espacio para clientes (metros cuadrados)
  b. Espacio de la cocina (metros cuadrados)
  c. Otro (p. ej., oficina y almacenamiento)
- Iluminación
  a. Cantidad
  b. ¿Se reemplazaron las luces desde que adquirió el edificio?
- Equipos de climatización y agua caliente sanitaria
  a. Calentador de agua
  b. Sistema de climatización
  c. Equipos de refrigeración y calefacción destinados específicamente al espacio del restaurante y la cocina (p. ej., minisplit, aire acondicionado portátil, calentador, etc.)
  d. Termostatos
  e. Ventilación de la cocina (campanas)

Equipos de la cocina

1.1.1.1 Equipos para cocinar y calentar

- Para todos los equipos de cocina y almacenamiento en frío o calor, intentaremos recopilar la siguiente información:
  a. Información de la placa de identificación
  b. Patrones de uso (p. ej., uso diario o semanal)
- Equipos que buscamos
  a. Hornos
  b. Estándar
  c. Combinado (vapor + convección)
  d. Pizza
  e. Convección
  f. Parrilla
  g. Plancha
  h. Wok
  i. Freidoras
  j. Vitrinas para alimentos calientes
  k. Vaporeras
  l. Ollas arroceras
  m. Estufas
  n. Microondas

Figura 1: Ejemplo de placa de identificación

1.1.1.2 Equipos de almacenamiento y refrigeración

- Equipos que buscamos
  a. Refrigerador independiente
  a. Congelador horizontal
  b. Cámara de frío
  c. Máquina de hielo
  d. Vitrinas
- Información sobre las prácticas de almacenamiento
  a. Al almacenar en equipos frigoríficos, como cámaras de frío y refrigeradores, ¿existen procedimientos para reducir el consumo de energía?
  b. ¿Hay ocasiones en las que el refrigerador o congelador no alcanza las temperaturas deseadas?

Equipos de la parte delantera y trasera del restaurante

- Lavaplatos
  a. Información de la placa de identificación
  b. Tipo (comercial o doméstico)
- Otros equipos notables conectados (p. ej., televisores

email: restaurant@illumeadvising.com teléfono: (503) 894-6618 sitio web: energytrust.org/restaurantstudy

Help Us Understand Your Kitchen's Energy Needs And Get $250!

As an independent restaurant owner, we understand that you operate very differently from other businesses —and even other restaurants. At any given time, you might be cooking, doing inventory, fixing equipment, all while solving the unexpected challenges that come with operating a restaurant. Meanwhile, continued increases in food, labor, and operating costs considerably affect your profit margins.

Energy Trust can't cook—we're an independent nonprofit focused on clean energy solutions. But we'd love your help finding solutions that will benefit you and your restaurant's bottom line! In this unique study, we want to learn directly from independent restaurant owners how we can better save them money and energy.

Why is Energy Trust doing this? Restaurants have high operating costs, and Energy Trust is looking to learn how they can help independent restaurants save money and energy. We would like to learn what equipment you have, what equipment we could offer you, and what additional services Energy Trust could offer to help independent restaurants save money by reducing their energy costs.

Who can participate? Independent, non-franchised restaurant owners within Energy Trust's service territory (Portland General Electric, Pacific Power, NW Natural, Cascade, and Avista customers in Oregon) are potentially eligible. This study is limited to 60 participants, so not everyone eligible will be able to participate. Unfortunately, food carts are not eligible.

How can I benefit? Participating restaurants will receive a $250 Visa gift card—from ILLUME Advising, the independent research firm conducting this study—as a thank-you for your valuable time and help with improving Energy Trust's programs! After the study, ILLUME can share the study's overall findings and recommendations with those interested.

If interested, ILLUME can connect you with an Energy Trust team member who can meet with you to discuss Energy Trust's current equipment and rebates, which can reduce your operating costs.

What can I expect? ILLUME's team will visit your restaurant to understand your energy-using cooking and building equipment. We will also interview you about how Energy Trust can better serve you, which can be completed at your restaurant or via telephone or video call. The whole process should take about 2 hours. We will work around your schedule to make sure we speak with you at convenient times.

What if English is not my primary language? ILLUME will strive to communicate with you in your preferred language. We have partners who speak multiple languages and can connect with more language partners to accommodate you.

Who is doing the study? ILLUME Advising, an independent research firm, is leading this study on behalf of Energy Trust (www.illumeadvising.com).

EnergyTrust of Oregon

ILLUME

Contact

email: restaurant@illumeadvising.com

phone: (503) 894-6618

website: energytrust.org/restaurant-study

Open the camera app on your smart phone and point it at this code to go directly to the website link.

¡Ayúdenos a entender las necesidades energéticas de su cocina y obtenga $250!

Como propietario de un restaurante independiente, entendemos que su operación es muy diferente a la de otros negocios, e incluso a la de otros restaurantes. En cualquier momento usted puede estar cocinando, haciendo inventario o arreglando algún equipo, y al mismo tiempo tiene que resolver los retos inesperados de operar un restaurante. Mientras tanto, los continuos aumentos en los precios de los alimentos, la mano de obra y las operaciones afectan considerablemente su margen de ganancia.

Energy Trust es una organización independiente sin fines de lucro enfocada en soluciones de energía limpia. ¡Aunque no podemos cocinar, nos encantaría que nos ayude a encontrar soluciones que le beneficien a usted y a las cuentas de su restaurante! Este estudio busca conocer directamente de los dueños de restaurantes independientes cómo podemos ayudarle a ahorrar dinero y energía de mejor manera.

¿Por qué Energy Trust está haciendo esto? Los restaurantes tienen costos operativos elevados y Energy Trust quiere saber cómo puede ayudar a los restaurantes independientes a ahorrar dinero y energía. Nos gustaría saber qué equipo tiene, cuál otro podríamos ofrecerle y qué servicios adicionales podría proporcionarle Energy Trust para ayudar a los restaurantes independientes a ahorrar dinero al reducir sus costos de energía.

¿Quiénes pueden participar? Los dueños de restaurantes independientes, que no pertenezcan a franquicias, dentro del área de servicio de Energy Trust (clientes de Portland General Electric, Pacific Power, NW Natural, Cascade y Avista en Oregon) pueden ser elegibles. Este estudio se limita a 60 participantes, por lo que no todos los que sean elegibles podrán participar. Lamentablemente, los carritos de comida no son elegibles.

¿Cómo puedo beneficiarme? ¡ILLUME Advising, la empresa de investigación independiente que realiza este estudio, dará a los restaurantes participantes una tarjeta de regalo Visa de $250 como agradecimiento por su valioso tiempo y su ayuda para mejorar los programas de Energy Trust! Al terminar el estudio, ILLUME puede compartir con los interesados los resultados y las recomendaciones generales que se encontraron.

Si le interesa, ILLUME puede remitirlo a un miembro del equipo de Energy Trust para que se reúna con usted y puedan hablar sobre los reembolsos y equipos que Energy Trust actualmente ofrece, los cuales pueden reducir sus costos operativos.

¿Qué conlleva el estudio? El equipo de ILLUME visitará su restaurante para conocer los equipos de cocina y del establecimiento que utilizan energía. También le haremos una entrevista para entender cómo Energy Trust puede darle un mejor servicio. Ésta puede hacerse en su restaurante o por teléfono o videollamada. Todo el proceso podría durar alrededor de 2 horas. Nos adaptaremos a su horario para asegurarnos de hablar con usted en el momento que más le convenga.

¿Qué pasa si el inglés no es mi lengua materna? ILLUME procurará comunicarse con usted en su idioma de preferencia. Contamos con socios que hablan varios idiomas y podemos colaborar con otros más para adaptarnos a sus necesidades.

¿Quién realizará el estudio? ILLUME Advising, una empresa de investigación independiente, dirige este estudio en nombre de Energy Trust (www.illumeadvising.com).

EnergyTrust of Oregon

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Contacto

Correo electrónico: restaurant@illumeadvising.com

Teléfono: (503) 894-6618

Sitio web: energytrust.org/estudio-de-restaurante

Abra la aplicación de la cámara de su teléfono inteligente y apunte a este código para ir directamente al sitio web.

帮助我们了解您厨房的能源需求，即可获得 250 美元！

作为一家独立的餐馆业主，我们理解您的经营方式与其他企业（甚至是其他餐馆）有很大不同。在经营餐馆的过程中，您不只需要烹饪料理、清点库存、修理设备，还必须解决遇到的各种意想不到的挑战。与此同时，食品、劳动力和运营成本的持续增长严重影响了您的利润率。

Energy Trust 是一家独立非营利组织，专注于制定清洁能源解决方案。虽然我们不擅长烹饪，但我们希望获得您的帮助，以便找到对您和您的餐馆有利的解决方案！在这项独特的调查中，我们希望直接向独立餐馆业主了解如何更好地为他们节省资金和能源。

为什么 Energy Trust 要做这件事？餐馆的运营成本很高，Energy Trust 希望了解如何帮助独立餐馆节约资金和能源。我们希望了解您拥有哪些设备，我们可以为您提供哪些设备，以及 Energy Trust 可以提供哪些额外服务来帮助独立餐馆降低能源成本，从而节省开支。

谁可以参与？在 Energy Trust 服务范围内（Oregon 州内，Portland General Electric、Pacific Power、NW Natural、Cascade 和 Avista 的客户）的独立、非特许经营餐馆业主可能符合资格。本项调查仅限 60 人参加，因此并非所有符合条件的人都能参与。遗憾的是，餐车不符合条件。

我会获得什么好处？参与调查的餐馆将获得由 ILLUME Advising（开展本项调查的独立研究公司）提供的价值 250 美元的 Visa 礼品卡，以感谢您为改进 Energy Trust 的项目所付出的宝贵时间和帮助。调查结束后，ILLUME 会与感兴趣的人分享调查的总体结果和建议。

如果您感兴趣，ILLUME 可以为您联系一位 Energy Trust 团队成员，该成员将与您会面，以讨论 Energy Trust 当前的设备和返利，从而降低您的运营成本。

我需要做些什么？ILLUME 团队将访问您的餐馆，了解您使用的耗能烹饪和建筑设备。我们还将针对 Energy Trust 如何更好地为您提供服务与您进行对谈，对谈可在您的餐馆内完成，也可通过电话或视频通话进行。整个过程大约需要 2 个小时。我们将根据您a的日程安排，确保在合适的时间与您交谈。

如果英语不是我的母语，该怎么办？ILLUME 将努力用您偏好的语言与您沟通。我们有会讲多种语言的合作伙伴，并可与更多语言合作伙伴建立联系，以满足您的需求。

何人在进行这项调查？ILLUME Advising 是一家独立研究公司，代表 Energy Trust (www.illumeadvising.com) 开展这项调查。

EnergyTrust of Oregon

ILLUME

联系方式

电子邮件：restaurant@illumeadvising.com

电话：(503) 894-6618

网站：energytrust.org/restaurant-study-chinese

用智能手机上的相机app扫描代码即可直接跳转到网站链接。

Hãy giúp chúng tôi hiểu nhu cầu năng lượng nhà bếp của quý vị và nhận $250!

Là chủ nhà hàng độc lập, chúng tôi hiểu rằng cách thức hoạt động của quý vị rất khác so với các doanh nghiệp khác - và thậm chí các nhà hàng khác. Vào bất kỳ thời điểm nào, quý vị có thể nấu ăn, kiểm kê hoặc sửa chữa thiết bị, đồng thời giải quyết những thách thức bất ngờ phát sinh khi điều hành một nhà hàng. Trong khi đó, chi phí thực phẩm, nhân công và hoạt động liên tục tăng sẽ ảnh hưởng đáng kể đến biên lợi nhuận của quý vị.

Energy Trust không biết nấu ăn—chúng tôi là tổ chức phi lợi nhuận độc lập tập trung vào các giải pháp năng lượng sạch. Nhưng chúng tôi rất mong nhận được sự giúp đỡ của quý vị để tìm ra giải pháp có lợi cho quý vị và lợi nhuận nhà hàng của quý vị! Trong khảo sát độc đáo này, chúng tôi muốn tìm hiểu trực tiếp từ những chủ nhà hàng độc lập về cách chúng tôi có thể giúp họ tiết kiệm tiền và năng lượng tốt hơn.

Tại sao Energy Trust lại làm điều này? Các nhà hàng có chi phí hoạt động cao và Energy Trust đang tìm cách giúp các nhà hàng độc lập tiết kiệm tiền và năng lượng. Chúng tôi muốn tìm hiểu xem quý vị đang có thiết bị gì, chúng tôi có thể cung cấp thiết bị gì cho quý vị và Energy Trust có thể cung cấp thêm những dịch vụ nào để giúp các nhà hàng độc lập tiết kiệm tiền bằng cách giảm chi phí năng lượng.

Ai có thể tham gia? Các chủ nhà hàng độc lập, không nhượng quyền trong khu vực dịch vụ của Energy Trust (Portland General Electric, Pacific Power, NW Natural, Cascade, và các khách hàng Avista ở Tiểu bang Oregon) có khả năng đủ tiêu chuẩn. Khảo sát này chỉ giới hạn ở 60 nhà hàng độc lập nên không phải ai đủ tiêu chuẩn đều có thể tham gia. Thật không may, xe bán đồ ăn không đủ tiêu chuẩn.

Tôi có thể được lợi gì? Các nhà hàng tham gia sẽ nhận được thẻ quà tặng Visa trị giá $250- từ ILLUME Advising, công ty nghiên cứu độc lập thực hiện khảo sát này-như lời cảm ơn vì đã dành thời gian quý báu và giúp cải thiện các chương trình Energy Trusts! Sau khi khảo sát, ILLUME có thể chia sẻ những phát hiện và khuyến nghị chung của khảo sát với những người quan tâm.

Nếu quan tâm, ILLUME có thể kết nối quý vị với một thành viên trong nhóm Energy Trust, người có thể gặp quý vị để thảo luận về các khoản giảm chi phí và thiết bị hiện tại của Energy Trust, giúp quý vị giảm chi phí hoạt động.

Tôi có thể mong đợi điều gì? Nhóm của ILLUME sẽ đến thăm nhà hàng của quý vị để tìm hiểu về sử dụng năng lượng nấu ăn của thiết bị và xây dựng thiết bị. Chúng tôi cũng sẽ phỏng vấn quý vị về cách Energy Trust có thể phục vụ quy vị tốt hơn. Việc này có thể thực hiện tại nhà hàng của quý vị hoặc gọi qua điện thoại hoặc gọi video. Toàn bộ quá trình sẽ mất khoảng 2 giờ. Chúng tôi sẽ sắp xếp theo lịch trình của quý vị để bảo đảm chúng tôi có thể nói chuyện với quý vị vào thời điểm thuận tiện.

Nếu tiếng Anh không phải là ngôn ngữ chính của tôi thì sao? ILLUME sẽ cố gắng giao tiếp với quý vị bằng ngôn ngữ quý vị mong muốn. Chúng tôi có những đối tác nói nhiều ngôn ngữ và có thể kết nối với nhiều đối tác ngôn ngữ hơn để hỗ trợ quý vị.

Ai là người thực hiện khảo sát này? ILLUME Advising, một công ty nghiên cứu độc lập, thay mặt cho Energy Trust, dẫn đầu thực hiện khảo sát này (www.illumeadvising.com).

EnergyTrust of Oregon

ILLUME

Liên lạc

email: restaurant@illumeadvising.com

điện thoại: (503) 894-6618

website: energytrust.org/restaurant-study-vietnamese

Mở ứng dụng camera trên điện thoại thông minh và quét mã này để truy cập trực tiếp liên kết trang mạng.

Appendix B – Restaurant Interview Guide

Energy Trust Oregon Independent Restaurant Study: Restaurant Owner Discussion Guide

Energy Trust of Oregon hired ILLUME Advising to study independent restaurants, with a special interest in restaurants that serve non-American cuisine as well as those owned by individuals where English is not their primary language.

This document provides an overview of the topics and questions ILLUME hopes to discuss with restaurant owners as part of this study. The discussion likely will not follow the exact order presented in this document, some topics may not be discussed at all, and other topics not represented here may be discussed if brought up by the restaurant owner. But this document provides an idea of the type of feedback Energy Trust is hoping to receive as part of this study.

Research Approach

Where and when the discussions take place are up to the restaurant owner, and could be in-person, over the phone, or online such as Microsoft Teams or Zoom. ILLUME expects to speak with restaurant owners for up to an hour, although we will be happy with whatever time they can provide. Restaurant owners will receive a $250 VISA gift card as a thank you for their time for this discussion as well as the on-site equipment survey.

The information shared with ILLUME will remain anonymous and not shared with any individual or company outside of ILLUME. They will compile the information from all discussions (up to 60) and report on key themes in aggregate, not identifying any specific restaurant or owner by name. Your specific information will not be shared with anyone, and the data will be destroyed one year after the study.

Table 1 shows the type of topics ILLUME is looking to discuss with restaurant owners followed by example questions that may be asked.

Table 1. Discussion Topics

PRIMARY Discussion Topics
Interactions with and perceptions of their utility and governmental organizations.
Their greatest needs and priorities and relevance or impact of energy and equipment on those needs.
Typical equipment purchasing, repair, and replacement strategies, including where owners find and purchase equipment, as well as how they make decisions about upgrades.
Behavioral questions to provide additional context on data gathered through the site visit, for instance understanding how kitchen staff utilize kitchen equipment and adhere to maintenance procedures in place.

Introduction

Thank you for taking the time to speak with us today. Energy Trust is looking to support restaurant owners like you and what we discuss today will help them provide services that better meet your needs. Do you have any questions before we begin?

1. To start with, could you tell me about yourself and your restaurant.

a. What motivated you to open a restaurant?

b. What type of food do you serve?

c. How long have you had this business?

d. How many employees do you have working during your busiest shifts?

e. What are some of your daily responsibilities?

f. Do you own or lease this building?

g. What is your primary language?

h. What language do you most often use as you're doing business? What language would you prefer to do business in?

Restaurant Expenses and Energy Bills

[Purpose of section: to learn about the needs of the restaurant overall and how energy costs fits into day-to-day decision-making]

Now, I'd like to ask you about the different needs and priorities you have at your restaurant.

2. Think about the expenses of running your restaurant. We imagine they include rent or building costs, paying employees, marketing, food, equipment, and utility costs, to name a few.

a. Which of these do you worry about the most?

b. Has this changed in recent years? If so, how?

3. Roughly, what percentage of your monthly expenses come from energy bills? To what extent do you feel you have control over your energy bill?

4. What, if any, actions do you take to manage your energy bill?

a. In the past few years have you made any changes in your restaurant that you believe could have lowered your energy bills?

b. Are there any upgrades or changes you are considering in the future?

Restaurant Equipment

[Purpose of section: to learn what equipment they use in the restaurant and how the restaurant owner approaches equipment repair and replacement]

Next, I'd like to ask you about the equipment you use in your restaurant. For the next few questions, please think of all the different types of energy-using equipment that your restaurant has. This could include things like fryers, refrigerators, ovens and cooktops, heating and cooling equipment, lighting, and so on.

5. What equipment in your restaurant was already in place when you moved in?

a. [If equipment was in the space] How important was having this equipment already available for you in your decision to choose this location?

6. Is there equipment you would like to have but don't for one reason or another? Do you have work-arounds for not having this equipment?

Equipment purchase

7. Where do you typically go to purchase your kitchen equipment?

8. Why do you go to that company / those companies/individuals? What factors did you consider, and do you typically consider when deciding which vendors to purchase equipment from?

9. We know there are many considerations when selecting and purchasing equipment, and that may be different for different types of equipment. But in general, what is most important to you when you are making decisions on what equipment to purchase?

a. [If not mentioned] To what extent, if at all, do you consider energy or operational costs in your decision?

10. Would you say you typically purchase new equipment or used equipment when you make purchases? What are the things you consider when making that decision?

Equipment maintenance

11. Can you tell me about any regular equipment maintenance you have done?

12. Are you having any problems with any of your kitchen equipment at the moment?

13. What steps do you usually take to address problems with your equipment? For example, do you have certain vendors you work with, do you try to fix it yourself, do you rely on someone you know personally, and so on?

14. When equipment breaks, how do you decide whether to repair or replace it? What factors influence your decision? [Probe for things like time, cost, etc.]

15. How do you identify the person or vendor to fix equipment?

New equipment and upgrades

16. How often do you upgrade equipment that is not broken? What would make you decide to purchase equipment that is not broken? It would be helpful to hear an example.

17. [Skip if already addressed] Are you planning on purchasing any equipment in the next year? If, so:

a. What do you plan to buy, and what factors will be most important?

b. Where/who are you planning to purchase it from?

Restaurant Relationships, Culture, and Perception

[Purpose of section: to learn about the relationships that restaurant business owners have, how their language/community/culture influence their business, and how restaurant owners perceive organizations and their awareness of programs from utilities or government organizations]

Community is important for all of us. We'd like to understand how you perceive community, and how it plays a role in your business relationships and day-to-day business decisions.

18. Thinking of your own business, how do you define your community? Who, or what types of organizations or characteristics, would be a component of those within your community? [Probe for things like cultural, language, proximity, similarity in business, etc.]

19. In what ways does your community or culture impact or influence your business practices? How does it influence the community/culture of the guests at the restaurant?

20. How important is it to you that contractors and businesses you work with are part of your community?

21. [If English is not their primary language] Does the language you use change depending on who you're interacting with? If so, how?

a. Does the language others speak through business interactions (outside of your network of friends, family, and acquaintances) affect your experiences?

b. Can you describe any situations where you may be more hesitant or less likely to reach out to an individual or company for business-purposes if you are not sure if they speak your primary language?

22. Are there any other unique cultural or community values that define or impact how you do business or relate to your customers or vendors?

a. [If yes] Could you give me some examples?

We'd like to understand the role business relationships play in the way you prefer to conduct business. We also have a few questions about programs or organizations you may have heard of that help restaurants save energy.

23. How, if at all, do you engage with other restaurant owners/managers or restaurant supply companies? How frequently and for what purposes?

a. How would you describe your relationship with them?

24. What is your most trusted business relationship or relationships? What makes them more trustworthy ?

25. Do you interact with your energy company? If so, how?

26. Have you ever reached out to your energy company to help address energy needs? If so, what did you reach out to them about?

27. Have you ever had an energy-related situation and chose not to reach out to your energy company? If so, what was the situation, and what kept you from reaching out?

28. Are you familiar with any programs that your utility or Energy Trust provides that help restaurants save energy?

[If yes]

a. How did you find out about them?

b. Have you participated or been involved in any of their programs? Why or why not?

29. When you see products or programs that can "save energy," does that grab your attention? [Probe for: what would grab their attention (i.e., costs)]

30. What types of services would be helpful for Energy Trust to provide to you, energy savings or otherwise?

31. How would you prefer to receive information from your utility or Energy Trust on energy-saving programs? [Probe for: email, mail, text]

Closing

32. That's all the questions I have for you. Do you have anything else you'd like to add?

33. [IF STILL LOOKING FOR PARTICIPANTS] We are still looking for other restaurant owners to participate in this study. Do you know any other restaurant owners that might be interested in participating?

34. Would you be willing to contact them on our behalf, or provide us with their contact information? If we call them, can we let them know you referred them to us? [PROVIDE INFORMATION AS NEEDED]

35. The information from this research will be summarized and made available. As a reminder, no restaurants will be named and data will not be associated with your restaurant. Would you be interested in receiving information on the results of this study? [If so, probe on how they'd like to be engaged]

36. Would you be interested in learning about programs that Energy Trust offers that may be able to support your restaurant and reduce your energy cost? We can provide information about or refer you to their Existing Building or Small Business program if interested? (If so, confirm we can share their contact information)

37. Is there any other way we, Energy Trust, or your energy provider can support you?

Thank you so much for speaking with us today. We really appreciate you taking the time to share your experiences.

[GATHER INFORMATION ON WHERE TO SEND THE GIFT CARD OR THANK YOU PAYMENT]

Appendix C – Site Visit Guide

Small Restaurant Study Data Collection Form

Site Information

Analyst:

Days Open:

Hours Open:

Restaurant Type: Sit-Down or Counter Service

Building Type: Standalone or connected to other buildings

Hot Cooking Equipment

Equipment	Y/N	Fuel Type	Qty	Manufacturer/Model	Age	Usage by Day	Usage by Shift	Condition**	Picture Taken?
Combination Oven		Electric Gas				1-2 3-4 5+ Frequent Once per week Couple times per week	Morning Afternoon Evening 2+ Shifts All Shifts	Good Average Poor	
Standard Oven		Electric Gas						Good Average Poor	
Pizza Oven		Electric Gas						Good Average Poor	

Charbroiler/Grill		Electric Gas						Good Average Poor	
Broiler		Electric Gas						Good Average Poor	
Griddle		Electric Gas						Good Average Poor	
Fryer		Electric Gas						Good Average Poor	
Wok		Electric Gas						Good Average Poor	
Hot Food Cabinet		Electric Gas						Good Average Poor	
Range		Electric Gas						Good Average Poor	
Rice Cooker		Electric Gas						Good Average Poor	
Microwave		Electric Gas						Good Average Poor	
Steamer		Electric						Good Average	

		Gas						Poor	
Induction Cooktop		Electric Gas						Good Average Poor	
Toaster		Electric Gas						Good Average Poor	
Panini Press		Electric Gas						Good Average Poor	

* Usage Pattern

By Day and By Shift

** Condition: Good, Average, Poor

i. Good—No visible defects. Appears to be newer and/or well taken care of
ii. Average—Normal wear and tear. Some cosmetic issues, but no visible defects or damage
iii. Poor—Visible damage or defects. Not operating as intended

Picture upload for each item in Hot Cooking Equipment table

Kitchen Ventilation

	Manufacturer/ Model	Age	Fan Type*	Fan Control*	Estimated Linear Ft of Hood
Kitchen Ventilation Equipment 1			Single Speed 2 Speed VFD	Manual Automatic DCV	
Kitchen Ventilation			Single Speed		

Equipment (2-5)			2 Speed VFD		

*Fan Type and Control Method is information that can be found via manufacturer spec sheets based on model.

Kitchen ventilation Picture Upload

Cold Storage Equipment

	Present (Y/N)	Residential or Commercial	Manufacturer/Model	Age	Proper seals?	Seals Condition
Walk-in Freezers						Good Average Poor
Chest Freezer						
Prep Fridge						
Ice Maker						
Kegerator						
Walk – in Cooler/Refrigerator						
Slushie/Ice Cream Machine						
Other Cold Storage Equipment (1-10)						

Cold Storage Picture Upload

Lighting

	Square Footage	Lighting Qty	Lighting Type	Control
Kitchen				Light switch Dimmer Occupancy sensor Timer Other
Customer				
Storage				
Restroom				
Office				
Exterior				
Other Lighting (1-10)				

Lighting Picture Upload Question

Additional Notes:

Display Cases

	Open or Closed?	Type of Food	Manufacturer/Model	Age
Drink Display				
Food display				
Cooler Display (1-5)				

Display Cases Picture Upload (1-3)

- Stocking practice information (may be asked during interview)
  - When stocking cold equipment such as walk-in freezers, fridges are there procedures to reduce energy use?
  - Are there times when the refrigerator or freezer is not hitting desired temperatures?
  - If strip curtains are present are they tied back during the day or when door is opened?

Thermostat

a. Thermostat type

a. Manual, programmable, or smart?

Envelope

- Exterior doors

a. Seals present: Y / N

b. Condition: Good, Average, Poor

- Windows

Window Type	# of Windows	Condition	Film Present?	Location(s)
Single Pane		Good Average Poor		
Double Pane		Good Average Poor		

Appendix E

Window Picture Upload

HVAC and DHW Equipment

- Water Heater

	Type	Fuel	Manufacturer/Model	Age
Water heater	Condensing Electric Resist. Heat Pump Tankless _____	Electric Gas Other _____		
Water heater (secondary if present)	Condensing Electric Resist. Heat Pump Tankless _____	Electric Gas Other _____		

HVAC Picture Upload

- HVAC System Controls
  - Thermostat Model: _____
  - Setpoints:
    - Heating: _____
    - Cooling : _____
  - Are there any schedules in place?
  - Are there any occupancy sensors present?
- Additional Heating and Cooling Equipment

Equipment 1	Type	Fuel	Manufacturer/Model	Age	Setpoint
Equipment 2	Portable AC Space Heater Mini- Split _____	Electric Gas			Low Med High
Equipment 3	Portable AC Space Heater Mini- Split _____	Electric Gas			
Equipment 4	Portable AC Space Heater Mini- Split _____	Electric Gas			

Additional HVAC Equipment Upload

Additional notes

Back and Front of Restaurant Equipment

- Dishwashers

a. Nameplate information
b. Type (commercial or domestic)
c. Check Pressure (If over pressurized, can be wasting water)

Dishwasher Picture Upload

- Spray rinse nozzles

a. Quantity : ____

b. GPM (if visible on the device) ____

- Other Notable Plug Loads

Spray Rinse Nozzles Picture Upload

Restaurant Equipment Pictures (4)

Restaurant Equipment Picture Description(4)

Maintenance

The interview will ask general questions about maintenance practices. While on location, the auditor will attempt to capture equipment-specific maintenance practices, such as:

- Is there regularly scheduled maintenance?
- Are grease filters regularly cleaned?
- Are refrigeration coils cleaned regularly?

- Are there any start-up/shut-down procedures in place?
- Are there any water leaks?

Site Visit Summary Section

Appendix D – Verified Equipment

Table 11, Table 12, and Table 13 summarize the specific equipment, manufacturer, and model number for equipment that was catalogued during the restaurant site visits where the research team was able to verify and catalogue specific model numbers. Due to issues in access nameplates and model numbers for cooking equipment, the listed equipment is limited compared to the observed equipment in the facilities. Where applicable the research team also noted when the verified equipment was ENERGY STAR certified.

Table 11. Cold Storage Verified Equipment

ENERGY STAR	CATEGORY	MANUFACTURER	MODEL NUMBER	CAPACITY (CU. FT.)
Yes	Storage/Other	Hoshizaki	EUR48A	12
Yes	Specialized Equipment	Atosa	YR140-AP-161	
Yes	Specialized Equipment	Hoshizaki	KM-660MAJ	
Yes	Refrigerators	Frigidaire	FFUE2022AW5	20
Yes	Refrigerators	Whirlpool	WZF34X18DWOO	17.7
Yes	Refrigerators	Turbo Air	MSR-49NM	49
Yes	Refrigerators	True Refrigeration	TPP-44	
Yes	Refrigerators	Traulsen	G22012	46
Yes	Refrigerators	Atosa	MCF8707GR	44.8
Yes	Prep Fridges	True Refrigeration	QA-48-18M-B	
Yes	Prep Fridges	True Refrigeration	TSSU-48-12	
Yes	Prep Fridges	Turbo Air	TSR-35GSD-N	29.19
Yes	Prep Fridges	True Refrigeration	TSSU-48-12-HC	
Yes	Prep Fridges	True Refrigeration	TWT-36	
Yes	Freezers	Turbo Air*		
Yes	Freezers	True Refrigeration	T-72F	
Yes	Freezers	Frigidaire	FFUE2022AW1	20
Yes	Freezers	Turbo Air	TSF-49SD-N	39.9
Yes	Freezers	Hoshizaki	EF2A-FS	38.61
No	Storage/Other	Turbo Air	MST-48-N	12
No	Specialized Equipment	Avantco	178CPSS47HC	15.2
No	Refrigerators	True Refrigeration	GMD-49	
No	Refrigerators	Norlake	R49-S	49
No	Refrigerators	Norlake	R49-S	49
No	Refrigerators	Avantco	178SSPT48HC	12
No	Refrigerators	Other/Unknown	VR-26-BEV-TROP-RH	26
No	Refrigerators	US Refrigeration	USUV-28	7
No	Refrigerators	Turbo Air	M3F47-2-N	42.3
No	Prep Fridges	Turbo Air	MST-72-N	19
No	Prep Fridges	Atosa	MSF8308GR	21.1
No	Prep Fridges	Saturn	FB48-18	14.7
No	Other/Accessory	Perlick	4404	
No	Freezers	Kenmore	253.16082105	
No	Freezers	Frigidaire	LFFH20F3QWG	20.2

No	Freezers	Frigidaire	PLFU1778ES2	17
No	Freezers	Other/Unknown	CFUD21TW	20.6
No	Freezers	Frigidaire	FFFC20M4TW	19.8
No	Freezers	Turbo Air	MSF-49NM	49

*ENERGY STAR sticker observed on the equipment

Table 12. Cooking Verified Equipment

None of the verified cooking equipment is ENERGY STAR certified.

TYPE	ENERGY STAR CERTIFICATION EXISTS?	MANUFACTURER	MODEL NUMBER	CAPACITY (CU. FT.)
Steamers and Warmers	Yes	Duke	E303	
Steamers and Warmers	Yes	Hobart	HC24EA3	
Ovens	Yes	Blodgett	ZEPHAIRE-200-G	
Ovens	Yes	Baker's Pride	4151	76.2
Microwaves	No	Sharp*	R21LCFS	1
Microwaves	No	Sharp*	R21JCA	1
Microwaves	No	Panasonic	NN-SN96JS	2.2
Microwaves	No	Panasonic	NN-SC668S	1.3
Cooktops and Burners	No	LG	LRE3060ST	6.3

*Commercial Microwaves

Table 13. Newly Replaced Water Heaters

ENERGY STAR	MANUFACTURER	MODEL NUMBER	CAPACITY (GALLON)
Yes	Rinnai*		
No	Bradford White	ERE250T6-INCWW	50
No	Rheem**	XE40M09EL55U1	40
No	Rheem	82V52-2	50
No	Rheem	PRO+G75-76NRH	75
No	GE	GE50T06TAG	50
No	Rheem**	XE50T06CG45UO	50
No	Bradford White	M250S6DS-1NCWW	50
No	Rheem	PROG50-38NRH60	
No	A. O. Smith	ECT 52 210	50
No	Bradford White	MI403S6FBN	40

*ENERGY STAR sticker observed on the equipment
**Recently replaced (Age=1 year old)

Appendix E – Market Actor Interview Guide

Energy Trust of Oregon Independent Restaurants: Maintenance and Service Providers In-Depth Interview Guide

As a part of the research for the Energy Trust of Oregon's Independent Restaurant Study, ILLUME will be gathering information from supply side contractors and service providers in the restaurant equipment industry. This document is a discussion guide for researchers to use when conducting those in-depth interviews. The overall focus of this research is to understand why and how independent restaurant owners choose their energy-using equipment. The study findings will serve as proof of concept to help programs, manufacturers, and others in the supply chain better understand how they can best serve this population. The supply side research is crucial to understanding these equipment decisions and the purchasing pipeline.

This interview guide includes an overview of the research, research questions, recruitment language, sample plan, and interview questions organized by research question.

Overview

ILLUME Advising will conduct in-depth interviews with restaurant equipment maintenance contractors and service providers to understand how these contractors integrate into and assist a restaurant's purchasing decisions, how these contractors understand energy efficiency, and how ETO can best serve these small, independent restaurants in the supply chain.

Research Approach

ILLUME will conduct up to 12 interviews with contractors and service providers sourced from previous restaurant site visits, restaurant retailer contacts, and online research. ILLUME will conduct all interviews remotely using MS Teams or Zoom apps. The study will provide an electronic gift card in the amount of $150 for completion of each full interview.

Research Questions

The interviews will be semi-structured conversations focused on the key discussion topics. Error! Reference source not found. shows those questions which sections of the guide address them.

Table 1. Research Question Index

RESEARCH QUESTIONS	QUESTION NUMBER
• How many/what kinds of restaurants do they work with?	A1, A2, A3
• How do they get connected with minority-owned restaurants?	A3
• How does working with small, independent restaurant owners differ from larger or chain restaurants)?	A4
• What is their process for recommending equipment to these restaurant owners?	A7 – A31

• When do they find that they are making equipment recommendations to customers? • What are the most important attributes of a piece of equipment for them to confidently recommend it? • Is Energy efficiency factoring into conversations with restaurant owners when making equipment recommendations?	A32, A33
• How do they consider efficiency levels when making equipment recommendations to restaurant owners? (E.g., are they talking about impacts of equipment on energy usage, operating costs?) • How does the process of working with standard range equipment differ from specialty equipment? • What is their awareness level of energy efficiency programs/incentives and ETO specifically? • Do they consider these programs when making equipment recommendations?	A34, A35

Note on Harassment and Demeaning Conduct

ILLUME prioritizes the safety of our research team. We do not condone harassment or conduct that is demeaning or disparaging to our team.[20] Should the researcher feel unsafe or uncomfortable, or that they have been treated in a disrespectful manner, the researcher may choose to end the interview at their discretion. Should this occur, the team member can use the following script to end the conversation:

"Thanks for taking the time to speak with us today. That's all the questions we have for you."

Interview Recruitment Email/Phone Script

Email Recruitment Script (for those who have already helped us in the study, we will personalize this more)

Subject: Energy Trust of Oregon Small Independent Restaurant Study needs your input!

Dear [NAME],

I am with ILLUME Advising, a national consulting firm doing market research on behalf of the Energy Trust of Oregon. We are gathering information from small independent restaurant owners, equipment and service providers who support those businesses. The report we provide to ETO will help it design more effective and beneficial programs to help restaurant owners save energy through energy-efficient equipment.

[20] ILLUME's harassment policy includes the following: *ILLUME's non-harassment policy aims to protect every person in our company from harassment and discrimination, including: • Physical harassment: unwelcome physical contact such as touching, impeding, or blocking movement, or any physical interference with work. • Verbal harassment: disparaging or disrespectful comments, jokes, slurs, innuendoes, teasing, and other sexual talk such as jokes, personal inquiries, persistent and unwanted courting, and derogatory insults. • Nonverbal harassment: suggestive or insulting sounds, obscene gestures, leering, or whistling. • Visual harassment: displays of explicit or offensive calendars, circulation of derogatory content, posters, pictures, drawings, or cartoons that reflect disparagingly upon a class of persons or a particular person. • Sexual harassment: unwelcome sexual advances, requests for sexual favors, and other verbal or physical harassment of a sexual nature*

I am reaching out to you because we would like to learn more about your experiences working with this sector and hear any insights on how best to steer restaurant owners toward more energy-efficient options.

We are offering a $150 gift card for completing a virtual interview (up to 45 min). Please respond with some possible dates and times in the next two weeks that could work for you to have an MS Teams or Zoom call.

If you have questions on the legitimacy of this research, contact Leila …

Phone Recruitment Script (for those who have already helped us in the study, we will personalize this more)

Hello [NAME].

This is Joe Kramer with ILLUME Advising. Energy Trust of Oregon hired us to help them better understand the buying behavior and equipment decisions made by small independent restaurant owners. Part of this study is talking with equipment and service providers like yourself to get your thoughts and understanding of the market. ETO will use this information to design more effective programs promoting energy-efficient equipment.

Would you be willing to have a short phone interview with us? We expect the call to take no more than 45 minutes and will send you a $150 gift card as a thank you.

What days and times could work for you?

Key and Notes on this Guide

The following guide provides an outline of the conversation that the researcher will have with the program participant. This guide is not a script for the conversation, rather, it highlights the lines of questioning we anticipate exploring with participants and the topics we will delve into. When conducting in-depth interviews, ILLUME researchers reflect the language of participants and explore the areas of interest and concern to participants. In some cases, this may mean that the interview topics below are covered by the researcher in a different order than listed here. Similarly, the interviewer will use their own words in asking these questions so that they are integrated into the flow of a conversation, and where relevant, will reflect the terminology used by the participant.

Introduction

[Purpose of section: The initial section includes a guide for the beginning of the conversation and a few initial questions to establish rapport with the participant.]

Thanks so much for taking the time to speak with us today. As a reminder, we have up to 30 minutes' worth of topics we'd like to discuss with you. The information you provide to us will be used to help the Energy Trust of Oregon provide services to help independent restaurant owners save money.

Also, for note taking purposes, I would like to record this interview. All recordings and notes will be kept confidential, and we will not reveal your identity in our final report or any final deliverables. Also, should you change your mind, you can ask me to stop recording at any time. Can I record this interview?

[Wait until they consent to press record.]

[IF NO, do not record but take notes.]

[Begin recording]

Do you have any questions before we begin?

A.1 Tell me about yourself and your business/organization.

a. Location of business
b. Types of customers your business serves, and location of those customers.
c. What types of equipment do you most commonly service?
d. .What is your experience with specialty equipment in small restaurants? E.g. pizza ovens, wok burners, holding cabinets, steam trays, etc.
[Optional probes]
e. Primary job roles and responsibilities
f. How long has the business been in operation?
g. How many employees?
h. How did you get into this industry?

Process of Working with Restaurants

[Purpose of section: To learn more about their work with independent restaurants and how it may differ from working with restaurant chains.]

Next, I would like to hear more about your process for working with independent restaurants.

A.2 How much of your business is with small independent restaurants (that are non-franchised, few restaurants, generally smaller)?

1) How many of these restaurants do you work with in a typical year?

A.3 How much of your business is with ethnically specific cuisines, such as Mexican food, Thai food, Indian food etc.?

1) Are there any kinds of restaurants you deliberately focus on more than others? If so, why?

2) [Probe if needed] What do you like in particular about working with these restaurants?
3) What are the benefits of working with these restaurants?

A.4 Is your process of working with these independent restaurant owners different from working with chain or franchised restaurants?

[PROBE for] …

1) Advertising
2) Coming to service equipment (scheduling etc)
3) Types of equipment present

A.5 [if not covered in previous question] What benefits do you see working with these small independent restaurants?

[PROBE for] …

1) Relationships and trust
2) Types of equipment present

A.6 [if not covered in previous question] Do you experience any challenges when working with or trying to connect with these smaller, independent restaurants?

[PROBE for] …

1) Cultural or language issues
2) Advertising
3) Coming to service equipment (scheduling etc)
4) Types of equipment present
5) Issues with these pieces of equipment (not maintained, maintenance improperly done etc)

A.7 [if experience barriers] How do you address those?

Equipment and Decisions

ASK IF A1.c = GAS RANGES and BUILT IN GAS GRIDDLES

A.8 Are you usually called in when a range is malfunctioning or failing, or to perform normal maintenance such as inspections?

1) Does the process for these two services differ?
2) [if not covered] What volume of your business is maintenance versus servicing failing equipment?
3) [if not covered and serve both chain and small restaurants] Does this differ for small, independent restaurants versus chain or franchised restaurants?

A.9 When a customer's range requires a major repair, how often do customers consider replacing the equipment rather than having the repair done?

[PROBE for] …

1) What factors play into a customer's decision?
2) What role are you playing in a customer's decision?

A.10 When a customer's range is unable to be repaired or they decide to upgrade, how often do you consult with restaurant owners on what equipment they should purchase next?

A.11 When recommending specific equipment to customers, what do you take into consideration in your recommendation?

[PROBE for] …

1) Brand
2) Serviceability / Maintenance / Reliability
3) Replacing failing equipment with like equipment to limit installation costs (i.e, avoiding need for wiring upgrade, running a gas line, ventilation modifications, etc.)
4) Ease of use

A.12 How do customers prioritize attributes in making their choices? What matters most to them?

1) Do owners want to hear, and do they listen to your opinions on equipment options?

A.13 How do costs of operating or the efficiency of the equipment influence your recommendations?

1) In your experience are energy costs typically part of restaurant owners' buying decisions?
2) If yes, who brings it up?
3) How is it presented to the customer – is it cost to operate?
4) Do you or customers ever talk about EnergyStar certification?

ASK IF A1.c = OVENS

A.14 Are you usually called in when an oven is malfunctioning or failing or to perform normal maintenance, such as inspections?

1) Does the process for these two services differ?
2) [if not covered] What volume of your business is maintenance versus servicing failing equipment?
3) [if not covered and serve both chain and small restaurants] Does this differ for small, independent restaurants versus chain or franchised restaurants?

A.15 When a customer's oven requires a major repair, how often do customers consider replacing the equipment rather than having the repair done?

[PROBE for] …

1) What factors play into a customer's decision?

2) What role are you playing in a customer's decision?

A.16 When a customer's oven is unable to be repaired or they decide to upgrade, how often do you consult with restaurant owners on what equipment they should purchase next?

A.17 When recommending specific equipment to customers, what do you take into consideration in your recommendation?

[PROBE for] …

1) Brand
2) Serviceability / Maintenance / Reliability
3) Replacing failing equipment with like equipment to limit installation costs (i.e, avoiding need for wiring upgrade, running a gas line, ventilation modifications, etc.)
4) Ease of use

A.18 How do customers prioritize attributes in making their choices? What matters most to them?

1) Do owners want to hear, and do they listen to your opinions on equipment options?

A.19 How do costs of operating or the efficiency of the equipment influence your recommendations?

1) In your experience are energy costs typically part of restaurant owners' buying decisions?
2) If yes, who brings it up?
3) How is it presented to the customer – is it cost to operate?
4) Do you or customers ever talk about EnergyStar certification?

ASK if A1.c = COUNTERTOP or FREESTANDING GAS or ELECTRIC GRIDDLES

A.20 Are you usually called in when a freestanding or countertop griddle is malfunctioning or failing or to perform normal maintenance, such as inspections?

1) Does the process for these two services differ?
2) [if not covered] What volume of your business is maintenance versus servicing failing equipment?
3) [if not covered and serve both chain and small restaurants] Does this differ for small, independent restaurants versus chain or franchised restaurants?

A.21 When a customer's griddle requires a major repair, how often do customers consider replacing the equipment rather than having the repair done?

[PROBE for] …

1) What factors play into a customer's decision?
2) What role are you playing in a customer's decision?

A.22 When a customer's griddle is unable to be repaired or they decide to upgrade, how often do you consult with restaurant owners on what equipment they should purchase next?

A.23 When recommending specific equipment to customers, what do you take into consideration in your recommendation?

[PROBE for] …

1) Brand
2) Serviceability / Maintenance / Reliability
3) Replacing failing equipment with like equipment to limit installation costs (i.e, avoiding need for wiring upgrade, running a gas line, ventilation modifications, etc.)
4) Ease of use

A.24 How do customers prioritize attributes in making their choices? What matters most to them?

1) Do owners want to hear, and do they listen to your opinions on equipment options?

A.25 How does costs of operating or the efficiency of the equipment influence your recommendations?

1) In your experience are energy costs typically part of restaurant owners' buying decisions?
2) If yes, who brings it up?
3) How is it presented to the customer – is it cost to operate?
4) Do you or customers ever talk about EnergyStar certification?

ASK if A1.c = FRYERS

A.26 Are you usually called in when a fryer is malfunctioning or failing or to perform normal maintenance, such as inspections?

1) Does the process for these two services differ?
2) [if not covered] What volume of your business is maintenance versus servicing failing equipment?
3) [if not covered and serve both chain and small restaurants] Does this differ for small, independent restaurants versus chain or franchised restaurants?

A.27 When a customer's fryer requires a major repair, how often do customers consider replacing the equipment rather than having the repair done?

[PROBE for] …

1) What factors play into a customer's decision?
2) What role are you playing in a customer's decision?

A.28 When a customer's fryer is unable to be repaired or they decide to upgrade, how often do you consult with restaurant owners on what equipment they should purchase next?

A.29 When recommending specific equipment to customers, what do you take into consideration in your recommendation?

[PROBE for] …

1) Brand
2) Serviceability / Maintenance / Reliability
3) Replacing failing equipment with like equipment to limit installation costs (i.e, avoiding need for wiring upgrade, running a gas line, ventilation modifications, etc.)
4) Ease of use

A.30 How do customers prioritize attributes in making their choices? What matters most to them?

1) Do owners want to hear, and do they listen to your opinions on equipment options?

A.31 How do costs of operating or the efficiency of the equipment influence your recommendations?

1) In your experience are energy costs typically part of restaurant owners' buying decisions?
2) If yes, who brings it up?
3) How is it presented to the customer – is it cost to operate?
4) Do you or customers ever talk about EnergyStar certification?

ASK if A1.c = REFRIGERATION EQUIPMENT, including FREEZERS and ICE MAKERS

A.32 Are you usually called in when a refrigerator is malfunctioning or failing or to perform normal maintenance, such as tune-ups or coil cleaning?

1) Does the process for these two services differ?
2) [if not covered] What volume of your business is maintenance versus servicing failing equipment?
3) [if not covered and serve both chain and small restaurants] Does this differ for small, independent restaurants versus chain or franchised restaurants?

A.33 When a customer's refrigerator requires a major repair, how often do customers consider replacing the equipment rather than having the repair done?

[PROBE for] …

1) What factors play into a customer's decision?
2) What role are you playing in a customer's decision?

A.34 When a customer's refrigerator is unable to be repaired or they decide to upgrade, how often do you consult with restaurant owners on what equipment they should purchase next?

A.35 When recommending specific equipment to customers, what do you take into consideration in your recommendation?

[PROBE for] …

1) Brand
2) Serviceability / Maintenance / Reliability
3) Replacing failing equipment with like equipment to limit installation costs (i.e, avoiding need for wiring upgrade, running a gas line, ventilation modifications, etc.)
4) Ease of use

A.36 How do customers prioritize attributes in making their choices? What matters most to them?

1) Do owners want to hear, and do they listen to your opinions on equipment options?

A.37 How do costs of operating or the efficiency of the equipment influence your recommendations?

1) In your experience are energy costs typically part of restaurant owners' buying decisions?
2) If yes, who brings it up?
3) How is it presented to the customer – is it cost to operate?
4) Do you or customers ever talk about EnergyStar certification?

ASK if A1.d = YES, SPECIALTY

A.38 How often do you encounter specialty equipment, such as woks, rotisseries, pizza ovens, steam trays, rice cookers, or tandoori ovens when called out to repair equipment?

A.39 Do you encounter difficulties servicing or performing maintenance on these specialty pieces of equipment versus standard cookline or refrigeration equipment?

A.40 Are you usually called in when this equipment is malfunctioning or failing or to perform normal maintenance such as tune-ups or cleaning?

A.41 Does the process for these two services differ (e.g., is maintenance done on a regular schedule vs as needed)?

A.42 When this equipment requires a major repair, how often do customers consider replacing the equipment rather than having the repair done?

1) What factors play into a customer's decision?
2) What role are you playing in a customer's decision?

A.43 When the customer's specialty equipment is unable to be repaired or they decide to upgrade, how often do you consult with the restaurant owners on what equipment they should purchase next?

A.44 When recommending specific equipment to customers, what do you take into consideration in your recommendation?

[PROBE for] …

1) Brand
2) Serviceability / Maintenance / Reliability
3) Replacing failing equipment with like equipment to limit installation costs (i.e, avoiding need for wiring upgrade, running a gas line, ventilation modifications, etc.)
4) Ease of use

A.45 How do customers prioritize attributes in making their choices? What matters most to them?

1) Do owners want to hear, and do they listen to your opinions on equipment options?

A.46 How do costs of operating or the efficiency of the equipment influence your recommendations?

1) In your experience are energy costs typically part of restaurant owners' buying decisions?
2) If yes, who brings it up?
3) How is it presented to the customer – is it cost to operate?
4) Do you or customers ever talk about EnergyStar certification?

Energy Efficiency Programs

A.47 Have you heard of any energy efficiency programs that offer incentives or discounts on energy efficient restaurant equipment?

A.48 Have you heard of any efficiency programs for businesses offered by Energy Trust of Oregon? (If yes) please describe.

1) (If yes) how did you first learn about the ETO program?
2) (if yes) do you ever mention these programs when making equipment recommendations?

A.49 How can ETO help you promote energy efficient equipment to your customers?

1) Based on answers so far, probe on: education, rebates, mid-stream incentives, energy audits.
2) What could ETO do to make participating in a program that promotes energy efficient equipment through rebates or incentives easier for your business?
    a. Probe for: process barriers, trust issues

[SKIP TO END]

Closing

That's all the questions I have for you.

A.50 Is there anything I should have asked you about but didn't?

A.51 Do you have anything else you'd like to add?

A.52 [If still recruiting] Are there any other contractors you know who commonly work with these small, independent restaurants that you think it would be helpful for us to talk to?

1) [if yes] Do you have good contact information for them?

Thank you so much for speaking with us today. We really appreciate you taking the time to share your valuable insights in this industry.

As I stated before we would like to give you a $150 gift card as a thank you for your time. Would you like to receive that gift card by mail or email**? [Interviewer record and confirm contact information for sending the incentive.]**

Thank you again for your time.

Notes

This section includes space for the interviewer or note taker to reflect on the interview and provide any overarching impressions, comments, or questions. In developing the guide, the team may choose to include prompts for these notes to help in the analysis process. For example, highlights, pain points, concerns, challenges, or questions that a customer experienced might be prompts for notes included in this document.

Appendix F – Peer Program Comparison

Table 14 is a summary of the utility-funded programs reviewed by the research team as a part of this study. This table summarizes the offerings by equipment type as well as by fuel type.

Table 14. Common Restaurant Rebate Offering by Other Utilities

EQUIPMENT	FUEL TYPE	UTILITIES	SERVICE TERRITORY	ENERGY TRUST REBATE
Fryers	Gas & Electric	PG&E, SoCalGas, SCE, SDG&E, Avista, DTE, Rhode Island (National Grid), PSE	CA, ID, WA, MI, RI	Yes
	Electric Only	Duke Energy, Mass Save	IN, NC, SC, MA	
	Gas Only	Southwest Gas	CA, NV	
Griddles	Gas & Electric	PG&E, SoCalGas, SCE, SDG&E, Avista, DTE, Rhode Island (National Grid), PSE	CA, ID, WA, MI, RI	Yes
	Electric Only	Duke Energy, Mass Save	IN, NC, SC, MA	
	Gas Only	Southwest Gas	CA, NV	
Convection Ovens	Gas & Electric	PG&E, SoCalGas, SCE, SDG&E, Avista, DTE, Rhode Island (National Grid), PSE	CA, ID, WA, MI, RI	Yes
	Electric Only	Duke Energy, Mass Save	IN, NC, SC, MA	
Combination Ovens	Gas & Electric	PG&E, SoCalGas, SCE, SDG&E, Avista, DTE, Rhode Island (National Grid), PSE	CA, ID, WA, MI, RI	Yes
	Electric Only	Duke Energy, Mass Save	IN, NC, SC, MA	
Steamers	Gas & Electric	PG&E, SoCalGas, SCE, SDG&E, Avista, DTE, Rhode Island (National Grid), PSE	CA, ID, WA, MI, RI	Yes
	Electric Only	Duke Energy, Mass Save	IN, NC, SC, MA	
	Gas Only	Southwest Gas	CA, NV	
Refrigerators & Freezers	Electric Only	PG&E, SoCalGas, SCE, SDG&E, DTE, Duke Energy, Mass Save, Rhode Island (National Grid), PSE	CA, MI, IN, NC, SC, MA, RI, WA	Limited
Ultra-Low Temp Freezers	Electric Only	PG&E, SoCalGas, SCE, SDG&E, Avista, DTE, Rhode Island (National Grid), PSE	CA, ID, WA, MI, RI	No
Ice Machines	Electric Only	PG&E, SoCalGas, SCE, SDG&E, Avista, DTE, Duke Energy, Mass Save, Rhode Island (National Grid), PSE	CA, ID, WA, MI, IN, NC, SC, MA, RI	Yes

SMART THERMOSTAT PILOT EVALUATION

Submitted to:
Energy Trust of Oregon

Prepared by:
Verdant Associates, LLC

Verdant Associates, LLC
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July 8, 2025

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1 EXECUTIVE SUMMARY

This Honeywell T9 Smart Thermostat Study was developed as a coordinated research project to study the impacts of the smart thermostat on gas and electric heated homes. The smart thermostat is an updated thermostat that has been well received by HVAC contractors, consumers, and utilities implementing HVAC demand response programs. Ideally these thermostats can be used to increase comfort, reduce peak demand, and reduce energy consumption. Energy Trust undertook this research project to determine if the thermostat was suitable for self-installation and set-up, to assess how satisfied users were with the setup and their experience using the thermostat, and to evaluate the energy impact of the smart thermostat.

The research project was implemented as a randomized controlled trial (RCT). Following the recruitment of participants, eligible households were randomly assigned to treatment and control groups, where treatment group homes were mailed a smart thermostat and control group homes were asked to maintain their existing thermostat for a year. Energy Trust would mail the control homes a new thermostat and an incentive after the study concluded.

Energy Trust chose the Verdant Team (composed of Verdant Associates and Cadeo) to evaluate the study. Cadeo led the process evaluation, assessing the customers' ability to self-install the smart thermostats and their satisfaction with the thermostats. Verdant led the impact evaluation assessing the energy impacts of the smart thermostats when installed in gas and electric heated single-family homes.

As shown in Table 1-1, the Project targeted 200 treatment and control group homes for both gas and heat pump heated homes. The impact analysis began with the 601 sites listed in Table 1-1.[1] The sites in Table 1-1 are presented by their treatment or control group and by heating fuel prior to attrition. As illustrated below, the gas heated homes have 184 treatment and 225 control sites while the central heap pump homes fell substantially short of the RCT targets with 81 treatment and 111 control sites.

[1] The number and distribution of homes used in the process analysis is listed in Table 3-1.

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TABLE 1-1: TARGET AND ACHIEVED IMPACT SAMPLE SIZES FOR SMART THERMOSTAT STUDY BY HEATING SYSTEM TYPE

Primary Heating System Type	Target Treatment Group Sites	Target Control Group Sites	Achieved Treatment Group Sites - Impacts	Achieved Control Group Sites - Impacts
Gas Furnace	200	200	184	225
Central Heat Pump	200	200	81	111

1.1 FINDINGS

The Process assessment found that 88 percent of study participants thought the study enrollment process was easy. Within the treatment group, 75 percent confirmed the smart thermostat was currently installed, six percent reported that they had installed and then removed the thermostat, 12 percent reported having abandoned the installation of the thermostat due to difficulty, and eight percent reported that they had not tried to install the thermostat. The 25 percent share of treatment homes where the thermostat was either removed or not installed due to difficulty was higher than anticipated. Within the installed treatment group, 74 percent reported satisfaction with the smart thermostat and 76 percent reported using their smart phone to access the thermostat's geofencing features.[2] Nearly all the installed treatment group plan to continue using their smart thermostat after the study is completed, indicating a high level of satisfaction among those customers who chose to maintain the installation of the thermostat.

Table 1-2 presents the claimed savings from the project tracking (PT) data and the annual estimated impacts derived from quarterly and hourly difference-in-difference regression models (presented in Section 4 below). Given the pilot nature of the study, Energy Trust requested that the evaluation focus on the impacts achieved by the installed measures, or a best-case savings methodology. The gas furnace models found no therm savings from installing the smart thermostat. Assessing the electric impact of the thermostats in the gas heated homes revealed a small statistically significant increase in electric usage. The electric analysis for heat pump heated homes found a savings of 377.1 kWh, or an observed realization rate of 41.8 percent. The observed realization rate compares the estimated kWh savings to the claimed value. Note that this annual savings value for heat pump homes has a 90% confidence interval that ranges from 123.3 kWh to 630.7 kWh, with relative precision of +/- 67%. While the confidence interval does not cross zero, the upper and lower limits do cover a large range of possible savings.

[2] The geofencing features use your smart phone's locate to adjust the thermostats settings based on your presence in the home or away from home. This feature is designed to increase savings.

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TABLE 1-2: CLAIMED AND ESTIMATED SAVINGS BY PRIMARY HEATING TYPE AND FUEL

Primary Heating System Type	Claimed Therms	Estimated Therms	Claimed kWh	Estimated kWh
Gas Furnace	32.07	0	58.79	-83
Central Heat Pump	-	-	902.54	377.1

Memo

To: Board of Directors

From: Giang Proepper, Data Analyst – Evaluation
Andrew Shepard, Senior Project Manager – Residential
Sarah Castor, Evaluation and Engineering Manager

cc:

Date: July 16, 2025

Re: Staff Response to the Honeywell Smart Thermostat Pilot Evaluation

Energy Trust of Oregon undertook a pilot evaluation of Honeywell's T9 smart thermostat to determine if the model was suitable for inclusion in the Residential program's smart thermostat offering. The goals of the pilot evaluation were to assess customer satisfaction with the thermostats and determine the gas and electric energy savings. The pilot evaluation used a randomized controlled trial (RCT) to evaluate effectiveness. It included 601 homes divided into a treatment group of customers who received the thermostat at no cost and a control group of customers who were asked to maintain their existing thermostat for one year.

A survey revealed that 75% of customers who received the thermostat installed it, while 25% either removed or failed to initially install it due to issues such as wiring incompatibility or unclear instructions. One-third of those who attempted installation reported that it was difficult, and they sought help from online resources, contractors, or Honeywell support. Of the customers who installed the thermostat, 74% were satisfied, and 93% planned to continue using it. For comparison, 95% of participants in Energy Trust's standard smart thermostat offering reported being satisfied with the performance of their unit, according to 2024 Fast Feedback surveys.[1] Additionally, 54% installed a Smart Sensor with their T9 thermostat, which provides temperature readings from a different location than the thermostat, with 68% expressing satisfaction with the Smart Sensor. Smartphone connectivity was used by 76% of participants who installed the thermostat to access the unit's geofencing features, and 78% were satisfied with the geofencing features. These findings indicate that most participants who installed the thermostat were taking advantage of the features that are intended to save energy and maintain home comfort.

The pilot evaluation found no statistically significant gas savings in homes with gas furnaces, and a small increase in electric usage of 83 kWh was observed. Heat pump homes demonstrated statistically significant annual electric savings of 377 kWh, representing a 42% realization rate compared to the 902 kWh savings that Energy Trust currently claims for other smart thermostats in homes heated with heat pumps. The evaluator also examined the relationship between savings and time of year; this analysis confirmed that there were no significant gas savings for gas furnaces at any point in the year. For homes with heat pumps, savings were largest in the fourth quarter of the year, which was the initial installation period. After that, savings dropped to nearly zero in the winter heating season and became negative by the spring, followed by a small amount of savings during the summer

[1] 2024 Fast Feedback Survey End of Year Report. https://www.energytrust.org/wp-content/uploads/2025/05/Energy-Trust-2024-Fast-Feedback-EOY-Report-FINAL.pdf

cooling season. Based on these findings, the program does not see a path to cost-effective savings and does not plan to include the Honeywell T9 thermostat in its smart thermostat offering.

This evaluation provided consistent feedback with other studies to improve the installation instructions for self-install smart thermostats. The Residential program intends to explore potential resources for installing smart thermostats for do-it-yourself participants.

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2 INTRODUCTION

2.1 DESCRIPTION OF THE PROJECT

The subject of this evaluation is a research project created by Energy Trust of Oregon's (Energy Trust) Residential program, which was designed to help assess the effectiveness of the Honeywell T9 smart thermostats. Although prior research on an early Honeywell smart thermostat model showed less favorable results,[3] the T9 appeared to be more promising. Its benefits include its broad market availability and a generally positive reception among both HVAC contractors and consumers.

This research project (the Project) provided a free thermostat and a cash incentive to residential customers in Energy Trust territories to install a smart thermostat in their homes, focusing on two primary smart thermostat installation scenarios: homes primarily heated by gas furnaces and homes primarily heated by central heat pumps. The properties eligible for this program include:

- Single-family and manufactured homes.
- Homes with electricity or gas services provided by one of Energy Trust's funding utilities.
- Those primarily heated by functioning gas furnaces or central heat pumps (no electric furnaces).
- Residences that have not participated in prior Energy Trust smart thermostat incentive programs.
- Homes that do not already have certain types of smart thermostats installed.

Recruitment for the Project began in June 2023. The Project was implemented as a randomized controlled trial (RCT) using a recruit and delay experimental design where prospective study participants were recruited, reviewed for eligibility, and then randomized into treatment and control groups. Recruits in the control group were asked to leave their existing thermostats in place for one year and would receive the thermostat and cash incentive upon completion of the study. The participant group was given a free smart thermostat to install in their home and told they would receive a cash incentive following a year of participation. Treatment and control participants could opt-out of the Project at any time.

[3] Energy Trust of Oregon Smart Thermostat Pilot Evaluation: https://www.energytrust.org/wp-content/uploads/2016/12/Smart_Thermostat_Pilot_Evaluation-Final_wSR.pdf

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2.2 EVALUATION OBJECTIVES

The primary purpose of the process evaluation was to determine the treatment customers' ability to self-install the thermostats, their satisfaction with the thermostats, and the overall satisfaction with the Project. The evaluation team implemented a participant web survey, collecting information from treatment and control customers. The survey offered an incentive for all respondents and was emailed to all participants in the RCT Project.

The primary objective of the impact evaluation was to assess the energy impacts of smart thermostats when installed in gas and electric heated single-family homes. Given that Energy Trust's primary impact evaluation goal was to evaluate the impact of smart thermostats, customers who opt out of the RCT were not included in the impact analysis. If the goal of the evaluation, however, had been to estimate the impact of a future thermostat program, the evaluation would have included customers who opted out of the Project. Using an intent-to-treat analysis would have included treatment households that failed to install their smart thermostat and control households that purchased and installed a smart thermostat during the Project. Therefore, the evaluation of the impact of the smart thermostats was a best-case scenario of savings, relying exclusively on treatment homes where the thermostats were installed and controls who did not install alternative smart thermostats during the treatment period.

Energy Trust's plan for the Project was to recruit and enroll a minimum of 200 treatment and control group homes with gas furnaces and central heat pump heating systems, for a total of 800 homes within the RCT. The planned distribution of heating fuels for participant homes is displayed in Table 2-1. The Project team realized during the recruitment period that it was likely they would fall short of the heat pump recruitment goal.

TABLE 2-1: TARGET AND ACHIEVED SAMPLE SIZES FOR SMART THERMOSTAT STUDY BY HEATING SYSTEM TYPE

Primary Heating System Type	Target Treatment Group Sites	Target Control Group Sites	Achieved Treatment Group Sites - Impacts	Achieved Control Group Sites - Impacts
Gas Furnace	200	200	184	225
Central Heat Pump	200	200	81	111

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3 PARTICIPANT SURVEY

3.1 APPROACH

The Verdant/Cadeo team used the census of study participants as of mid-April 2024, releasing the online survey outreach invitation May 28, 2024. We followed up with non-respondents by sending up to three reminder emails. The survey campaign ran from May 28 to June 17, 2024. We offered all qualified respondents the opportunity to receive a $20 Tango e-gift card with an option to donate the incentive to the American Red Cross or to decline the e-gift card.

We received 293 completed surveys for a final overall response rate of 45%. The final overall sample size provided 90% confidence and at least 10% precision per sample group, and 4% precision overall. Table 3-1 summarizes study participant sizes and survey response by sample group. We received higher response rates from the control groups than the treatment groups that received a smart thermostat from the pilot.

TABLE 3-1: PROCESS STUDY PARTICIPANT SAMPLE SIZES AND SURVEY RESPONSE BY SAMPLE GROUP

Study Group & Primary Heating System	Participant population	Completed surveys	Response rate	Confidence / Precision
Treatment Group & Central Heat Pump	107	38	36%	90% +/- 10%
Treatment Group & Gas Furnace	225	101	45%	90% +/- 6%
Control Group & Central Heat Pump	95	46	48%	90% +/- 9%
Control Group & Gas Furnace	222	108	49%	90% +/- 6%
Total	**649**	**293**	**45%**	**90% +/- 4%**

3.2 SURVEY RESULTS

We have presented the results by the four sample groups for consistency. However, for all the results, we performed statistical tests comparing differences by sample group, by study assignment (treatment vs. control), and by primary heating equipment type (central heat pump vs. gas furnace). As appropriate, we call out significant findings of these group differences in the body of the report. The demographic and housing characteristic information collected during the survey is presented in the Survey Appendix.

3.2.1 Key Takeaways

- Most participants (including both treatment and control groups) thought the pilot's enrollment process was easy (88%) and the information provided was clear (77%). A small but notable portion of both groups said the initial information was unclear (14%).
- A large portion of the control group participants (42%) were unaware that they had been assigned to the control group. The high survey response rate among the control group participants indicates they remain engaged with the study.
- Among the treatment group, 75% confirmed that the thermostat is currently installed (referred to as "thermostat-installed group"), 6% reported that the thermostat was installed but later removed, 12% reported having abandoned the installation due to difficulty, and 8% reported they have not yet tried installing.
- Of treatment participants who reported at least attempting installation– currently installed + installed but removed + abandoned installation – one third (33%) indicated that self-installation was challenging. An even higher proportion of them (72%) reported seeking help during self-installation either from an Energy Trust rep, a contractor, a manufacturer, or online resources.
- Among the thermostat-installed group, three-quarters (76%) report using their smartphone to access the T9's geofencing features. More than three-quarters of them (78%) expressed satisfaction with these features.
- More than half (54%) of those who installed the thermostat (thermostat-installed group + installed but removed) reported installing a SmartSensor[4] and more than two-thirds of them (68%) expressed satisfaction with this device.
- 74% of the thermostat-installed group were satisfied with the smart thermostat overall, 12% were neutral and 14% were dissatisfied.
- While many treatment group participants noticed positive changes in comfort and decreased bills, 14% of the thermostat-installed group noticed their energy bills increased during the heating season.
- Three-quarters of the treatment group participants had a programmable (65%) or WiFi (10%) thermostat before the pilot.
- Almost half of the treatment group participants (47%) reported using supplemental heating, such as space heaters or wood stoves.
- Nearly all the thermostat-installed group (93%) plan to continue using the smart thermostat after the pilot.

[4] The SmartSensor provides location based temperature control by focusing cooling and heating in the high priority locations.

- More than two-thirds of the pilot participants (67%) provided a 'satisfied' rating and 6% reported a 'dissatisfied' rating about their overall experience with the pilot study. We did not observe statistical differences between the groups.

3.2.2 Pilot Awareness and Enrollment

We first asked the participants about their motivation to enroll in the Smart Thermostat Pilot Study (Table 3-2). While many participants chose multiple reasons, the top three reasons for participation included *the opportunity to save energy and money* (73%), *free thermostat offer* (63%), and *an opportunity to participate in energy conservation research* (56%). There are no statistically significant differences by group.

TABLE 3-2: MOTIVATION FOR PILOT ENROLLMENT (MULTIPLE RESPONSE ALLOWED)

	Treatment CHP* (n=38)	Treatment GF** (n=101)	Control CHP* (n=46)	Control GF** (n=108)	Total (n=293)
The opportunity to save energy and money	58%	75%	67%	79%	**73%**
The free thermostat offer	68%	68%	67%	54%	**63%**
To participate in energy conservation research	45%	56%	59%	58%	**56%**
The cash incentives for participating	45%	50%	54%	44%	**47%**
An interest in smart home technology	34%	43%	50%	45%	**44%**

*CHP is a customer with a central heat pump

**GF is a customer with a gas furnace

More than three-quarters of the participants (77%) reported the information (including study requirements) provided in the study's initial invitation email and website were "clear." (Table 3-3). Overall, a large percentage of the participants (88%) thought the enrollment process was "easy" (Table 3-4). There are no statistically significant differences by group.

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TABLE 3-3: CLARITY OF INFORMATION PROVIDED ABOUT PILOT

	Treatment CHP* (n=38)	Treatment GF** (n=101)	Control CHP* (n=46)	Control GF** (n=108)	Total (n=293)
Unclear	18%	13%	11%	14%	**14%**
Neutral	13%	7%	9%	10%	**9%**
Clear	68%	80%	80%	76%	**77%**
Total	**100%**	**100%**	**100%**	**100%**	**100%**

Note: We recoded very or somewhat unclear as "unclear" and very or somewhat clear as "clear". We also combined "not sure" responses with "neutral" response (mid-point).

*CHP is a customer with a central heat pump

**GF is a customer with a gas furnace

TABLE 3-4: OVERALL EASE OF ENROLLMENT PROCESS

	Treatment CHP* (n=38)	Treatment GF** (n=101)	Control CHP* (n=46)	Control GF** (n=108)	Total (n=293)
Difficult	3%	1%	2%	3%	**2%**
Neutral	18%	9%	9%	7%	**10%**
Easy	79%	90%	89%	90%	**88%**
Total	**100%**	**100%**	**100%**	**100%**	**100%**

Note: We recoded very or somewhat difficult as "difficult" and very or somewhat easy as "easy". We also combined "not sure" responses with "neutral" response (mid-point).

*CHP is a customer with a central heat pump

**GF is a customer with a gas furnace

When we asked the control group participants whether they were aware of the assignment, 42% reported they were unaware (Table 3-5). However, only a small portion (12%) expressed dissatisfaction with the study's communication about their role as a member of the control group (*CHP is a customer with a central heat pump

**GF is a customer with a gas furnace

Table 3-6).

TABLE 3-5: AWARENESS OF CONTROL GROUP ASSIGNMENT

	Control CHP* (n=46)	Control GF** (n=108)	Total (n=154)
Yes	59%	57%	**58%**
No	41%	43%	**42%**
Total	**100%**	**100%**	**100%**

*CHP is a customer with a central heat pump

**GF is a customer with a gas furnace

TABLE 3-6: SATISFACTION WITH COMMUNICATION ABOUT CONTROL GROUP ASSIGNMENT

	Control CHP* (n=46)	Control GF** (n=108)	Total (n=154)
Dissatisfied	15%	11%	**12%**
Neutral	30%	30%	**30%**
Satisfied	54%	59%	**58%**
Total	**100%**	**100%**	**100%**

Note: We recoded very or somewhat dissatisfied as "dissatisfied" and very or somewhat satisfied as "satisfied". We also combined "don't know" responses with "neutral" response (mid-point).

*CHP is a customer with a central heat pump

**GF is a customer with a gas furnace

In addition, the pilot asked the control group participants not to remove or replace their thermostat until the end of the pilot period. However, 4% of the control group participants (n=6) reported they have replaced their thermostat since enrolling in the pilot.

3.2.3 Thermostat Installation and Set-up

Among the treatment group participants, we assessed the smart thermostat installation status (Table 3-7). All treatment group participants confirmed receiving the thermostat. However, only three-quarters (75%) reported their smart thermostat is currently installed (referred to later as the "thermostat-installed group"). Eighteen percent of the treatment participants (n=17) reported they attempted to install the thermostat but either removed it later (6%) or abandoned installation due to difficulty they encountered (12%). The remaining 8% of the treatment participants reported they have not tried installing it yet.

TABLE 3-7: TREATMENT GROUP: INSTALLATION STATUS

	Treatment CHP* (n=38)	Treatment GF** (n=101)	Total (n=139)
Have not received	0%	0%	**0%**
Currently installed ("thermostat-installed group")	74%	75%	**75%**
Installed but removed ***	13%	3%	**6%**
Abandoned installation due to difficulty	8%	13%	**12%**
Have not tried installing	5%	9%	**8%**
Total	**100%**	**100%**	**100%**

*CHP is a customer with a central heat pump

**GF is a customer with a gas furnace

*** A statistically significant difference between the two groups.

The challenges encountered by those "installed but removed" or "abandoned installation due to difficulty" (n=24) are summarized below:

- Incompatibility with existing system (n=9). These respondents often cited extra wires from the wall not matching the smart thermostat. One indicated the incompatibility damaged their furnace.
- Challenges with self-installation (n=8), often citing a need to hire a professional.
- A perceived product malfunction (n=4). One indicated the temperature setting did not stay at the set temperature, resulting in an increased heating bill.

Those reporting they had not tried to install the smart thermostat (n=11), indicated they:

- Were unable to self-install the T9 (n=4)
- Lacked time to install the T9 (n=3)
- Already have a similar technology (n=2)
- Are apprehensive of 'smart' technologies (n=2)

We asked the thermostat-installed group and those that attempted to install the smart thermostat (installed but removed + abandoned installation) to rate the overall ease of the installation process (Figure 3-1). Less than half of these treatment participants (43%) rated overall installation process "easy," while a third (33%) rated the process as "difficult or very difficult."

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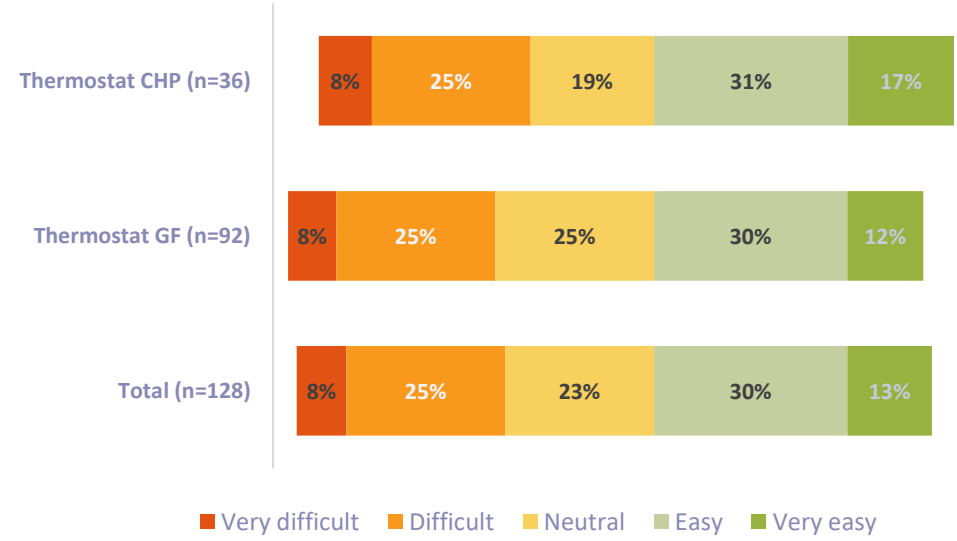
FIGURE 3-1: OVERALL RATE OF SMART THERMOSTAT INSTALLATION (AMONG INSTALLED OR ATTEMPTED INSTALLING)



Note: We combined "not sure" responses with "neutral" response (mid-point).

When asked those with difficulties to describe the difficulties they faced (n=42), four themes emerged across both treatment groups:

- Need for professional installation or assistance or additional research (n=12)
- Wiring complexities (n=10)
- Incompatibility issues with existing systems (n=3)
- Lack of clear or comprehensive instructions (n=5).

Nearly three-quarters (72%) of the treatment participants that installed or attempted to install the smart thermostat reported they needed to seek help during installation. Sources of help sought included online information, Honeywell customer service, contractors, and Energy Trust representatives (Table 3-8).

TABLE 3-8: SOURCES OF INSTALLATION HELP (AMONG INSTALLED OR ATTEMPTED INSTALLING, MULTIPLE RESPONSES ALLOWED)

Source	Treatment CHP* (n=36)	Treatment GF** (n=92)	Total (n=128)
Online resources (online discussion/forum, YouTube, etc.)	36%	35%	**35%**
Honeywell customer service or technical assistance	28%	16%	**20%**
A contractor	11%	22%	**19%**
Energy Trust representative	6%	5%	**5%**

*CHP is a customer with a central heat pump

**GF is a customer with a gas furnace

The survey sought to understand the installation location of thermostats. Among the thermostat-installed group, nearly all (96%) confirmed their thermostat is installed in a central, well-ventilated area of their home, but 8% of the treatment CHP group indicated otherwise (Table 3-9).

TABLE 3-9: THERMOSTAT INSTALLED IN CENTRAL, WELL-VENTILATED AREA IN HOUSE (AMONG TREATMENT GROUP WHO INSTALLED OR ATTEMPTED INSTALLING)

	Treatment CHP* (n=28)	Treatment GF** (n=76)	Total (n=104)
Yes	92%	97%	**96%**
No	4%	0%	**1%**
I'm not sure	4%	3%	**3%**
Total	**100%**	**100%**	**100%**

*CHP is a customer with a central heat pump

**GF is a customer with a gas furnace

Note: 97% of the control group also reported "yes".

3.2.4 Thermostat Usage and Features

We asked the treatment group participants about how they use several key features of the smart thermostat.

Among the thermostat-installed group, three-quarters (76%) reported their smart thermostat is connected to at least one household smartphone (Table 3-10). One respondent said it is connected to Amazon Alexa (in the 76% yes group) and another did not have a smartphone (in the 21% no group). A small portion of these respondents (9%) said multiple smartphones are connected to their smart thermostat.

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TABLE 3-10: SMART THERMOSTAT CONNECTED TO SMARTPHONE (AMONG THERMOSTAT-INSTALLED)

	Treatment CHP* (n=28)	Treatment GF** (n=76)	Total (n=104)
Yes	79%	75%	**76%**
No	21%	21%	**21%**
Other	0%	4%	**3%**
Total	**100%**	**100%**	**100%**

*CHP is a customer with a central heat pump

**GF is a customer with a gas furnace

The smart thermostat provides the following features:

- **Location-based temperature control**. A smartphone enabled feature that automatically adjusts temperature based on smartphone location tracking of occupancy (i.e. geofencing).
- **Smart scheduling**. A smartphone enabled feature that adds a sleep period to the location-based temperature control feature (i.e. a period where you adjust the temperature during your sleep hours).
- **Time-based scheduling**. Does not require a smartphone connection, and enables a scheduled program based on sleep/wake and away/home schedules (similar to a programmable thermostat).

Among the features enabled by smartphone connection, the location-based temperature control feature is reportedly used by about a third of the smartphone connected thermostat-installed group (36%) (Table 3-11). The smart scheduling feature, which adds a sleep period, is even more popular (63%).

The time-based scheduling feature can be accessed with or without smartphone connection. About three-quarters of smartphone connected thermostat-installed group (74%) reported using this feature, similar to the proportion of non-smartphone connected installed treatment participants (73%) that reported using this feature.

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TABLE 3-11: SMARTPHONE FEATURES BEING USED (AMONG SMARTPHONE CONNECTED, MULTIPLE RESPONSES ALLOWED)

	Treatment CHP* (n=22)	Treatment GF** (n=54)	Total (n=76)
Location-based temperature control	45%	31%	**36%**
Smart scheduling	68%	61%	**63%**
Time-based scheduling	86%	69%	**74%**

*CHP is a customer with a central heat pump

**GF is a customer with a gas furnace

Among the thermostat-installed group, more than half (57%) reported they infrequently used the manual adjustment features of their thermostat settings. Thirty nine percent of the thermostat-installed group reported never or only once in a few months manually adjusting their smart thermostat while 18% reported making monthly manual adjustments. About 40% (17% weekly and 13% daily) reported they need to make a manual adjustment to the smart thermostat's setting weekly or more frequently.

TABLE 3-12: FREQUENCY OF MANUAL ADJUSTMENT (AMONG THERMOSTAT-INSTALLED)

	Treatment CHP* (n=28)	Treatment GF** (n=76)	Total (n=104)
Never-/once every few months	46%	37%	**39%**
Monthly	11%	21%	**18%**
Weekly	32%	25%	**27%**
Daily	11%	14%	**13%**
I'm not sure	0%	3%	**2%**
Total	**100%**	**100%**	**100%**

*CHP is a customer with a central heat pump

**GF is a customer with a gas furnace

Of the 27 participants in the thermostat-installed group with the location-based temperature control feature enabled via smartphone app, more than three-quarters (78%) reported being satisfied with their experience with this feature.

TABLE 3-13: SATISFACTION WITH LOCATION-BASED TEMPERATURE CONTROL FEATURE

	Treatment CHP* (n=10)	Treatment GF** (n=17)	Total (n=27)
Dissatisfied	0%	0%	**0%**
Neutral	30%	18%	**22%**
Satisfied	70%	82%	**78%**
Total	**100%**	**100%**	**100%**

*CHP is a customer with a central heat pump

**GF is a customer with a gas furnace

Note: We recoded very or somewhat dissatisfied as "dissatisfied" and very or somewhat satisfied as "satisfied". We also combined "don't know" responses with "neutral" response (mid-point).

Along with the smart thermostat, the treatment group participants received a SmartSensor device that can be installed in a different room from the smart thermostat unit to prioritize heating and cooling specific rooms for comfort. More than half of the participants that installed the smart thermostat (thermostat-installed group + installed but removed group) (54%) said they installed the SmartSensor. Two participants reported purchasing and installing additional SmartSensors on their own. The SmartSensors were most commonly installed in bedrooms (52% of those installed), living rooms (22%), and hallways (15%).

TABLE 3-14: INSTALLATION OF SMARTSENSOR

	Treatment CHP* (n=33)	Treatment GF** (n=79)	Total (n=112)
Yes	52%	54%	**54%**
No	45%	38%	**40%**
I didn't know about this option	3%	8%	**6%**
Total	**100%**	**100%**	**100%**

*CHP is a customer with a central heat pump

**GF is a customer with a gas furnace

More than two-thirds of those who installed the SmartSensor (68%) reported they were satisfied with the performance of the SmartSensor. A very small percentage (n=2) reported dissatisfaction, citing that they observed discomfort in rooms without the sensor or an increase in energy usage

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TABLE 3-15: SATISFACTION WITH SMARTSENSOR

	Treatment CHP* (n=17)	Treatment GF** (n=43)	Total (n=60)
Dissatisfied	0%	5%	**3%**
Neutral	18%	33%	**28%**
Satisfied	82%	63%	**68%**
Total	**100%**	**100%**	**100%**

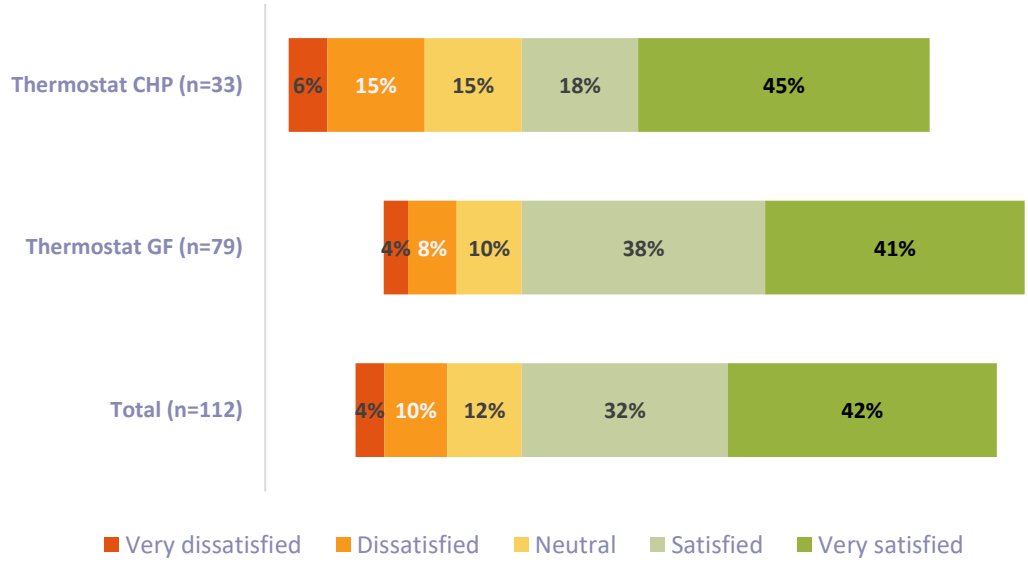
*CHP is a customer with a central heat pump

**GF is a customer with a gas furnace

Note: We recoded very or somewhat dissatisfied as "dissatisfied" and very or somewhat satisfied as "satisfied". We also combined "don't know" responses with "neutral" response (mid-point).

Approximately three-quarters (74%) of the thermostat-installed group rated their overall satisfaction with features and usability of the smart thermostat as 'satisfied' or 'very satisfied' on a five-point scale, while a small but notable portion of them (14%) reported overall dissatisfaction with the smart thermostat.

FIGURE 3-2: OVERALL SATISFACTION WITH THE SMART THERMOSTAT



Note: We combined "not sure" responses with "neutral" response (mid-point).

3.2.5 Comfort and Energy Savings

We asked the thermostat-installed group about notable changes in winter and summer comfort (Figure 3-3) since installing their smart thermostat. While a large portion reported no change in comfort, more

than half (51%) reported increased comfort during the heating season and 31% during the cooling season. Only a small portion reported decreased comfort.

FIGURE 3-3: CHANGE IN COMFORT BY SEASON (N=104)

When we asked about the changes in energy bills observed since installing the smart thermostat, 40% reported decreased bills during the heating season and 21% during the cooling season. A smaller but notable portion (14%) reported a higher winter bill. A substantial portion reported it was still too early to tell and 43% to 50% stated that they did not observe a change in their energy bills.[5]

[5] The timing of the participant survey was during the first year following smart thermostat installation. It is possible that insufficient time had elapsed for participants to observe utility bill impacts.

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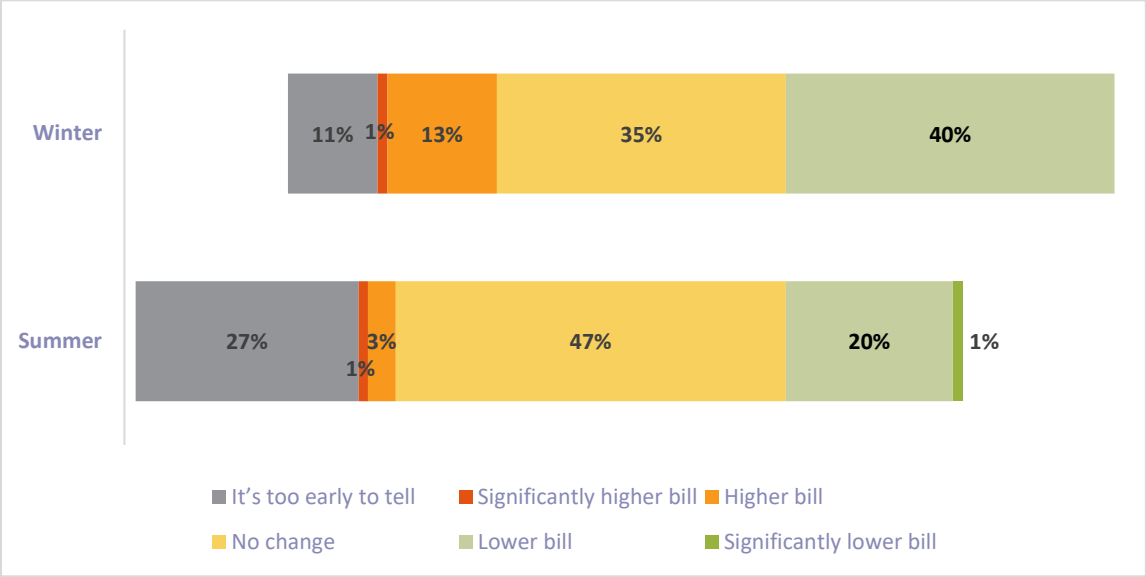
FIGURE 3-4: CHANGE IN BILL BY SEASON (N=104)



3.2.6 Home and Heating System Characteristics

Treatment group participants reported pre-pilot thermostat type (Table 3-16), choosing from the following thermostat types and descriptions:

- **Manual-only** thermostat with no scheduling or programming capability
- **Programmable** thermostat that allows automatic temperature adjustments based on programmed times of day
- **Wi-Fi** thermostat that has capabilities of programmable thermostat in addition to wireless connection which enables homeowners to access it remotely for convenience while in the home or away
- **Smart** thermostat that can do everything programmable or Wi-Fi thermostat models can, in addition to "smart" or learning technology which allows the control to set temperatures based on you your preferences, home occupancy, and other factors

Three-quarters (75%) said they had a programmable or WiFi thermostat which allows automatic temperature adjustments based on programmed times of day (WiFi enables remote access). Nineteen percent said they had a manual-only thermostat. Six percent said they already had a smart thermostat.

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TABLE 3-16: THERMOSTAT PRIOR TO PILOT

	Treatment CHP* (n=38)	Treatment GF** (n=101)	Total (n=139)
Manual-only	21%	18%	**19%**
Programmable	66%	64%	**65%**
WiFi	11%	10%	**10%**
Smart	3%	7%	**6%**
Not sure	0%	1%	**1%**
Total	**100%**	**100%**	**100%**

*CHP is a customer with a central heat pump

**GF is a customer with a gas furnace

Additionally, we assessed the pilot participants' supplemental heating use. Across the groups, 47% of the participants reported using supplemental heating sources to heat any part of their home in addition to or instead of the primary heating system (Table 3-17). The most common supplemental heating equipment used included gas fireplaces and portable/plug-in heaters (Table 3-18). Note that no data was collected to establish how regularly these pilot participants used their supplemental heating.

TABLE 3-17: SUPPLEMENTAL HEATING USED

	Treatment CHP* (n=38)	Treatment GF** (n=101)	Control CHP* (n=46)	Control GF** (n=108)	Total (n=293)
Yes	45%	51%	46%	44%	**47%**
No	55%	49%	54%	56%	**53%**
Total	**100%**	**100%**	**100%**	**100%**	**100%**

*CHP is a customer with a central heat pump

**GF is a customer with a gas furnace

TABLE 3-18: SUPPLEMENTAL HEATING EQUIPMENT USED

	Treatment CHP* (n=38)	Treatment GF** (n=101)	Control CHP* (n=46)	Control GF** (n=108)	Total (n=293)
Fireplace (gas)	13%	24%	13%	25%	**21%**
Portable, plug-in heater (radiant, infrared, ceramic heater, etc.)	11%	28%	11%	14%	**18%**
Wood or pellet stove	16%	4%	13%	5%	**7%**
Fireplace (propane, wood)	11%	7%	11%	4%	**7%**
Electric wall heater	5%	3%	2%	4%	**3%**
Ductless mini-split heat pump	5%	0%	4%	1%	**2%**
Fireplace (electric)	0%	2%	0%	1%	**1%**
Electric baseboard	0%	0%	0%	1%	**0%**
Other	5%	1%	4%	2%	**2%**

*CHP is a customer with a central heat pump

**GF is a customer with a gas furnace

3.2.7 Feedback and Expectations

A majority of the thermostat-installed group (93%) reported planning to continue using the smart thermostat after the pilot.

TABLE 3-19: PLAN TO CONTINUE USING THE SMART THERMOSTAT AFTER PILOT (AMONG THERMOSTAT-INSTALLED)

	Treatment CHP* (n=28)	Treatment GF** (n=76)	Total (n=104)
Yes	93%	93%	**93%**
No	0%	1%	**1%**
Too early to tell	7%	5%	**6%**
Total	**100%**	**100%**	**100%**

*CHP is a customer with a central heat pump

**GF is a customer with a gas furnace

More than two-thirds of the pilot participants (67%) rated their overall satisfaction with Energy Trust's Honeywell Smart Thermostat Pilot Study as 'satisfied' or 'very satisfied' on a five-point scale. There was no statistical difference observed between groups.

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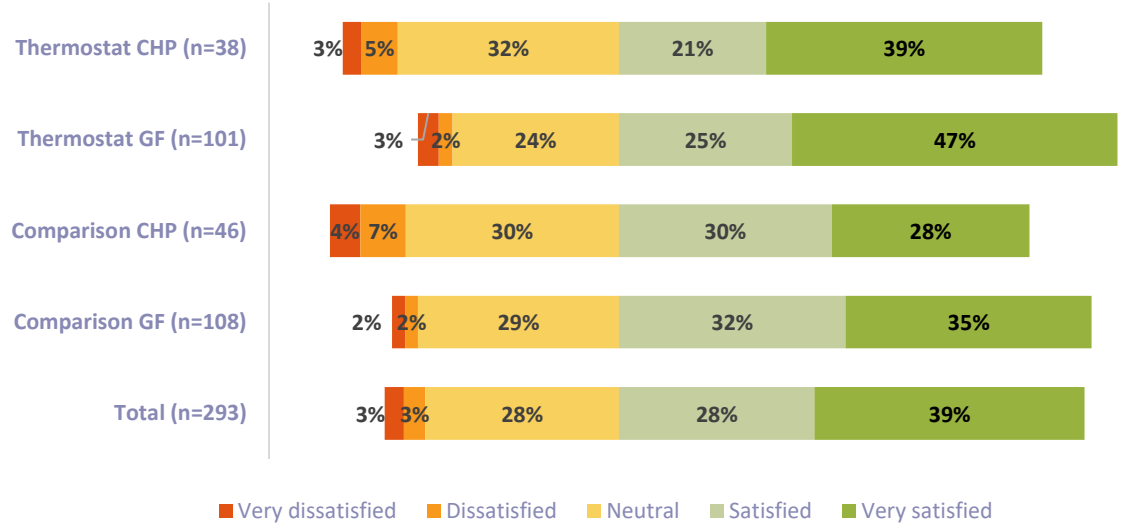
FIGURE 3-5: OVERALL SATISFACTION WITH PILOT



Note: We combined "not sure" responses with "neutral" response (mid-point).

Finally, we asked the participants to provide any suggestions about improving similar studies in the future.

The treatment group's suggestions focused on the practical aspects of using and installing the device. Themes included:

- Enhanced installation support
  - Offer local professional installation support at no cost
  - Provide clearer instructions and resources for installation
  - Be upfront that installation may require hiring a contractor
- Smart thermostat technical improvements
  - Add battery backup to save settings during power outages
  - Improve WiFi connectivity and app functionality
  - Enhance user interface for easier programming, especially for seniors
  - Add features that provide feedback on energy usage
- Communication
  - Provide better ongoing communication about the study
  - Offer technical support or a helpline for issues
  - Give more information about the thermostat's features and compatibility
  - Address concerns about privacy and data collection (e.g., W-9 forms, WiFi connectivity)

The controls group's suggestions centered on understanding their role in the study and receiving updates about its progress. Themes included:

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- Communication
  - Provide more frequent updates about the study
  - Clarify the purpose of the control group
  - Send reminders about participation in the study
- Study design
  - Offer more upfront information about system compatibility
  - Share findings and results of the study with participants

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4 IMPACT DATA AND METHODS

4.1 DATA SOURCES

This section describes the various data sources used for the impact evaluation.

4.1.1 Participant Data

Energy Trust provided Verdant with a Participant List (PL) dataset, which consisted of the 690 unique homes (as indicated by ETO site ID field) that were recruited for the Project. These data served as the master list of all study participants with their initial RCT group disposition and heating system, and also included the home type and other information needed to link these homes with other data sources.

4.1.2 Project Tracking Data

A key supplement to the PL dataset was a Project Tracking (PT) dataset that included data on participation in other Energy Trust programs for the 690 recruited participant sites going back roughly 13 months before the study recruitment began. These data included project details associated with the home, including electric and gas energy savings, installation dates, and household HVAC equipment types. These data were critical in determining the recent installation of other energy-efficiency measures that could interfere with the ability to isolate the impact from the installation of the smart thermostats.

The PT data was also important in helping to determine the final group disposition of the participant homes. The initial RCT group for each site in the PL included some classifications that were ambiguous. Instead of a clean “TREATMENT” and “CONTROL” classification, the data included values such as “TREATMENT, MOVED FROM CONTROL” and “REMOVED FROM CONTROL.” While the former might seem to be a clear case for the treatment group, Verdant wanted to validate that the site also had a valid record for the smart thermostat installation in the tracking data.

After an assessment of the data and applying some professional judgment, with a bias towards removing uncertainty, the 690 homes were reduced to a total of 601 due to uncertainty about the actual role of the home in the RCT. . Table 4-1 presents the count of sites by heating type and final RCT group disposition for the 601 homes not dropped from this evaluation. These data indicate that the project met their goal of recruiting 400 gas heated homes but fell short for heat pump households. Table 4-1 also presents the ex ante savings for smart thermostats in gas and electric heated treatment homes. The treatment homes with gas furnaces had small electric savings associated with the expected impact of the smart thermostats on central air conditioning and fan usage.

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TABLE 4-1: PROJECT COUNTS FOR TREATMENT AND CONTROL BY HEATING TYPE AND PER CAPITA CLAIMED SAVINGS[6]

Participant Group	Number of Participants	Gas Savings (Therms)	Electric Savings (kWh)
Gas Heating Treatment	184	32.07	58.79
Gas Heating Control	225	0	0
Electric Heat Pump Treatment	81	0	902.54
Electric Heat Pump Control	111	0	0

4.1.3 Customer Relationship Management Data

Energy Trust provided Verdant with a Customer Relationship Management (CRM) dataset. The CRM data contains information about sites that help tie a project in the PT database to a customer bill; this includes the site address, electric provider, gas provider, year that property was built, total square footage, main heating system and fuel(s), main water heating system and fuel(s), Energy Trust region, and heating and cooling zones. For this use case, the CRM dataset was also used to map latitudes and longitudes to their respective sites to determine the closest TMY and weather stations.

4.1.4 Weather Data

For the gas analysis, Energy Trust provided Verdant with historical daily weather data and typical meteorological year (TMY) for all the weather stations represented in treatment and control group homes. Verdant used "TMYx" as the latest version of TMY data. These daily data included daily min, max, and average temperature by weather station.

For the electric analysis, which requires hourly data, Verdant obtained the historical weather from National Oceanic and Atmospheric Administration (NOAA) using a publicly available API. Multiple years of weather data were selected for a set of cities necessary to cover the climate variability associated with the program homes. For the hourly TMY data, Verdant used a TMYx version provided by https://climate.onebuilding.org/default.html, which had series for dozens of cities in Energy Trust's service territory. For the purposes of this report, TMY refers to the type of data used, whereas TMYx refers to the specific version.

[6] There were a small number of sites in the PT data that reported gas and/or electric savings that were inconsistent with their heating or control/treatment type. These sites were reassigned the correct savings, which is represented in this table.

An important note for this step is that there was not always an exact match between weather stations and participant's site. Thus, some weather data was selected from matching method using the latitude and longitude information for the participant's homes and the weather data from the closest city and weather station using the Haversine formula.[7]

4.1.5 Utility Customer Information (Gas and Electric Energy Usage)

Energy Trust provided monthly gas and electric Utility Customer Information (UCI) data for program participants. These data represented monthly energy records for each household from mid-2022 through late 2024 and customer information such as: name, addresses, account number,customer ID. , meter number, presmise ID, etc. For the electric analysis, Energy Trust provide additional hourly electricity AMI data for a period extending from one year prior to the first study start date through one year after the last study start date.

4.1.6 Data Cleaning and Quality Control

Data review and cleaning were necessary to identify and resolve data quality issues in preparation for the impact analysis. Types of data cleaning include:

- Flagging any anomalies such as excessively high or excessively low usage. For electricity, analysis was restricted to homes with annual consumption between 2,000 kWh and 35,000 kWh. For gas, homes with less than 150 therms or more than 1,500 therms annually were eliminated from the analysis.
- Removing sites that have additional energy efficiency installations during the pre and/or post installation periods above a certain energy savings threshold (this can lead to changes in energy usage mistakenly attributed to the smart thermostats).
- Removing duplicate records, such as sites that had more than one unique identifier.
- Properly coding and handling missing values and observations. Examples include:
  - Sites that do not have an entry in the PL dataset, therefore no means to know which experimental group they were assigned.
  - Sites in the PL dataset that do not have billing data.
- Removing sites with solar installations (for electric analysis).
- And other data anomalies referenced in Table 4-2, Table 4-3, and Table 4-4.

[7] The Haversine Formula calculates the shortest distance between two points in space.
Closest Distance = 6371 x (2 x atan2(√a, √(1−a))), where a = $\sin^2(\Delta latitude/2) + \cos(lat1).\cos(lat2).\sin^2(\Delta longitude/2)$

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An important detail that was considered when cleaning the data was the study's focus on evaluating the impact of the smart thermostats. If the focus of the study were on program impacts, the analysis data set would include treatment and control customers who had previously installed smart thermostats and treatment customers who never installed the smart thermostats. Limiting the evaluation to those customers who previously did not have smart thermostats and treatment customers who successfully installed the smart thermostats focused the evaluation on the impact of the smart thermostats. With this intention in mind, there were certain sites that were removed from the analysis that would not have been removed if the focus was program impacts. The following characteristics were used as filters to remove data that would interfere with estimating the impacts of the thermostats:

- Participants in the control group that had Honeywell T9 smart thermostats or DirectShip smart thermostats installed prior to the study.
- Participants in the treatment group with both Honeywell T9 smart thermostats and DirectShip smart thermostats installed.

Table 4-2 and Table 4-3 below describe the data cleaning attrition for gas heated homes, first for the gas analysis and then for the electric analysis. For gas heating homes, the smart thermostat was expected to save therms during the heating season and electricity during the cooling and heating season. The first three sources of attrition across these two tables were the same – sites were removed from the analysis if they had other smart thermostats installed during the pre- or post-installation period. In the gas impacts attrition table, 16 homes were removed from the analysis sample due to high levels of other measured savings in the PT data and 30 homes were removed because they had no gas billing data. In the electric attrition table for gas heated sites, 90 sites were removed for no electric usage information while 2 sites were removed for the presence of solar. Sites were also removed for having anomalously high gas usage, too high or too low electric usage, and for insufficient periods of gas or electric usage information. The gas data cleaning removed approximately 25 percent of the gas analysis sites while the electric data cleaning for gas heated sites led to slightly more attrition.

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TABLE 4-2: ATTRITION TABLE FOR GAS IMPACTS ANALYSIS OF SITES WITH NATURAL GAS FURNANCES

Attrition Reason	Treatment Sites Dropped	Control Sites Dropped	Total Sites Dropped	Total Sites Remaining
Start	-	-	-	409
Control group with Honeywell thermostat installed	0	3	3	406
Control group with DirectShip thermostat installed	0	7	7	399
Treatment group with DirectShip thermostat	2	0	2	397
Customers with non-thermostat high energy efficient savings (>50 therms annually) in the PT data	5	11	16	381
Sites without gas billing data	3	27	30	351
High average daily therms (> 4 therms)	0	6	6	345
Insufficient data to have a deadband of at least 30 days.	2	4	6	339
Had more than 3 months of missing data for pre and/or post period	20	17	37	302

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TABLE 4-3: ATTRITION TABLE FOR ELECTRIC IMPACTS ANALYSIS OF SITES WITH NATURAL GAS FURNANCES

Attrition Reason	Treatment Sites Dropped	Control Sites Dropped	Total Sites Dropped	Total Sites Remaining
Start	-	-	-	409
Control group with Honeywell thermostat	0	3	3	406
Control group with DirectShip thermostat	0	7	7	399
Treatment group with DirectShip thermostat	2	0	2	397
Sites without electric billing data	41	59	90	307
Solar	1	1	2	305
Missing data throughout	3	0	3	302
High hourly kwh usage (>64 kwh)	0	1	1	301
Low average daily usage (<5 kwh)	0	4	4	297
Customers with non-thermostat high-savings (>200 kWh annually) installations	2	4	6	291
Modeling failure during weather normalization	0	1	1	290

Table 4-4 presents the attrition that occurred while cleaning the electric heating data. The electric attrition also started with the removal of households that installed other smart thermostats during the analysis period. The single largest source of attrition for electric heated homes is missing electric usage data (leading to the attrition of 37 sites). Sites were also eliminated from the analysis sample if they had solar, anomalous usage, or the weather normalization models performed poorly (a poorly performing weather normalization model was determined by the OpenEEMeter software). The data cleaning process removed 81 sites or 43 percent of the electric sample.

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TABLE 4-4: ATTRITION TABLE FOR ELECTRIC IMPACTS ANALYSIS OF SITES WITH CENTRAL HEAT PUMPS

Attrition Reason	Treatment Sites Dropped HP Heat	Control Sites Dropped	Total Sites Dropped	Total Sites Remaining
Start	-	-	-	192
Control group with Honeywell thermostat	0	4	4	188
Control group with DirectShip thermostat	0	6	6	182
Sites without electric billing data	9	28	37	145
Likely solar home	7	7	14	131
Excessive Missing Data	0	1	1	130
Duplicate site ids	0	4	4	126
Other project with high kwh (>200 kwh)	5	2	7	119
Modeling failure during weather normalization	5	3	8	111

Combining Data

To assess the energy impacts of the Smart Thermostat Program it was necessary to combine and clean the PT data, the CRM data, the PL data, and the UCI data. The merging process was implemented using et_site_id as the primary key, where et_site_id is a variable that is generally unique by utility to a customer and assigned by Energy Trust.

Creating the Final Analysis Dataset

The electric and gas billing records were cleaned to ensure that the mapping of utility data to participant metadata was treated correctly and that anomalies were properly removed from the data, such as excessively long or short billing intervals. The varying availability of fields related to the billing intervals added to the difficulty of creating the final analysis dataset. Table 4-5, Table 4-6, and Table 4-7 present the final number of site counts for the control group and treatment groups for the gas heating analysis, the electric analysis of gas heating homes and the electric heat pump sample.

TABLE 4-5: FINAL GAS ANALYSIS DATASET FOR SITES WITH GAS FURNACES

Measure	Total
Sites in Control Group	150
Sites in Treatment Group	152
Total Control and Treatment Sites	302
Total Sites Dropped (including Opt-outs)	107

TABLE 4-6: FINAL ELECTRIC ANALYSIS DATASET FOR SITES WITH GAS FURNACES

Measure	Total
Sites in Control Group	145
Sites in Treatment Group	145
Total Control and Treatment Sites	290
Total Sites Dropped (including Opt-outs)	119

TABLE 4-7: FINAL ELECTRIC ANALYSIS DATASET FOR SITES WITH HEAT PUMPS

Measure	Total
Sites in Control Group	56
Sites in Treatment Group	55
Total Control and Treatment Sites	111
Total Sites Dropped (including Opt-outs)	81

4.2 ENERGY IMPACTS ANALYSIS

The estimation of both gas and electricity impacts for the smart thermostats relied on methods defined in the Uniform Methods Project (UMP), which prescribes an industry standard two-stage modeling approach for evaluations of this nature.[8] The first stage developed weather-normalized estimates of energy usage for both treatment and control homes in the pre- and post-installation periods. In the second

[8] See "Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol" in "The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures" in https://www.nrel.gov/docs/fy17osti/68564.pdf. Details are found in section 4.3, "The Two-Stage Approach."

stage, the weather-normalized energy usage data were applied in a difference-in-differences (DiD) panel data model to determine the thermostat energy impacts. The subsequent sections describe these two steps in more detail.

4.2.1 Weather Normalization

While the approaches are conceptually similar, due to the different periodicity of the gas and electric consumption data, the weather normalization methods differed for the two fuels. The remainder of this section explains the fuel-specific approaches.

Monthly Gas Normalization

The development of weather-normalized gas usage was based on the Princeton Scorekeeping Method (PRISM) approach, which estimates the average daily consumption in each billing cycle as a function of average daily heating-degree days (HDD). The model is run for multiple HDD temperature thresholds (40 to 65 by five-degree increments) and then selects the HDD base temperature (or threshold) that results in the best model, as determined by the model R-squared. Verdant's scripts for selecting the model also check that the parameter estimates for the HDD variable is the right sign, but when estimating gas consumption this rarely figures in the model selection.

An example of the PRISM approach is presented in Table 4-8, which shows the results of the regression model for all thresholds for both pre- and post-installation periods, with models ranked based on the R-squared. There are two characteristics of this example worth highlighting. The first is that the R-squared can vary substantially for the different thresholds. For example, in the pre period, the highest ranked model has an R-squared of 0.99, which is more than 0.04 higher than the lowest rank model. While such a difference might not seem substantial, it accounts for an additional four percent of explained variability in consumption, so using this threshold "base temperature" for normalization is going to provide a much better result. The other item of note is that the threshold selected can vary by the period. In cases of weatherization, there can be an intuitive shift towards lower thresholds in the post period, as the improved shell means that the homes require colder outdoor temperatures to trigger heating. In the cases of thermostats, such a relationship is not necessarily as clear. Regardless, a later summary table will show how thresholds shifted from pre to post for the full set of homes with gas furnaces.

TABLE 4-8: EXAMPLE OF PRISM MODEL SELECTION FOR SINGLE HOUSEHOLD

Period	HDD Base Temperature	Adjusted R-Square	Rank
Pre	45	0.983	3
	50	***0.993***	***1***
	55	0.990	2
	60	0.975	4
	65	0.950	5
Post	45	0.888	5
	50	0.956	4
	55	***0.984***	***1***
	60	0.981	2
	65	0.962	3

This PRISM modeling and selection process was conducted for the pre and post period for all treatment and control group homes with gas heat. Table 4-9 presents the distribution of R-squared values for the final models selected for weather normalization.[9] The distributions include every home with gas data before many of the attrition steps. The findings in the table illustrate that even with the poorer models included, the average R-squared values for the gas furnace homes are 0.96 and 0.97 for the pre and post periods, respectively. Based on the 10th percentile, 90% of the gas furnace homes in the pre period had an R-squared of at least 0.917. This figure improved to 0.95 in the post period.

TABLE 4-9: DISTRIBUTION OF R-SQUARED FOR FINAL GAS USAGE NORMALIZATION MODELS

	Central Heat Pump		Gas Furnace	
Period	**Pre**	**Post**	**Pre**	**Post**
Site Count	39	39	321	321
Mean	0.919	0.929	0.961	0.966
Std	0.117	0.125	0.072	0.086
Min	0.471	0.529	0.232	0.060
10%	0.803	0.833	0.917	0.950
50%	0.968	0.971	0.981	0.989
max	0.995	0.999	0.999	0.999

[9] The final analysis of gas impacts was conducted only for homes with gas furnaces. Nevertheless, the weather normalization was done for all participant homes with gas data to not limit any later potential analysis, so results for both heating systems are presented here. Due to the decision to implement the PRISM analysis for all homes with gas data, the site counts for this analysis are not consistent with the attrition tables above.

High R-squared values in weather normalization models are common with gas heated homes since a large share of the usage is highly dependent on outdoor temperatures. The curiosity in Table 4-9 is that homes with heat pumps also have high R-squared values. On average their model fit is not as good as the gas furnace homes, but not nearly as diminished as we would expect for homes that in theory are using electricity for most or all heating. The gas weather sensitivity of the heat pump homes may indicate that some of these homes frequently use their gas furnaces for backup.

In addition to knowing that the weather normalization models performed well (as indicated by the R-squared summary), another useful validation of the models is an assessment of the final HDD thresholds selected, which is presented in Table 4-10. There are two important items to review in this table. The first is that the highest frequency of selected HDD thresholds should not be the upper or lower bound of the modeled thresholds, and we can see that this is not the case. For example, for the pre thresholds for the gas furnace homes, the highest frequencies are in the 60- and 55-degree base temperatures bins, with marked declines in frequency in the adjacent bins. Were we to find the highest frequencies in the lowest or highest thresholds, it would signify that the PRISM approach should have included additional thresholds for the weather normalization model selection.[10]

TABLE 4-10: COUNT OF HOMES BY FINAL PRE AND POST HDD THRESHOLDS

Heating System	Pre Threshold	Post Threshold					
		45	50	55	60	65	Total
CENTRAL HEAT PUMP	45	**1**	1	1	2	1	6
	50	2	**3**	2	0	1	8
	55	2	1	**4**	3	1	11
	60	0	0	0	**5**	2	7
	65	0	1	1	2	**2**	6
	Sub Total	**5**	**6**	**8**	**12**	**7**	**38**
NATURAL GAS FURNACE	45	**0**	1	1	3	2	7
	50	1	**4**	7	4	0	16
	55	2	8	**37**	32	4	83
	60	0	2	17	**101**	30	150
	65	0	1	1	20	**39**	61
	Sub Total	**3**	**16**	**63**	**160**	**75**	**317**
	Total	**8**	**22**	**71**	**172**	**82**	**355**

[10] An argument could be made that a 70-degree threshold should have been included in lieu of or in addition to the 45-degree threshold, but the small number of homes potentially selected and marginal improvement did not justify re-doing the analysis.

The second element of interest in Table 4-10 is the change in thresholds from pre to post. For the gas furnace homes, the diagonal elements—which indicate no change in the final threshold—account for 57% of the homes. The item of concern are those elements farthest from the diagonal, which indicate large changes in the threshold selected. For example, a change from 45 in the pre period to 60 or 65 in the post could be indicative of some significant change in the household, such as major weatherization or the addition or removal of an occupant. There are a small number of the larger shifts, however, Verdant did not select to make this part of the exclusion criteria since there are later assessments of the normalized usage that would likely capture any major anomalies. Also, note that the counts in this table reflect the removal of any home that had either a pre or post model with an R-squared lower than 0.4.

Normalized Usage Calculation and Validation

Once the final temperature thresholds were selected for the pre and post periods for each home, the final step was to apply the model parameter estimates to the appropriate HDD based on monthly TMY data to generate the normalized gas consumption for each household and period. The result is a data set that contained the 12 months of normalized gas consumption based on the pre period and 12 months for the post period for each household.

Despite the simple nature of this step, it was still important to conduct quality control and validation. To this end, during the normalized usage calculation, the routine saves the actual and TMY HDD values as well as the actual and normalized usage values. Verdant reviewed these data to ensure that the TMY and actual HDD values were within reasonable bounds and that the normalized and actual gas usage did not deviate by extreme amounts. No sites were eliminated during this validation process.

Hourly Electricity Normalization

The development of weather-normalized hourly electricity consumption was done using OpenEEMeter, an open-source Python package used to develop estimates of avoided energy consumption resulting from various types of interventions, with the estimation of weather-normalized energy consumption part of its core functionality.

The data requirements for OpenEEMeter are simply hourly kWh and temperature series for the pre and post periods and a series of hourly TMY temperatures to be used for normalization. Using these inputs, OpenEEMeter employs the time of week and temperature (TOWT) piecewise regression modeling approach developed by Lawrence Berkeley National Labs. This TOWT model segments the hourly electricity data for each household and period into bins based on occupancy, temperature, and time of week and selects the optimal temperature thresholds to estimate energy consumption. The output is an 8,760 hourly series of normalized electricity consumption for “baseline” and “reporting” periods, which are the OpenEEMeter nomenclature for pre and post.

For the gas normalization results, we were able to present summaries on the model performance and temperature thresholds chosen. Unfortunately, a disadvantage to OpenEEMeter is that the underlying complexity of the model makes it difficult to extract and summarize these details in a concise way. While OpenEEMeter is not technically a black box, since it is open source and all the underlying scripts are readily available, the underlying complexity of the Python objects and functions make it very burdensome, even requiring customization, to extract all these underlying results. In addition, the number of parameters estimated by the models are far too many to digest into an easily understood summary.

Despite the lack of details on model results, there is one important aspect of the OpenEEMeter approach that merits discussion because of its potential impact on the methods employed to estimate impacts. With a PRISM-based weather normalization approach, the normalized hourly consumption in the pre and post series will almost always be highly correlated. While the coefficients for temperature will be different in both periods, if the TMY temperature goes up or down, the normalized usage will generally follow. Unless a home for some reason were to lose temperature sensitivity, due to electrification of heating, for example, the normalized consumption for pre and post will be highly correlated.

In the OpenEEMeter results, this is not always the case. In fact, nearly 15% of the heat pump homes had a correlation between pre and post hourly consumption below 0.5, with a few sites negatively correlated across periods. While this is not a large share of the homes, the finding led to initial concerns about the ability to estimate the DiD models on the full set of 8,760 hourly data. Even when the average of the normalized consumption was lower for the post period, the variability in the hourly differences could lead to very large standard errors, which led us to explore these cases further.

An example of a house with highly correlated hourly consumption is shown in Figure 4-1, which pairs a scatter plot of the pre and post normalized consumption with a line plot that summarizes the estimated occupancy for the same home. In the graph showing occupancy, the lines represent the average percentage likelihood that the home is occupied and using heating or cooling energy in a given hour across the year. In the plot on the right side of Figure 4-1, the occupancy patterns in both periods are very similar, with only a small discrepancy in the morning hours. Given the similar occupancy, we get the expected high correlation in the estimated consumption.

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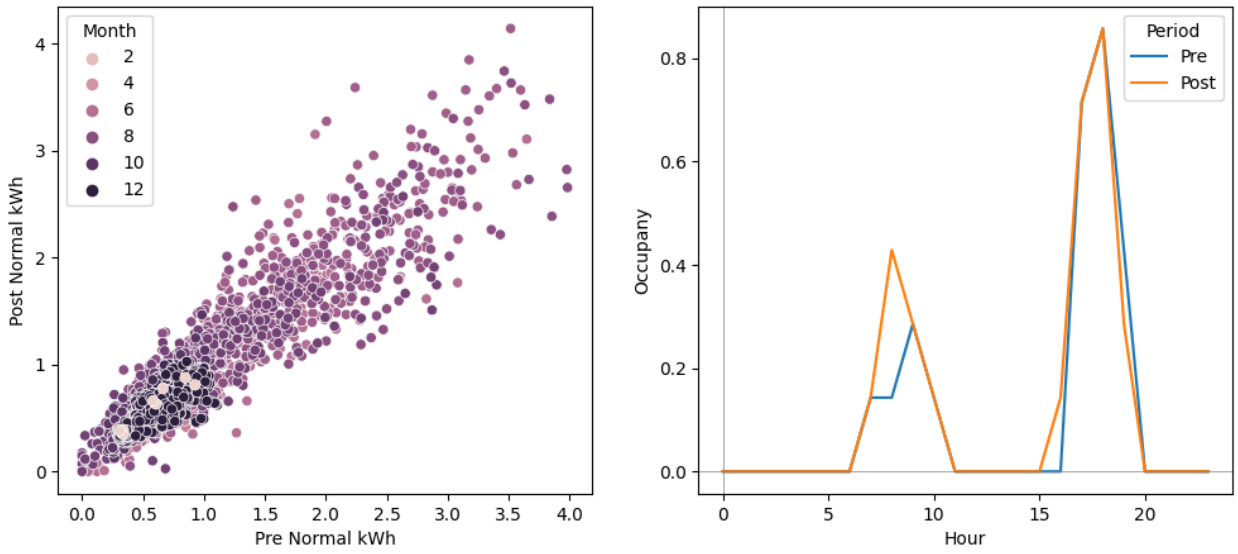
FIGURE 4-1: EXAMPLE OF HIGH CORRELATION PRE AND POST NORMALIZED HOURLY CONSUMPTION



In contrast, Figure 4-2 presents an example of a home where the pre and post occupancy patterns are very different. In the pre period, the TOWT model estimated that the house was occupied only in the morning hours, roughly from 7:00 am to noon, and not with a high level of occupancy throughout the year. In contrast, in the post period the home was occupied roughly 30% of the time in the early morning, with much higher occupancy in the afternoon and evening hours. The effect of this minimal overlap in occupancy is seen in the very low correlation between pre and post usage in the scatter plot. In the pre period when the model determined the house was occupied and estimated higher levels of consumption, in the post period the normalized consumption was very low in comparison. Even if the average hourly kWh is similar for both periods, at the row level in the hourly TMY the differences are going to be very large.

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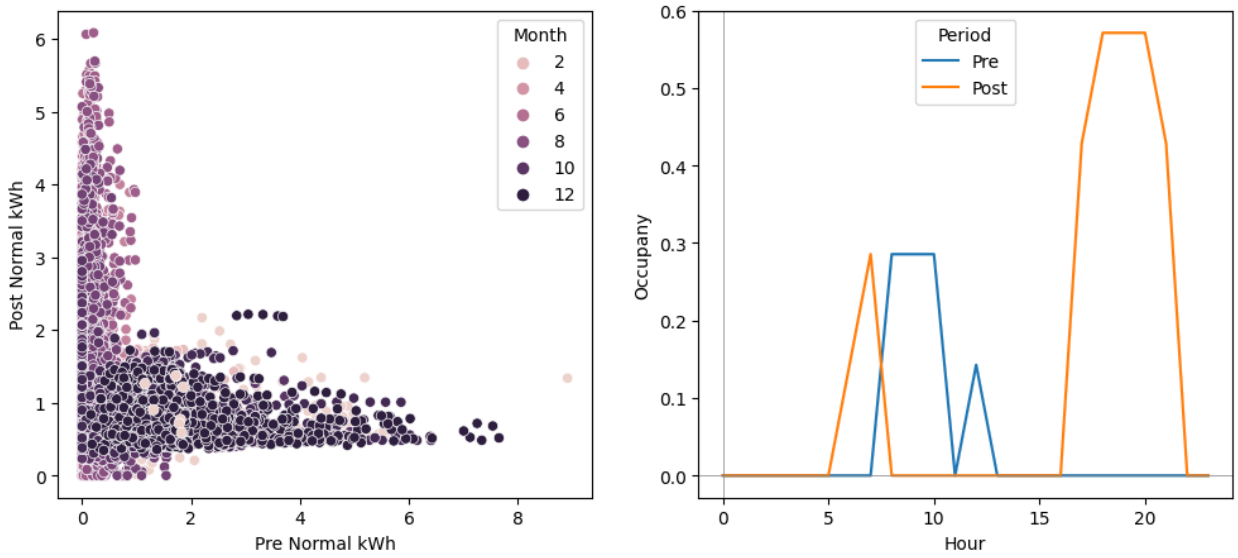
FIGURE 4-2: EXAMPLE OF LOW CORRELATION PRE AND POST NORMALIZED HOURLY CONSUMPTION



This finding—in addition to the UMP methodology calling for aggregation—led Verdant initially to estimate the models on data aggregated by site, quarter, and hour but as discussed later in the section below, the final models leveraged the 8,760 hourly data.

4.2.2 Energy Impacts Analysis Using Monthly Gas Billing Data

The estimation of gas impacts for the smart thermostat used the weather normalized monthly gas consumption data in a difference-in-differences (DiD) panel regression model.[11] In this model, which was estimated separately for each month, the difference in pre- and post-installation normalized usage was estimated as a function of being in the treatment group, with the resulting parameter estimate representing the DiD impacts of the thermostats.

4.2.3 Energy Impacts Analysis Using Hourly Electric Billing Data

The estimation of electric impacts was conducted in the same way as the gas, with three key differences. First, instead of monthly data, the model inputs used the 8,760 hourly normalized consumption directly from the OpenEEMeter model. Second, the model was estimated by quarter and hour, with the aim of

[11] Estimate Δ usage = $ß_0 + ß_{part*} * X_{part}$, where X_{part} is the dummy variable indicating the treatment group. It is worth noting that this specification will return identical results to a DiD specification where the normalized usage (rather than the delta) is modeled as a function of period, treatment, and period interacted with treatment.

getting the seasonal and time-of-day impacts associated with the thermostats. Finally, the impacts were estimated separately for the homes with heat pumps versus those with gas furnaces.

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5 FINDINGS

This section describes the results, including charts and tables used to highlight key findings.

5.1 GAS DIFFERENCE-IN-DIFFERENCE MODEL IMPACTS

Gas impacts were based on monthly DiD regression models. While these models will yield identical aggregate impacts compared to an annual model, the intent was to see if the model could identify the savings in the winter months when they are most likely to occur. Even though gas consumption is very low in the summer months and is unlikely to affect an annual model, we did not want those non-heating months to obscure the thermostat impacts.

While we estimated monthly regression models for gas impacts, the simple DiD calculations at an annual level provide a helpful conceptual illustration of the method. Figure 5-1 presents the results from a simple DiD calculation based on the annual average daily therms for the homes with gas furnaces. In the left side plot, which uses a narrow axis range that allows for a visual comparison of the series with the annotated values in the figure, one can see that the treatment group increased its average daily consumption by nearly 0.05 therms. However, the control group also increased its consumption by nearly 0.034 therms, so the resulting DiD calculation shows an increase of 0.0138 therms for treatment homes. These same data are presented on the right side, but with the y axis starting at zero to demonstrate that what might seem like a substantial difference is nearly imperceptible on a larger scale.

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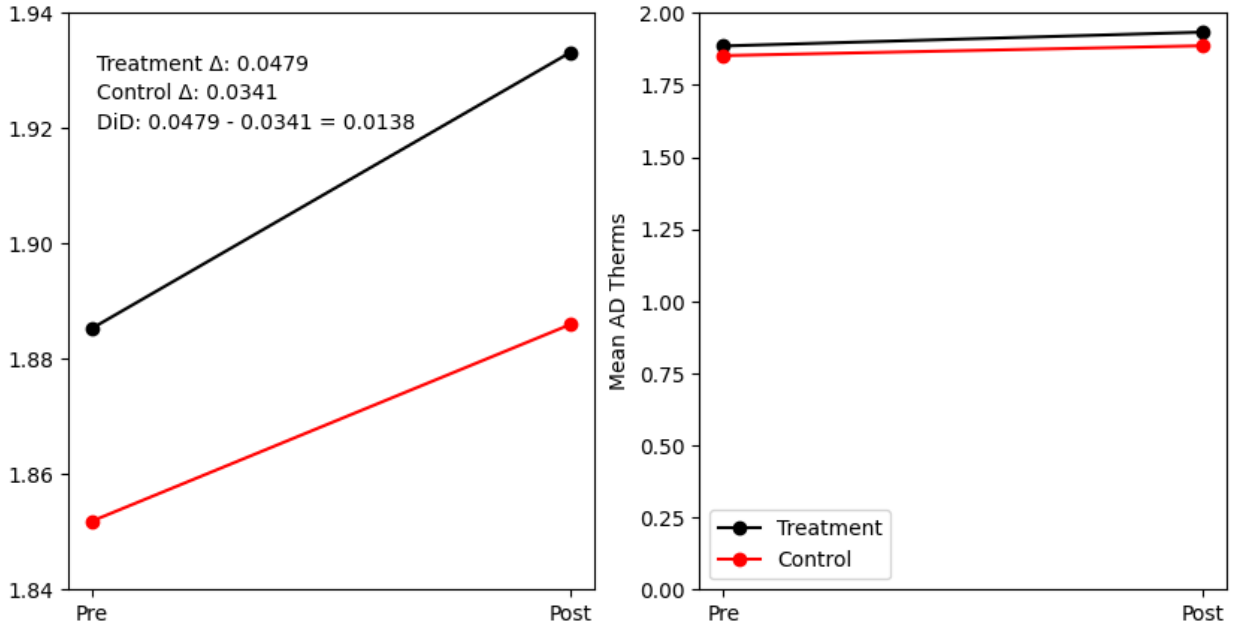
FIGURE 5-1: DID CALCULATION FOR TREATMENT AND CONTROL GROUPS



As described in the methods section above, Verdant used DiD regression models to assess the impact of the smart thermostat on consumption in gas heated households. These models estimate the impacts as a simple DiD calculation, but they also produce standard errors to allow us to ascertain whether the results are statistically significant. Table 5-1 presents the estimated DiD coefficients by month for the gas impacts in homes with gas furnaces. In all months but April, the model shows DiD estimates indicating an increase in gas consumption for the treatment cohort, but in all cases the parameter estimates are not statistically significant.

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TABLE 5-1: ESTIMATED SMART THERMOSTAT MONTHLY GAS IMPACTS

Month	Coefficient	P-Value
January	0.050	0.303308
February	0.016	0.695585
March	0.008	0.834053
April	-0.005	0.911709
May	0.002	0.965156
June	0.012	0.550015
July	0.008	0.600018
August	0.006	0.719324
September	0.006	0.786559
October	0.002	0.953088
November	0.015	0.693971
December	0.044	0.351505

The results from the annual and monthly analyses consistently find that the smart thermostats had no statistically significant impact on gas heating usage. To illustrate just how small these estimated impacts are, Figure 5-2 shows normalized gas consumption post-installation for the treatment homes and the estimated counterfactual usage. To create the estimated counterfactual usage, the estimated DiD coefficients are removed from the normalized usage to provide an estimate of consumption if the thermostats had not been installed. As illustrated below, the treatment and counterfactual load shapes are nearly indistinguishable, supporting the finding that the smart thermostats had no impact on the use of gas in gas heated homes.

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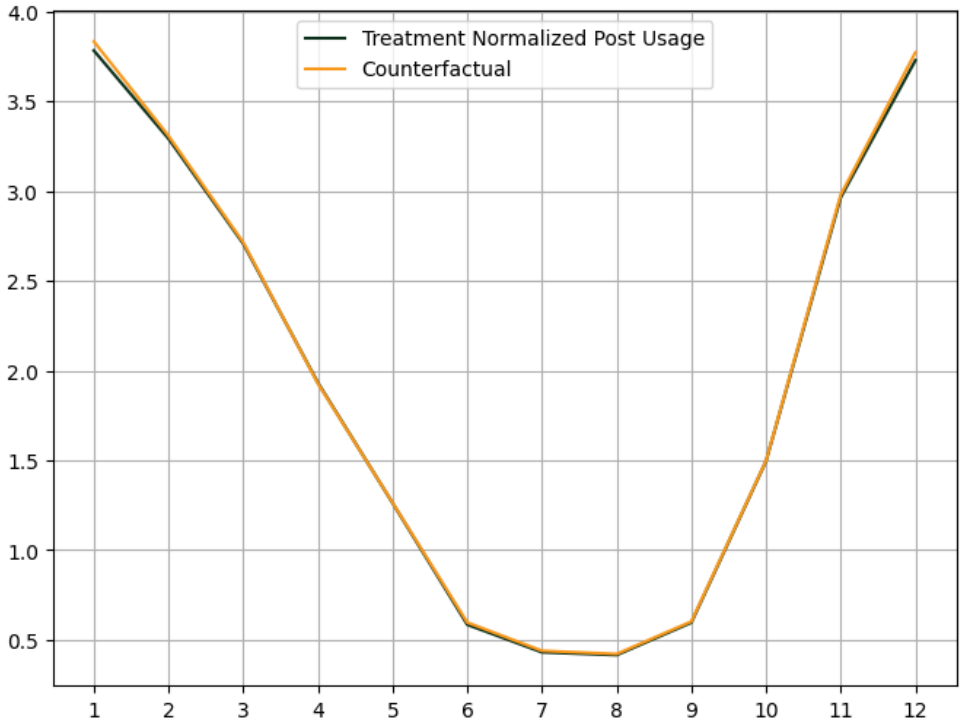
FIGURE 5-2: NORMALIZED MONTHLY POST AND COUNTERFACTUAL CONSUMPTION FOR GAS TREATMENT HOMES



5.2 ELECTRIC DIFFERENCE-IN-DIFFERENCES MODEL IMPACTS

The results of the modeling for the electric impacts for the homes with each heating system consist of a table of 96 coefficients representing the DiD impacts by quarter and hour. Table 5-2 presents the estimated coefficients for the hourly DiD heat pump models. These models were estimated using hourly pre/post normalized usage data for treatment and control homes on a quarterly basis. Estimating the models on a quarterly basis facilitated the estimation of heating and cooling impacts while allowing for shoulder months where the usage and impact of the smart thermostat may differ from those of the heating and cooling seasons. The hourly quarterly results presented below show that the smart thermostat was estimated to statistically significantly reduce usage across several hours in Q1, Q3, and Q4 (green colored cells). During Q1 and Q4 it is likely that the thermostats were leading to a reduction in heating usage while the reduction observed in Q3 likely represents a decline in air conditioning (AC) usage. During Q2, however, the thermostats were estimated to increase usage (yellow cells). It is possible that many customers previously turned off their thermostat during all or parts of the transitional weather months of Q2 and they were leaving their new smart thermostat on.

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TABLE 5-2: ESTIMATED SMART THERMOSTAT HOURLY ELECTRIC IMPACTS BY QUARTER FOR HOMES WITH HEAT PUMPS

Hour Beginning	First Quarter		Second Quarter		Third Quarter		Fourth Quarter	
	Coef.	P-Value	Coef.	P-Value	Coef.	P-Value	Coef.	P-Value
0	-0.166	0.00*	0.089	0.00*	-0.088	0.00*	-0.181	0.00*
1	-0.109	0.00*	0.072	0.00*	-0.084	0.00*	-0.163	0.00*
2	-0.124	0.00*	0.050	0.00*	-0.107	0.00*	-0.205	0.00*
3	-0.173	0.00*	0.012	0.30	-0.124	0.00*	-0.270	0.00*
4	-0.138	0.00*	0.003	0.81	-0.151	0.00*	-0.143	0.00*
5	0.094	0.00*	0.063	0.00*	-0.136	0.00*	0.055	0.03*
6	-0.071	0.01*	0.133	0.00*	-0.002	0.92	-0.134	0.00*
7	-0.014	0.65	0.264	0.00*	-0.072	0.00*	-0.521	0.00*
8	0.058	0.03*	0.198	0.00*	-0.133	0.00*	-0.318	0.00*
9	-0.150	0.00*	0.090	0.00*	-0.171	0.00*	-0.455	0.00*
10	-0.046	0.04*	0.061	0.01*	-0.234	0.00*	-0.336	0.00*
11	0.052	0.01*	0.104	0.00*	-0.144	0.00*	-0.221	0.00*
12	0.102	0.00*	0.184	0.00*	-0.024	0.20	-0.168	0.00*
13	0.021	0.25	0.195	0.00*	0.050	0.01*	-0.184	0.00*
14	0.003	0.87	0.125	0.00*	0.015	0.42	-0.201	0.00*
15	0.017	0.33	0.162	0.00*	0.035	0.07	-0.182	0.00*
16	0.033	0.08	0.169	0.00*	0.033	0.08	-0.148	0.00*
17	0.082	0.00*	0.108	0.00*	0.052	0.01*	-0.140	0.00*
18	0.093	0.00*	0.214	0.00*	0.080	0.00*	-0.099	0.00*
19	0.064	0.00*	0.190	0.00*	0.109	0.00*	-0.097	0.00*
20	0.033	0.08	0.130	0.00*	-0.039	0.03*	-0.105	0.00*
21	-0.103	0.00*	0.098	0.00*	-0.112	0.00*	-0.225	0.00*
22	-0.140	0.00*	0.116	0.00*	-0.094	0.00*	-0.172	0.00*
23	-0.112	0.00*	0.100	0.00*	-0.057	0.00*	-0.141	0.00*

*Indicates a statistically significant result at the 0.05 level. The green color indicates a statistically significant reduction in usage while the yellow color indicates a statistically significant increase.

Figure 5-3 displays the average quarterly load shapes for the treatment group, illustrating the treatment normalized post and counterfactual load shapes. The first and fourth quarters' treatment load shapes were visibly lower than the counterfactual load or the load the average home would have if they hadn't installed the smart thermostat. The illustrated decline in the Q1 and Q4 morning treatment load relative to the counterfactual is consistent with the negative morning hour estimated coefficients in Table 5-2. The Q4 illustration of the treatment and counterfactual loads shows a substantial difference in the loads from approximately 7 am to 4 pm, this reduction in the treatment load is also consistent with the larger, statistically significant parameter estimates during this period in Table 5-2. The third quarter treatment and counterfactual load shapes in Figure 5-3 show a reduction in the treatment load relative to the

counterfactual during the night and morning hours but no reduction in load during the afternoon to early evening summer peak hours. The Q2 loads illustrate that the treatment load is generally above or higher than the counterfactual, or that there is an increase in usage during this time. This is also consistent with the generally positive estimate coefficient for Q2 in Table 5-2. These results point to the smart thermostats leading to a reduction in electricity usage for heat pump homes during Q1, Q3, and Q4 and an increase in usage during Q2.

FIGURE 5-3: QUARTERLY PLOT OF SMART THERMOSTAT HOURLY ELECTRIC IMPACTS FOR HOMES WITH HEAT PUMPS

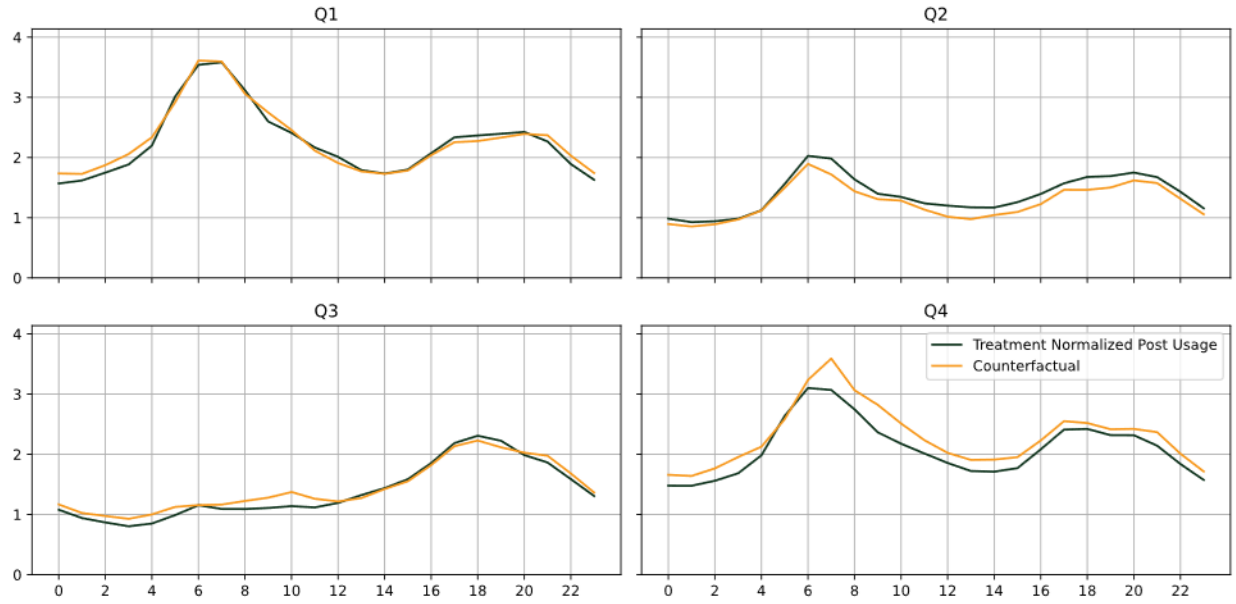

Table 5-3 and Figure 5-4 present the estimated DiD electric impact findings for gas heating homes. The ex ante electric savings for these sites (58.79 kWh) was substantially lower than the ex ante savings for heat pump heated homes (902.54). The DiD Q2 model coefficients were generally positive, small, and statistically significant, indicating that smart thermostats lead to a small increase in usage during the second quarter. During Q1, Q3, and Q4 there were various positive and negative estimated coefficients, but no clearly discernible pattern. The illustrations of the treatment normalized post and counterfactual load shapes in Figure 5-4**Error! Reference source not found.** also show little difference between these two loads, pointing to no consistent impact of the smart thermostat on the electric usage of gas heating homes. Given the small ex ante savings estimates for this sub-group of homes, it is not surprising that the analysis found no consistent impact.

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TABLE 5-3: ESTIMATED SMART THERMOSTAT HOURLY ELECTRIC IMPACTS BY QUARTER FOR HOMES WITH GAS FURNACES*

Hour Beginning	First Quarter		Second Quarter		Third Quarter		Fourth Quarter	
	Coef.	P-Value	Coef.	P-Value	Coef.	P-Value	Coef.	P-Value
0	-0.003	0.67	-0.013	0.04*	-0.046	0.00*	0.033	0.00*
1	0.019	0.00*	0.010	0.02*	-0.024	0.00*	0.045	0.00*
2	-0.019	0.00*	-0.001	0.80	-0.027	0.00*	0.010	0.03*
3	0.004	0.31	-0.005	0.32	-0.057	0.00*	0.020	0.00*
4	0.015	0.00*	0.018	0.00*	-0.026	0.00*	0.011	0.03*
5	0.004	0.51	0.030	0.00*	-0.019	0.00*	0.000	0.99
6	-0.039	0.00*	0.034	0.00*	0.000	0.93	-0.017	0.00*
7	-0.022	0.00*	0.001	0.84	-0.033	0.00*	-0.028	0.00*
8	0.019	0.00*	0.008	0.13	-0.025	0.00*	0.015	0.01*
9	0.046	0.00*	-0.023	0.00*	-0.007	0.23	0.038	0.00*
10	0.046	0.00*	0.007	0.31	0.005	0.42	0.015	0.02*
11	-0.001	0.83	0.021	0.00*	0.004	0.59	-0.030	0.00*
12	0.004	0.59	0.025	0.00*	0.005	0.51	-0.012	0.05
13	-0.012	0.05	0.030	0.00*	-0.003	0.73	-0.027	0.00*
14	0.030	0.00*	0.029	0.00*	-0.015	0.08	-0.017	0.01*
15	0.023	0.00*	0.033	0.00*	-0.050	0.00*	0.008	0.24
16	0.006	0.34	0.013	0.05	-0.032	0.00*	0.009	0.16
17	0.022	0.00*	0.045	0.00*	-0.009	0.35	0.008	0.22
18	-0.002	0.76	0.063	0.00*	0.025	0.01*	-0.030	0.00*
19	0.001	0.92	0.069	0.00*	0.043	0.00*	-0.021	0.00*
20	0.039	0.00*	0.076	0.00*	0.037	0.00*	0.012	0.07
21	0.077	0.00*	0.049	0.00*	0.032	0.00*	0.040	0.00*
22	0.045	0.00*	0.039	0.00*	0.046	0.00*	0.062	0.00*
23	0.022	0.00*	0.021	0.00*	0.018	0.00*	0.055	0.00*

*Indicates a statistically significant result at the 0.05 level. The green color indicates a statistically significant reduction in usage while the yellow color indicates a statistically significant increase.

Looking at the electric load shapes for gas heated homes (Figure 5-4), it is worth noting that the electric usage for these homes was substantially lower than for the heat pump homes (Figure 5-3). The lower electric usage for gas heating homes is consistent with expectations. If Energy Trust assumes, however, that all participant gas heated homes have central AC, we would expect the peak of these homes to be similar to the afternoon summer usage of heat pump homes. The average summer peak for gas heated homes, however, was approximately 0.5 kWh lower than the peak for heat pump homes. This lower summer peak may indicate that many of the gas heated homes do not have central AC, helping to explain the lack of electric impact for these homes.

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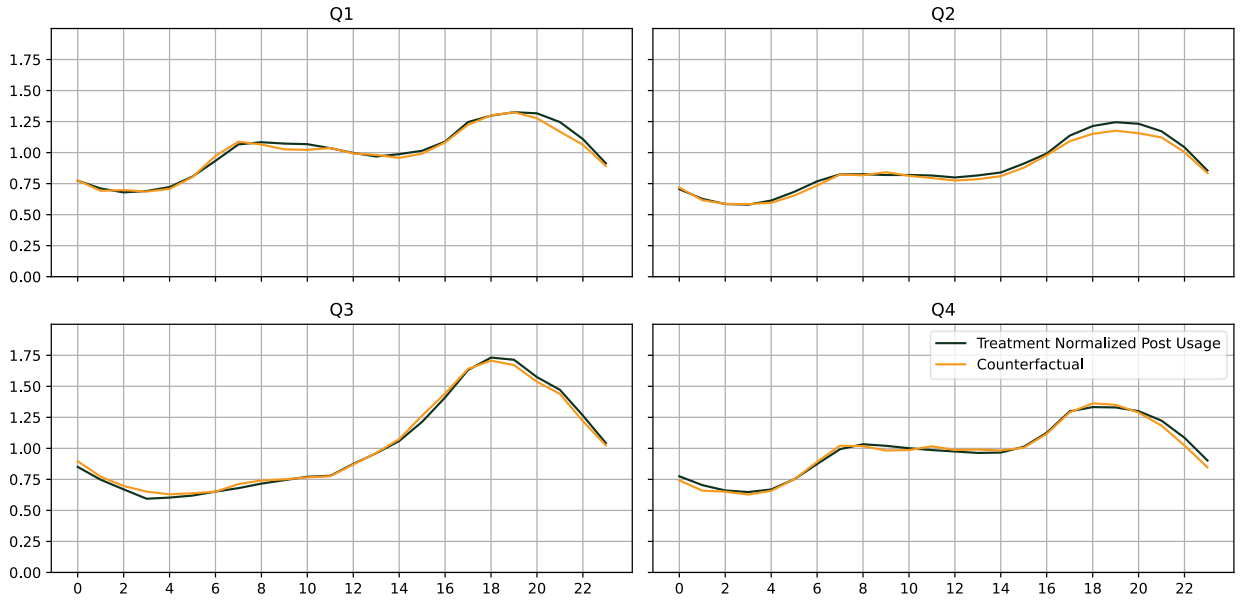
FIGURE 5-4: QUARTERLY PLOT OF SMART THERMOSTAT HOURLY ELECTRIC IMPACTS FOR HOMES WITH AC AND GAS FURNACES



The parameter estimates and load profiles are important and provide a useful view of the impacts by season and time of day. However, they do not easily convey the aggregate impacts of the thermostats. To this end, the parameter estimates in Table 5-2 and Table 5-3 can be used to develop quarterly and annual impacts from the installation of the smart thermostat. Table 5-4 and Table 5-5 present the average normalized pre and post electricity usage of treatment households along with two versions of the DiD impacts (using all coefficients and only statistically significant coefficients). The counterfactual usage subtracts the DiD impacts from the normalized post period usage to calculate the average usage of treatment sites if they hadn't installed the smart thermostat. The heat pump home results (see Table 5-4) show that the smart thermostat was estimated to reduce annual electricity usage by 377.1 kWh or approximately 42 percent of the ex ante savings of 902.54 kWh. These savings are largely derived from the fourth quarter where the thermostats were estimated to reduce the whole homes electricity usage by 8.6 percent.

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TABLE 5-4: ESTIMATED ANNUAL AND QUARTERLY IMPACTS FOR HOMES WITH HEAT PUMPS

Quarter	Normal Pre kWh	Normal Post kWh	DiD Impacts	Significant DiD Impacts	Counterfactual kWh All	Counterfactual kWh Significant	% change in kWh Counterfactual	% Sig change in kWh Counterfactual
1	5,040	4,875	-62.7	-71.1	4,938	4,946	-1.3%	-1.4%
2	3,185	3,031	266.8	265.4	2,764	2,765	9.7%	9.6%
3	3,236	3,045	-128.7	-134.0	3,173	3,179	-4.1%	-4.2%
4	4,814	4,642	-437.4	-437.4	5,079	5,079	-8.6%	-8.6%
Annual	**16,274**	**15,592**	**-362.0**	**-377.1**	**15,954**	**15,969**	**-2.3%**	**-2.4%**

The estimated quarterly and annual electric impacts for gas heated homes are presented in Table 5-5. Consistent with the hourly estimated coefficients presented above, the smart thermostat is estimated to cause a slight increase in electricity usage in these homes (83 kWh or one percent of whole home usage).

TABLE 5-5: ESTIMATED ANNUAL AND QUARTERLY ELECTRIC IMPACTS FOR HOMES WITH GAS FURNACES

Quarter	Normal Pre kWh	Normal Post kWh	DiD Impacts	Significant DiD Impacts	Counterfactual kWh All	Counterfactual kWh Sig	% Counterfactual	% Sig Counterfactual
1	2,210	2,174	29.1	29.1	2,145	2,145	1.4%	1.4%
2	1,964	1,904	52.9	50.8	1,851	1,854	2.9%	2.7%
3	2,365	2,242	-14.5	-12.7	2,257	2,255	-0.6%	-0.6%
4	2,233	2,174	18.0	15.8	2,156	2,158	0.8%	0.7%
Annual	**8,772**	**8,494**	**85.6**	**83.0**	**8,409**	**8,411**	**1.0%**	**1.0%**

Some of the results above are intuitive. For example, one would expect more savings in heat pump homes given the presence of both heating and cooling, which provides more opportunities for the thermostats to yield impacts. Similarly, it makes sense that the gas furnace homes only showed impacts in the third quarter, which in the Pacific Northwest is the most realistic time for any air conditioning savings to occur. In contrast, some of the results are not easily explained. The slight increase in annual electricity consumption for the gas heated homes is peculiar, but small enough to be attributed to the high variability we observed in the normalized consumption. Less understandable is the increase in consumption in the second quarter for the heat pump homes, which stands in contrast to the decrease in consumption observed the rest of the year. Overall, to properly interpret all the results would require a more comprehensive understanding of how the smart thermostats are expected to achieve savings, but with the relatively small study population, some of these anomalies are likely to defy obvious explanation.

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6 CONCLUSIONS AND RECOMMENDATIONS

Overall, the Honeywell T9 smart thermostats study found no significant gas savings. For electricity, the analysis resulted in 377.1 kWh annual savings (approximately a 42% realization rate) for homes with heat pumps and -83 annual kWh savings for homes with gas furnaces. Recommendations from this evaluation are provided separately for the impact and process components.

For the impact evaluation, the results varied based on the fuel and heating systems. The analysis of gas impacts found no evidence of statistically significant savings associated with the thermostat. Additionally, there was no evidence of electric savings in homes heated with gas furnaces. For homes with heat pumps, the analysis identified statistically significant savings, dominated by electric savings in the third quarter or summer season. The electric savings, while statistically significant, were imprecisely estimated due to small counts of participants and high variability in the estimated changes in consumption for both treatment and control groups. Collectively, the impact results lead to the following recommendations for programs:

- Programs should focus on homes with heat pumps.
- If gas heated homes are included in programs, targeting should focus on gas heated homes with central AC or high electrical usage during the summer months.
- Programs should attempt to enroll more participants, which would likely increase the precision of future evaluation efforts

If Energy Trust elects to continue incentivizing the Honeywell T9 smart thermostat, the claimed electric and gas savings should be adjusted to reflect the findings from this analysis.

The process evaluation reported that pilot participants (treatment and control group customers) found the pilot enrollment process easy. However, many control group participants were unaware they were assigned to the control group. For individuals in the treatment group, 93% planned to keep using the thermostat, approximately 75% used the geofencing features in the apps, and 54% installed SmartSensors to enable room-specific temperature zones. One-third of treatment customers who attempted to install the thermostat found the installation process difficult, and many of these customers reported seeking help from a third party. The process evaluation results lead to the following recommendations:

- In future experimental designs, work to improve participants' understanding of their role and keep them informed. This included frequent study updates, clearer explanations of the control group's purpose, reminders about participation, upfront information on system compatibility, and sharing the study's findings with participants.

- When asking customers to install equipment, clearer instructions and resources should be provided to guide users through the installation process.
- If information on smartphone apps and SmartSensors can be made available for all or a large share of treatment participants, this data should be incorporated into the impact evaluation.

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7 APPENDIX: SURVEY INSTRUMENT

7.1 RECRUITMENT EMAILS

Energy Trust of Oregon's Honeywell Smart Thermostat Study: Participant Survey

Email Outreach for the Thermostat Group

From: Cadeo Group
Subject: Earn $20 for 10-minute survey about your Honeywell Smart Thermostat
Message:

Hello ${e://Field/customerfirstname},

You enrolled in Energy Trust of Oregon's Honeywell Smart Thermostat Study last year. As part of this study, Cadeo – an energy-focused consulting firm – is conducting a brief survey on behalf of Energy Trust about your experience with the study and the new thermostat and to collect information about your home and occupancy. Your response will help Energy Trust determine whether the technology should be promoted to Oregon residents and understand how to improve customer experiences with programs like this.

This survey should take less than 10 minutes to complete, and Cadeo will send a $20 e-gift card (redeemable in most major online retailers) immediately after you complete it. Please note that we have a limited incentive fund available, therefore the survey will close as soon as we fully disburse these funds.

Click here to start the survey

If you have any questions about the legitimacy of this study, please contact Dan Rubado of Energy Trust at dan.rubado@energytrust.org. If you have any questions about taking this survey, please contact the study manager at Cadeo, Jun Suzuki (jsuzuki@cadeogroup.com | 503-483-2430).

Please be assured that we will adhere to all relevant data protection laws and regulations. Any information you provide will remain confidential and we will collect data anonymously. Your responses will be combined with those of other respondents and analyzed in aggregate. We will not disclose any personally identifiable information about you to third parties.

Best,
Cadeo Team

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Email outreach for the Control Group

From: Cadeo Group
Subject: Earn $20 for 5-minute survey about Energy Trust's thermostat study
Message:

Hello ${e://Field/customerfirstname},

You enrolled in Energy Trust of Oregon's Honeywell Smart Thermostat Study last year. You were selected for the Comparison Group and asked to leave your existing thermostat in place for one year. As part of this study, Cadeo – an energy-focused consulting firm – is conducting a brief survey on behalf of Energy Trust about your experience with the study so far as a member of the Comparison Group and to collect information about your home and occupancy. Your response will help Energy Trust determine whether the technology should be promoted to Oregon residents and understand how to improve customer experiences with programs like this.

This survey should take less than 5 minutes to complete, and Cadeo will send a $20 e-gift card (redeemable in most major online retailers) immediately after you complete it. Please note that we have a limited incentive fund available, therefore the survey will close as soon as we fully disburse these funds.

Click here to start the survey

If you have any questions about the legitimacy of this study, please contact Dan Rubado of Energy Trust at dan.rubado@energytrust.org. If you have any questions about taking this survey, please contact the study manager at Cadeo, Jun Suzuki (jsuzuki@cadeogroup.com | 503-483-2430).

Please be assured that we will adhere to all relevant data protection laws and regulations. Any information you provide will remain confidential and we will collect data anonymously. Your responses will be combined with those of other respondents and analyzed in aggregate. We will not disclose any personally identifiable information about you to third parties.

Best,
Cadeo Team

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7.2 SURVEY INSTRUMENT

Screening [ASK ALL]

S1. Are you the person in your household who is best able to answer questions about your household's experience with Energy Trust's Smart Thermostat Study [IF THERMOSTAT: or the Honeywell T9 Smart Thermostat] [IF COMPARISON: for which you were selected for the Comparison Group and asked to leave your existing thermostat in place for one year]?

[**SINGLE RESPONSE**]

1. Yes
2. No

[**ASK IF S1 =2**]

S2. Please provide the name and email address of the person best able to answer questions about your household's experience with the Energy Trust Honeywell Smart Thermostat Study?

1. Name: [**OPEN-ENDED RESPONSE**]
2. Email: [**OPEN-ENDED RESPONSE**]

-96. Prefer not to say

[IF S1=2, THANK AND TERMINATE (no incentive)]

Awareness and Enrollment [ASK ALL]

Q1. What motivated you to enroll in Energy Trust's smart thermostat study last year? Please select all that apply.

[**MULTIPLE RESPONSE, RANDOMIZE ITEMS 1-5**]

1. The opportunity to save energy and money
2. An interest in smart home technology
3. The free thermostat offer
4. To participate in energy conservation research
5. The cash incentives for participating
6. Another reason: please specify [**OPEN-ENDED RESPONSE**]

-96. I'm not sure [EXCLUSIVE]

[**ASK ALL**]

Q2. In the initial email from Energy Trust about the thermostat study, or on the website where you applied for the study, how clear was the information provided, including what was required of you?

[**SINGLE RESPONSE**]

1. Very unclear
2. Somewhat unclear
3. Neutral
4. Somewhat clear

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5. Very clear
-96. I'm not sure

[**ASK ALL**]
Q3. How would you rate the enrollment process, would you say it was…

[**SINGLE RESPONSE**]

1. Very difficult
2. Somewhat difficult
3. Neutral
4. Somewhat easy
5. Very easy
-96. I'm not sure

[**ASK IF GROUP=COMPARISON**]
Q4. Were you aware that you were assigned to the Comparison Group?

[**SINGLE RESPONSE**]

1. Yes
2. No
-96. I'm not sure

[**ASK IF GROUP=COMPARISON**]
Q5. How satisfied are you with the communication about your role as a member of the Comparison Group?

[**SINGLE RESPONSE**]

1. Very dissatisfied
2. Dissatisfied
3. Neutral
4. Satisfied
5. Very satisfied
-96. Don't know

Thermostat Installation and Set-Up [ASK ALL]

[**ASK IF GROUP=THERMOSTAT**]
Q6. Have you received and installed the Honeywell T9 smart thermostat?

[**SINGLE RESPONSE**]

1. Yes
2. Yes, I have received my Honeywell T9 smart thermostat, BUT I have not installed it
3. No, I have not received my Honeywell T9 smart thermostat [THANK AND TERMINATE (yes incentive)]

[**ASK IF Q6=1 (HAVE INSTALLED)**]

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Q7. Is the thermostat still installed?

[**SINGLE RESPONSE**]

1. Yes
2. No

[**ASK IF Q6=2 (RECEIVED BUT HAVE NOT INSTALLED)**]
Q8. Have you attempted installing it?

[**SINGLE RESPONSE**]

1. Yes, but I had difficulties and abandoned installation
2. Not tried yet

[**ASK IF Q7=2 (INSTALLED BUT REMOVED)**]
Q9. Please describe why you removed the thermostat.

1. [**OPEN-ENDED RESPONSE**]
2. Don't know

[**ASK IF Q8=1 (ATTEMPED INSTALLING BUT ABANDONED)**]
Q10. Please describe the difficulties you encountered in installing the thermostat.

1. [**OPEN-ENDED RESPONSE**]
2. Don't know

[**ASK IF Q8=2 (HAVE NOT ATTEMPTED INSTALLING)**]
Q11. What stopped you from installing the T9 smart thermostat?

1. [**OPEN-ENDED RESPONSE**]
2. Don't know

[**ASK IF Q6=1 OR Q8=1 (INTALLED OR ATTEMPTED INSTALLING)**]
Q12. How would you rate the installation process of the Honeywell T9 smart thermostat?

[**SINGLE RESPONSE**]

1. Very difficult
2. Difficult
3. Neutral
4. Easy
5. Very easy

-96. I'm not sure

[**ASK IF (Q12=1 OR 2) AND Q6=1 (INTALLED AND RATED SELF-INSTALL "DIFFICULT")**]
Q13. Please describe the challenges you encountered during the self-installation process.

1. [**OPEN-ENDED RESPONSE**]
2. Don't know

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[**ASK IF Q6=1 OR (Q6=2 AND Q8=1) (INTALLED OR ATTEMPED INSTALLING)**]

Q14. During installation, did you seek help from any of the following resources? Please select all that apply.

[**MULTIPLE RESPONSE**]

1. Energy Trust representative
2. A contractor
3. Honeywell customer service or technical assistance
4. Online resources (online discussion/forum, YouTube, etc.)
5. Anything else you used to seek help? [**OPEN-ENDED RESPONSE**]

-96. I'm not sure

[**ASK IF (GROUP=THERMOSTAT AND Q6=1) OR GROUP=COMPARISON**]

Q15. Is your thermostat in a central, well-ventilated area that represents the average temperature of the living space?

[**SINGLE RESPONSE**]

1. Yes
2. No
3. [DISPLAY IF GROUP=COMPARISON] There is no thermostat currently installed

-96. I'm not sure

[**ASK IF Q15=1 OR 2**]

Q16. Please describe the location of your [IF GROUP=THERMOSTAT: T9] thermostat placement in your house.

1. [**OPEN-ENDED RESPONSE**]
2. Don't know

Thermostat Usage and Features [ASK IF GROUP=THERMOSTAT]

[**ASK IF GROUP=THERMOSTAT AND Q7=1**]

Q17. You can access enhanced features of the Honeywell T9 smart thermostat when it's connected with your smartphone via the Resideo app. Is your T9 smart thermostat connected to your smartphone?

[**SINGLE RESPONSE**]

1. Yes, with my smartphone only
2. Yes, with my smartphone and other smartphones of other household members [How many total smartphones?: [**OPEN-ENDED RESPONSE**]
3. No
4. Other, please specify: [**OPEN-ENDED RESPONSE**]

-96. I'm not sure

[**ASK IF Q17=1 OR 2 (SMARTPHONE CONNECTED)**]

Q18. Please indicate if you use each of the following scheduling features **via your smartphone app**.

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Feature	Description	Using	Not using	Unaware of this feature
a. Location-based temperature control	Using your smartphone's location, T9 automatically adjust temperature when you leave and return home.	O	O	O
b. Smart scheduling	Adds a sleep period to location-based temperature control.	O	O	O
c. Time-based scheduling	Program a schedule based on times you wake, away, home, and sleep per day of week	O	O	O

[**ASK IF Q17=3 (SMARTPHONE NOT CONNECTED**]

Q19. Do you set time-based schedules (wake, away, home, sleep per day of week) on your T9 thermostat?

[**SINGLE RESPONSE**]

1. Yes
2. No
-96. Don't know

[**ASK IF GROUP=THERMOSTAT AND Q7=1**]

Q20. How often do you manually adjust your thermostat setting (without using automated scheduling features) either on the thermostat or through your smartphone app?

[**SINGLE RESPONSE**]

1. Never
2. Once in a few months
3. Monthly
4. Weekly
5. Daily
-96. Don't know

[**ASK IF Q18A=USING**]

Q21. How would you rate your experience with the location-based temperature control feature using your smartphone?

[**SINGLE RESPONSE**]

1. Very dissatisfied
2. Dissatisfied
3. Neutral
4. Satisfied

5. Very satisfied
-96. Don't know

[**ASK IF Q21=1 OR 2**]
Q22. Please describe why you were [PIPE Q21 RESPONSE] with the location-based temperature control.

1. [**OPEN-ENDED RESPONSE**]
2. Don't know

[**ASK IF GROUP=THERMOSTAT AND (Q7=1 OR Q7=2)**]
Q23. Your T9 smart thermostat came with an optional SmartSensor which can be installed in a different room to prioritize heating and cooling to specific rooms for comfort. Did you install the SmartSensor?

[**SINGLE RESPONSE**]

1. Yes
2. No
3. I didn't know about this option
-96. Don't know

[**ASK IF Q23=1**]
Q24. Did you purchase and install additional SmartSensors for your T9 smart thermostat?

[**SINGLE RESPONSE**]

1. Yes
2. No
-96. Don't know

[**ASK IF Q24=1**]
Q25. How many SmartSensors have you purchased and installed?

[**SINGLE RESPONSE**]

1. 1
2. 2
3. 3
4. 4
5. 5 or more
-96. Don't know

[**ASK IF Q23=1**]
Q26. In which room(s) are these SmartSensors installed? Please select all that apply.

[**MULTIPLE RESPONSE**]

1. Living room
2. Hallway
3. Bedroom

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4. Kitchen
5. Dining room
6. Home office
7. Basement
8. Other: please specify [**OPEN-ENDED RESPONSE**]
-96. I'm not sure [EXCLUSIVE]

[**ASK IF Q23=1**]
Q27. How would you rate the performance of the SmartSensor?

[**SINGLE RESPONSE**]

1. Very dissatisfied
2. Dissatisfied
3. Neutral
4. Satisfied
5. Very satisfied
-96. Don't know

[**ASK IF Q27=1 OR 2**]
Q28. Please describe why you were [PIPE Q27 RESPONSE] with the performance of the SmartSensor.

1. [**OPEN-ENDED RESPONSE**]
2. Don't know

[**ASK IF GROUP=THERMOSTAT AND (Q7=1 OR Q7=2)**]
Q29. Overall, how satisfied are you with the features and usability of the Honeywell T9 thermostat?

[**SINGLE RESPONSE**]

1. Very dissatisfied
2. Dissatisfied
3. Neutral
4. Satisfied
5. Very satisfied
-96. Don't know

Energy Savings and Comfort [ASK ALL]

[**ASK IF GROUP=THERMOSTAT AND Q7=1**]
Q30. Since installing the Honeywell T9 thermostat, have you noticed any changes in your home's comfort during the winter?

[**SINGLE RESPONSE**]

1. Significantly less comfortable
2. Less comfortable
3. No change
4. More comfortable

5. Significantly more comfortable
-96. It's too early to tell
-97. Don't know

[**ASK IF GROUP=THERMOSTAT AND Q7=1**]
Q31. How about during the summer?

[**SINGLE RESPONSE**]

1. Significantly less comfortable
2. Less comfortable
3. No change
4. More comfortable
5. Significantly more comfortable
-96. It's too early to tell
-97. Don't know

[**ASK IF GROUP=THERMOSTAT AND Q7=1**]
Q32. Since installing the Honeywell T9 thermostat, have you noticed any change in your home's energy bill during heating seasons?

[**SINGLE RESPONSE**]

1. Significantly higher bill
2. Higher bill
3. No change
4. Lower bill
5. Significantly lower bill
-96. It's too early to tell
-97. Don't know

[**ASK IF GROUP=THERMOSTAT AND Q7=1**]
Q33. How about during cooling seasons?

[**SINGLE RESPONSE**]

1. Significantly higher bill
2. Higher bill
3. No change
4. Lower bill
5. Significantly lower bill
-96. It's too early to tell
-97. Don't know

Home and Heating System Characteristics [ASK ALL]

[**ASK IF GROUP=THERMOSTAT AND Q7=1**]

Q34. Which type of thermostat best describes the thermostat you had prior to the Honeywell T9 thermostat?

[**SINGLE RESPONSE**]

1. **Manual-only** thermostat with no scheduling or programming capability
2. **Programmable** thermostat that allows automatic temperature adjustments based on programmed times of day
3. **Wi-Fi** thermostat has capabilities of programmable thermostat in addition to wireless connection which enables homeowners to access it remotely for convenience while in the home or away
4. **Smart** thermostat can do everything programmable or Wi-Fi thermostat models can, in addition to "smart" or learning technology which allows the control to set temperatures based on you your preferences, home occupancy, and other factors
5. Other, please specify: [**OPEN-ENDED RESPONSE]**

-96. There was no thermostat before T9 thermostat

-97. Don't know

[**ASK IF GROUP=COMPARISON**]

Q35. Since enrolling in this study, have you replaced your thermostat?

[**SINGLE RESPONSE**]

1. Yes
2. No

-96. Currently, there is no thermostat in my home

-97. Don't know

[**ASK IF Q35=1**]

Q36. Which type of thermostat best describes the thermostat you had before replacing?

[**SINGLE RESPONSE**]

1. **Manual-only** thermostat with no scheduling or programming capability
2. **Programmable** thermostat that allows automatic temperature adjustments based on programmed times of day
3. **Wi-Fi** thermostat has capabilities of programmable thermostat in addition to wireless connection which enables homeowners to access it remotely for convenience while in the home or away
4. **Smart** thermostat can do everything programmable or Wi-Fi thermostat models can, in addition to "smart" or learning technology which allows the control to set temperatures based on you your preferences, home occupancy, and other factors
5. Other, please specify: [**OPEN-ENDED RESPONSE]**

-96. There was no thermostat before updating

-97. Don't know

[**ASK IF (GROUP=COMPARISON AND Q35~=-96 (COMPARISON GROUP WITH THERMOSTAT)) OR (GROUP=THERMOSTAT AND (Q6=2 OR Q7=2) (REMOVED OR HAVEN'T INSTALLED))**]

Q37. Which type of thermostat best describes the thermostat you currently have in your home?

[SINGLE RESPONSE]

1. **Manual-only** thermostat with no scheduling or programming capability
2. **Programmable** thermostat that allows automatic temperature adjustments based on programmed times of day
3. **Wi-Fi** thermostat has capabilities of programmable thermostat in addition to wireless connection which enables homeowners to access it remotely for convenience while in the home or away
4. **Smart** thermostat can do everything programmable or Wi-Fi thermostat models can, in addition to "smart" or learning technology which allows the control to set temperatures based on you your preferences, home occupancy, and other factors
5. Other, please specify: [OPEN-ENDED RESPONSE]

-96. Currently, there is no thermostat in my home

-97. Don't know

[ASK ALL]

Q38. According to the program database, your house uses [PIPE IN: HEATING_PRIMARY] as the primary source of heat. Do you use any supplemental heating sources – such as a space heater, electric or gas fireplace, ductless mini-split heat pump, or something similar – to heat any part of your house? This would be in addition to – or instead of – the primary [PIPE IN: HEATING_PRIMARY].

[SINGLE RESPONSE]

1. Yes
2. No

-96. Don't know

[ASK IF=1]

Q39. Which supplemental heating equipment type(s) do you use? Please select all that apply.

[MULTIPLE RESPONSE]

1. Portable, plug-in heater (radiant, infrared, ceramic heater, etc.)
2. Electric baseboard
3. Electric wall heater
4. Fireplace (gas)
5. Fireplace (electric)
6. Fireplace (propane, wood)
7. Wood or pellet stove
8. Ductless mini-split heat pump
9. Other: please specify [OPEN-ENDED RESPONSE]

-96. I don't know [EXCLUSIVE]

Future Plans and Feedback

[ASK IF GROUP=THERMOSTAT AND Q7=1]

Q40. Do you plan to continue using the Honeywell T9 thermostat after the pilot ends?

[SINGLE RESPONSE]

1. Yes
2. No
-96. It's too early to tell
-97. Don't know

[**ASK IF Q40=2**]
Q41. Why don't you plan to continue using the Honeywell T9 thermostat after the pilot?

1. [**OPEN-ENDED RESPONSE**]
2. Don't know

[**ASK ALL**]
Q42. Overall, how satisfied are you with Energy Trust's Honeywell Smart Thermostat Pilot Study so far?

[**SINGLE RESPONSE**]

1. Very dissatisfied
2. Dissatisfied
3. Neutral
4. Satisfied
5. Very satisfied
-96. Don't know

[**ASK ALL**]
Q43. Do you have any suggestions about improving future studies like this?

1. [**OPEN-ENDED RESPONSE**]
2. Don't know

Demographics/Firmographics

We have a few questions that help us understand the characteristics of pilot study participants.

[**ASK ALL**]
Q44. What year were you born?

[**SINGLE RESPONSE**]

1. [**NUMERIC RESPONSE**]
-96. I prefer not to say

[**ASK ALL**]
Q45. Has the number of people living in your house changed since you enrolled in this study?

[**SINGLE RESPONSE**]

1. Yes. Please specify the change [**NUMERIC RESPONSE**]
2. No
-96. I prefer not to say

[**ASK ALL**]
Q46. Please select your annual household income from all sources in 2023 before taxes.

[**SINGLE RESPONSE**]

1. Under $20,000
2. $20,000 to under $30,000
3. $30,000 to under $40,000
4. $40,000 to under $50,000
5. $50,000 to under $60,000
6. $60,000 to under $75,000
7. $75,000 to under $100,000
8. $100,000 to under $150,000
9. $150,000 to under $200,000
10. $200,000 to under $250,000
11. $250,000 to under $300,000
12. $300,000 or more

-96. I prefer not to say

[**ASK ALL**]
Q47. Do you or members of your household own your home or do you rent it?

[**SINGLE RESPONSE**]

1. Own/buying
2. Rent/lease
3. Some other arrangement

-96. Don't know
-97. I prefer not to say

[**ASK ALL**]
Q48. How many square feet of living space are there in your residence (exclude garages, unfinished basements and unheated porches)?

[**SINGLE RESPONSE**]

1. Less than 500 SQFT
2. 500 to under 1,000 SQFT
3. 1,000 to under 1,500 SQFT
4. 1,500 to under 2,000 SQFT
5. 2,000 to under 2,500 SQFT
6. 2,500 to under 3,000 SQFT
7. Greater than 3,000 SQFT

-96. Don't know
-97. I prefer not to say

[**ASK ALL**]

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Q49. What is the highest level of education completed by anyone in your household?

[**SINGLE RESPONSE**]

1. High school, no diploma
2. High school graduate or equivalent (e.g. GED)
3. Trade or technical school
4. Some college (including Associate degree)
5. College degree (Bachelor's degree)
6. Some graduate school
7. Graduate degree, professional degree

-96. Don't know
-97. I prefer not to say

[**ASK ALL**]

Q50. About when was your home first built?

[**SINGLE RESPONSE**]

1. 2010 or later
2. 2000 to 2009
3. 1990 to 1999
4. 1980 to 1989
5. 1970 to 1979
6. 1960 to 1969
7. 1950 to 1959
8. 1940 to 1949
9. 1939 or earlier

-96. Don't know
-97. I prefer not to say

[**ASK ALL**]

Q51. Which categories describe your race, ethnicity, or origin? SELECT ALL THAT APPLY.

[**MULTIPLE RESPONSE**]

1. Black or African American
2. Chinese
3. Filipino
4. Hispanic, Latino or Spanish
5. Japanese
6. Korean
7. Middle Eastern or North African
8. Native American or Alaska Native
9. Native Hawaiian or Pacific Islander
10. South Asian or Indian
11. Vietnamese
12. Asian Origin not listed here
13. White, Caucasian, or European

14. None of these describe me. Please specify: [**OPEN-ENDED RESPONSE**]
-96. I prefer not to say

Conclusion

Thank you, these are all the questions we have today. Please confirm the information below so that Cadeo can send the $20 e-gift card to the correct email address (only one submission allowed per respondent). If you would prefer to donate your $20 incentive to the American Red Cross or would like to decline the incentive altogether, please indicate this below. Please make sure you click on the "Submit" button to complete this survey. Thank you again!

1. Your name: PIPE-IN (respondent can overwrite if a change is required)
2. Your email: PIPE-IN (respondent can overwrite if a change is required)

3. I would like to donate my $20 incentive to the American Red Cross [Single Response]
4. Decline $20 incentive [Single Response]

7.3 DEMOGRAPHICS AND HOUSING CHARACTERISTICS

This section provides the demographic and housing profiles of treatment and control group respondents.

TABLE 7-1: RESPONDENT AGE

	Treatment CHP (n=38)	Treatment GF (n=99)	Control CHP (n=46)	Control GF (n=108)	Total (n=291)
30s	3%	1%	9%	5%	**4%**
40s	16%	24%	15%	14%	**18%**
50s	13%	18%	9%	16%	**15%**
60s	21%	24%	24%	26%	**24%**
70s	37%	26%	35%	36%	**33%**
80s	11%	5%	9%	3%	**5%**
90s	0%	1%	0%	1%	**1%**
Total	**100%**	**100%**	**100%**	**100%**	**100%**

Note: We asked the year born.

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TABLE 7-2: CHANGE IN NUMBER OF HOUSEHOLD MEMBERS SINCE PILOT ENROLLMENT

	Treatment CHP (n=38)	Treatment GF (n=101)	Control CHP (n=46)	Control GF (n=108)	Total (n=293)
More people live here now	5%	6%	0%	7%	**5%**
No change in occupancy	87%	89%	96%	91%	**90%**
Fewer people live here now	8%	5%	4%	2%	**4%**
Total	**100%**	**100%**	**100%**	**100%**	**100%**

TABLE 7-3: HOUSEHOLD INCOME

	Treatment CHP (n=35)	Treatment GF (n=97)	Control CHP (n=45)	Control GF (n=104)	Total (n=281)
Under $20,000	0%	3%	7%	5%	**4%**
$20,000 to under $30,000	17%	4%	7%	7%	**7%**
$30,000 to under $40,000	6%	7%	11%	3%	**6%**
$40,000 to under $50,000	3%	5%	7%	6%	**5%**
$50,000 to under $60,000	3%	7%	9%	13%	**9%**
$60,000 to under $75,000	9%	11%	11%	13%	**11%**
$75,000 to under $100,000	11%	25%	13%	19%	**19%**
$100,000 to under $150,000	31%	23%	16%	15%	**20%**
$150,000 to under $200,000	17%	9%	13%	10%	**11%**
$200,000 to under $250,000	3%	5%	0%	6%	**4%**
$250,000 to under $300,000	0%	0%	4%	2%	**1%**
$300,000 or more	0%	0%	2%	2%	**1%**
Total	**100%**	**100%**	**100%**	**100%**	**100%**

TABLE 7-4: HOMEOWNERSHIP

	Treatment CHP (n=38)	Treatment GF (n=100)	Control CHP (n=46)	Control GF (n=108)	Total (n=292)
Own/buying	97%	99%	100%	99%	**99%**
Rent/lease	3%	1%	0%	1%	**1%**
Total	**100%**	**100%**	**100%**	**100%**	**100%**

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TABLE 7-5: EDUCATION

	Treatment CHP (n=38)	Treatment GF (n=101)	Control CHP (n=46)	Control GF (n=108)	Total (n=293)
High school, no diploma	**0%**	**1%**	**2%**	**0%**	**1%**
High school graduate or equivalent (e.g. GED)	**0%**	**4%**	**9%**	**6%**	**5%**
Trade or technical school	**5%**	**3%**	**2%**	**2%**	**3%**
Some college (including Associate degree)	**24%**	**13%**	**15%**	**17%**	**16%**
College degree (Bachelor's degree)	26%	33%	33%	31%	**31%**
Some graduate school	8%	4%	7%	6%	**5%**
Graduate degree, professional degree	37%	41%	33%	38%	**38%**
I'm not sure	0%	2%	0%	1%	**1%**
Total	**100%**	**100%**	**100%**	**100%**	**100%**

TABLE 7-6: RACE AND ETHNICITY (MULTIPLE RESPONSES ALLOWED)

	Treatment CHP (n=38)	Treatment GF (n=101)	Control CHP (n=46)	Control GF (n=108)	Total (n=293)
White, Caucasian, or European	95%	88%	96%	93%	**92%**
Hispanic, Latino or Spanish	3%	4%	0%	4%	**3%**
Native American or Alaska Native	0%	2%	2%	2%	**2%**
Chinese	0%	1%	0%	2%	**1%**
Black or African American	0%	2%	0%	0%	**1%**
Japanese	0%	1%	0%	1%	**1%**
Korean	0%	2%	0%	0%	**1%**
Middle Eastern or North African	3%	0%	0%	1%	**1%**
Filipino	0%	0%	0%	1%	**0%**
South Asian or Indian	0%	1%	0%	0%	**0%**
Asian Origin not listed here	0%	0%	0%	1%	**0%**
Native Hawaiian or Pacific Islander	0%	0%	0%	0%	**0%**
Vietnamese	0%	0%	0%	0%	**0%**
None of these describe me	0%	2%	4%	2%	**2%**

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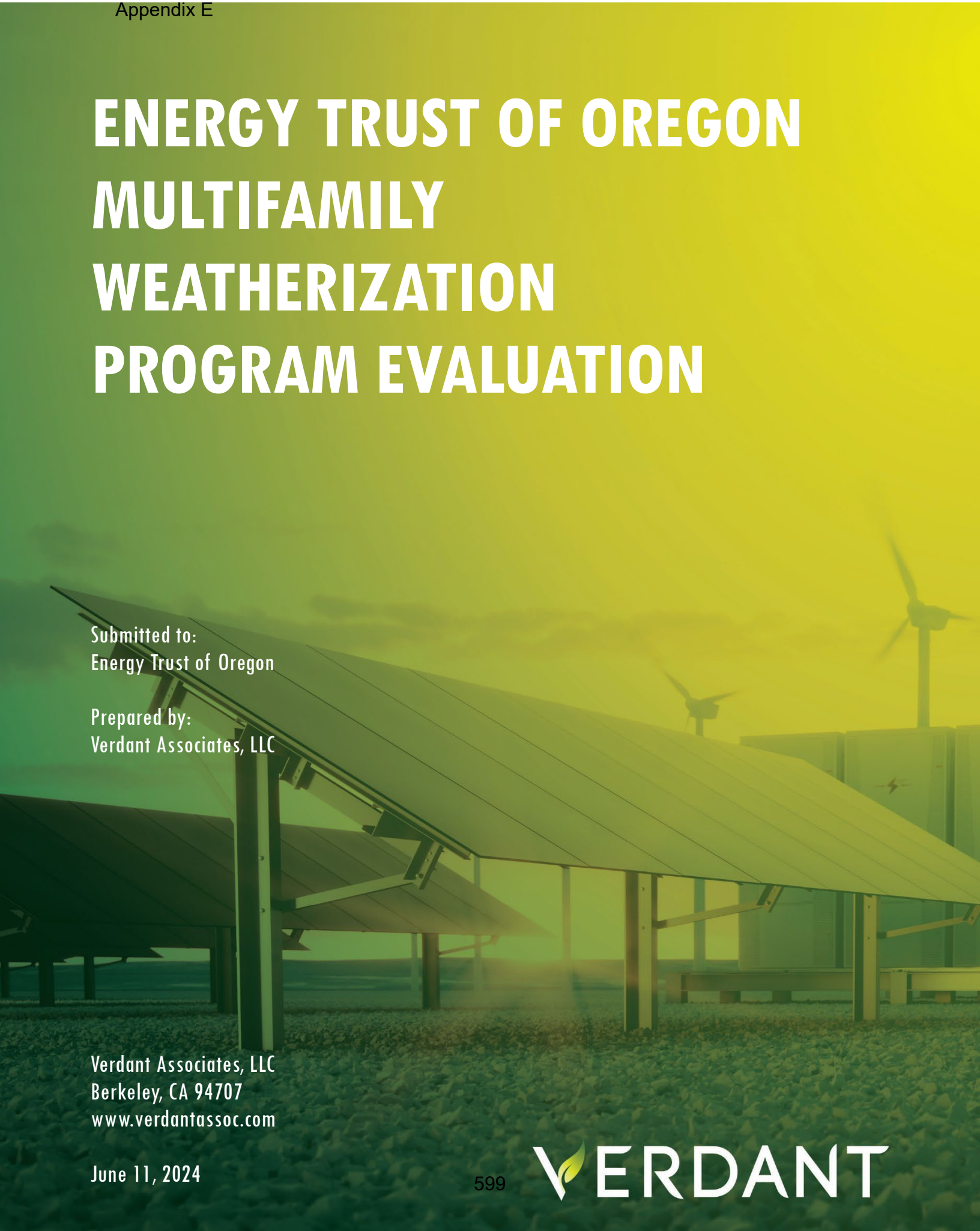
TABLE 7-7: HOME SIZE

	Treatment CHP (n=38)	Treatment GF (n=101)	Control CHP (n=46)	Control GF (n=108)	Total (n=293)
Less than 500 SQFT	0%	0%	0%	0%	**0%**
500 to under 1,000 SQFT	0%	10%	2%	11%	**8%**
1,000 to under 1,500 SQFT	16%	22%	20%	24%	**22%**
1,500 to under 2,000 SQFT	29%	35%	50%	33%	**36%**
2,000 to under 2,500 SQFT	21%	20%	17%	15%	**18%**
2,500 to under 3,000 SQFT	24%	9%	2%	10%	**10%**
Greater than 3,000 SQFT	11%	4%	9%	6%	**6%**
I'm not sure	0%	1%	0%	0%	**0%**
Total	**100%**	**100%**	**100%**	**100%**	**100%**

TABLE 7-8: HOME YEAR BUILT

	Treatment CHP (n=38)	Treatment GF (n=101)	Control CHP (n=46)	Control GF (n=108)	Total (n=293)
2010 or later	8%	8%	17%	6%	**9%**
2000 to 2009	24%	11%	7%	14%	**13%**
1990 to 1999	24%	10%	20%	6%	**12%**
1980 to 1989	3%	6%	13%	5%	**6%**
1970 to 1979	18%	11%	22%	9%	**13%**
1960 to 1969	8%	7%	7%	5%	**6%**
1950 to 1959	3%	13%	7%	9%	**9%**
1940 to 1949	3%	11%	2%	15%	**10%**
1939 or earlier	8%	23%	4%	29%	**20%**
I'm not sure	3%	1%	2%	2%	**2%**
Total	**100%**	**100%**	**100%**	**100%**	**100%**

ENERGY TRUST OF OREGON MULTIFAMILY WEATHERIZATION PROGRAM EVALUATION



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1 EXECUTIVE SUMMARY

Energy Trust of Oregon provides cash incentives for multifamily properties to make energy-related improvements to the building shell. Incentivized improvements include window retrofits and upgrades, and insulation retrofits. This evaluation assesses the energy savings from installations completed in program years 2016 to 2021. Table 1-1 presents the savings claimed by the program between 2016 and 2021.

TABLE 1-1: MULTIFAMILY WEATHERIZATION CLAIMED SAVINGS & PROJECTS BY MEASURE AND HEATING TYPE

Project Measure	Building Size	Claimed kWh	Claimed Therms	Claimed SQFT	Number of Projects
Electric Heat					
Window Upgrades	**Small**	967,734	0	237,580	922
Window Retrofit	**Large**	5,096,756	0	741,817	488
Insulation	**All**	974,347	0	1,513,104	476
Gas Heat					
Window Upgrades	**Small**	3,879	39,697	132,086	579
Insulation	**All**	26,131	17,427	356,498	217

The primary objective of this evaluation is to assess the program's electric and natural gas savings from incentivized measure installations by various domains of interest. Savings are categorized by measure type (window retrofits, window upgrades, and insulation), heating type (electric and gas), and building size (small and large).[1] Claimed savings can vary between small and large buildings due to differences in assumed baselines or building thermodynamics and their modeled energy usage.

Table 1-2 presents the estimated average energy savings per square foot of installed measures and the realization rates. The observed realization rates compare the modeled savings to the ex ante values. The ex ante values for window upgrades, however, represent market baselines while the estimated savings are relative to existing conditions. For windows upgrade measures installed at small sites, we calculated adjusted realization rates that reflect the estimated savings relative to an adjusted ex ante existing conditions baseline. The savings and realization rates are developed using data from program years 2016 to 2021.

The evaluation found that the realization rate for window retrofits and insulation in electric heated multifamily buildings is 65 and 67 percent, respectively, of ex ante values while the realization rate for insulation in gas heated buildings is 90 percent of the ex ante values. For window retrofit and insulation

[1] Small multifamily is two to four dwelling units or a side-by-side configuration and large multifamily is five or more dwelling units in a stacked configuration.

measures, the estimated realization rates are less than 100 percent, but the confidence intervals include a 100 percent realization rate, implying that the ex ante savings for these measures are not inconsistent with the study's measured values. Window upgrades are estimated to provide higher savings per square foot of window area than window retrofits but the estimated adjusted realization rate for window upgrades is only 34 percent for electric heated buildings and 10 percent for gas. For window upgrades, the adjusted realization rate and estimated confidence interval, is less than 100 percent, implying that the study's estimates of saving are statistically lower than the ex ante values.

TABLE 1-2: ESTIMATED SAVINGS SEGMENTED BY MEASURE, HEATING TYPE, AND SIZE

Energy	Measure	Building Size	Model n***	Estimated Energy Savings per SQFT Installed**	Realization Rate Observed	Realization Rate Adjusted
Electric Heat						
kWh	Window Upgrade	Small	320	5.61 ± 2.08	133% ± 49%	34% ± 12%
kWh	Window Retrofit	Large	100	4.87 ± 3.14	65% ± 42%	
kWh	Insulation	Small	140	0.45 ± 0.42	67% ± 63%	
kWh	Insulation	Large	0	Not evaluated	Not evaluated	
Gas Heat						
therm	Window Upgrade	Small	229	0.12 ± 0.09	40% ± 30%	10% ± 8%
therm	Insulation	Small	35	0.04 ± 0.02	90% ± 47%	
therm	Insulation	Large	0	Not evaluated	Not evaluated	

**For this and other columns with the "±" following the value, the second value indicates the 90 percent confidence interval.

***The "Model n" is the total number of install periods for each Analysis ID that went into the model. See section 3.2.2 for a description of Analysis ID.

The results presented in Table 1-2 were estimated using data for structures with nine or fewer units participating in the program. These results may not be representative when applied to the participant population due to the small share of Analysis IDs whose data were included in the model.[2] Due to data attrition issues, the study was not able to assess the savings for measures installed in campuses or structures with 10 or more units. These installations represent the minority of structures with installed measures but account for the majority of the program's savings. To remedy this in future program years we recommend the program implementer collect the following data in the program tracking database:

- A record for each individually treated unit, including address, apartment number, the square footage of insulation or windows installed in the unit, the premise id and meter number (linking directly to the billing data), an indicator to note if the unit is master-metered, the floor(s) the unit is on, and an identifier to associate other units that are in the same building.

[2] For electric heat measures the model includes approximately 30 percent of the original Analysis IDs with a higher share for small windows and insulation than larger window retrofits. The gas models include approximately 35 percent of the original Analysis IDs.

- For insulation measures that may affect multiple units, collect information on each unit the insulation affects and an identifier to associate units that are in the same building.
- For complexes and structures that are rentals, collect an average vacancy rate from the building owner as part of the application process.

MEMO

Date: 7/22/2024
To: Energy Trust Board of Directors
From: Dan Rubado, Sr. Project Manager – Evaluation
Sarah Castor, Evaluation and Engineering Manager
Patrick Urain, Sr. Program Manager – Commercial
Subject: Staff Response to the 2016-2021 Multifamily Weatherization Evaluation

Verdant Associates conducted a billing analysis of Energy Trust funded weatherization measures installed in multifamily buildings from 2016 to 2021, including insulation and efficient windows. This analysis was beset by data quality issues, particularly with larger buildings, so the results represent only a small portion of the program's total claimed energy savings for these measures. Because of these problems, the results have relatively low precision and can only be applied to multifamily buildings with fewer than 10 units. In addition, there may be comparability issues when trying to generalize the results to the broader program population, even among smaller buildings. Results from this study will be considered as one of many inputs into Energy Trust's measure development process to update deemed savings values for multifamily windows and insulation measures.

Verdant found window retrofits in buildings with five to nine units had electric savings of 4.87 kWh per square foot installed and a realization rate of 65%. However, due to low precision, this was not statistically different from the savings claimed by the program. Window upgrades measures in small buildings with two to four units had very low realization rates, at 34% for electricity and 10% for gas, both significantly lower than the savings claimed by the program. Alternatively, when the window upgrade measures were analyzed as retrofits, then savings were much higher—5.61 kWh and 0.12 therms per square foot installed for electric- and gas-heated buildings, respectively. This information may be helpful in assessing the cost-effectiveness of efficient window retrofits in small multifamily buildings, for which Energy Trust does not currently provide incentives.

Verdant found insulation measures in buildings with two to four units had electric savings of 0.45 kWh and gas savings of 0.04 therms per square foot installed, with realization rates of 67% and 90%, respectively. Due to low precision, the evaluated savings for these measures were not statistically different from the savings claimed by the program. However, given the low electric realization rate, it is likely the true average electricity savings per square foot of insulation in small multifamily are lower than claimed.

Verdant identified several significant data quality issues that complicated its analysis and limited the applicability of the results. They also provided a number of recommendations for improving Energy Trust's data entry processes and data systems to enable better analysis of multifamily buildings in the future. To address these data issues, Energy Trust will take the actions listed below, based on Verdant's recommendations.

First, many multifamily weatherization measures were installed only in a subset of dwelling units, but the individual units were not recorded in Energy Trust Project Tracking data, which made it more difficult to evaluate the impacts. To address this issue and improve future multifamily evaluations, Energy Trust's Existing Buildings program will begin recording the following information during multifamily project data entry and incentive processing:

- Identify individual dwelling units that receive incentivized measures in Energy Trust's Project Tracking system and link them to distinct building and dwelling unit identifiers in Energy Trust's CRM and Utility Customer Information systems.
- Record the address and unit number, building and unit site identifiers, utility meter and premise identifiers, quantity of measure installed in the unit, size of the unit, floor level, and a flag for master-metered buildings.
- Clean up multifamily site hierarchy information in Energy Trust's CRM system to identify distinct buildings on a campus and which units are located in each building.

Second, Energy Trust plans to begin recording the average vacancy rate for multifamily buildings installing weatherization measures. This information will be used to adjust the level of savings claimed for prescriptive measures and assess overall vacancy rates. Incorporating more accurate vacancy rates will align deemed savings values more closely with billing analysis results.

Third, Energy Trust's evaluation team will use alternative methods to validate measure assumptions and energy savings claims in multifamily buildings in the future, particularly in large multifamily buildings. These methods may include surveys, site visits and metering studies. This type of intensive evaluation work will be conducted as part of program-wide impact evaluations or as stand-alone research.

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2 INTRODUCTION

2.1 DESCRIPTION OF THE PROGRAM

Energy Trust of Oregon provides cash incentives for multifamily properties to make energy-related improvements, including to the shell of their buildings. Building shell improvements include window retrofits and upgrades, and insulation retrofits. Multifamily properties eligible for the program include duplexes, triplexes, fourplexes, side-by-side units and stacked structures with five or more units. These multifamily properties must have heating provided by Portland General Electric, Pacific Power, NW Natural, Cascade Natural Gas, or Avista.

For the program years from 2016 to 2020, the cash incentives for multifamily shell improvements were provided by a standalone Multifamily program, implemented by Lockheed Martin. In 2021, Energy Trust's Existing Buildings program, implemented by TRC Companies, took over services to the multifamily sector.

Energy Trust's multifamily services have included both small and large multifamily buildings, including duplexes and townhouses all the way to large apartment and condo towers. Savings for small multifamily efficiency measures are developed separately from measures for larger buildings, using the same assumptions and savings calculations as single-family residential structures (since they share many characteristics). Measures for large multifamily buildings use different assumptions and calculations based on the characteristics and thermodynamics of larger structures with stacked units. This evaluation assesses the energy savings from installations completed in program years 2016 to 2021.

2.2 CLAIMED SAVINGS

Between 2016 and 2021 Energy Trust incentivized 2,463 multifamily weatherization projects that claimed 7,068,846 kWh savings and 57,125 therms savings. This section provides the claimed savings broken down by measure, heating type, building size, region, and market type.

2.2.1 Claimed Savings by Program Measure

Table 2-1 lists the multifamily weatherization savings claimed by Energy Trust for windows and insulation broken down by type of measure. The Program's window installations are disaggregated into window upgrades and retrofits. The window upgrades occur in either gas or electric heated small buildings while the window retrofits are exclusively installed in larger buildings heated with electricity. The insulation claimed savings are broken down by ceiling, floor, wall, and knee wall installations.

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TABLE 2-1: MULTIFAMILY WEATHERIZATION CLAIMED SAVINGS AND PROJECTS BY MEASURE

Project Measure	Claimed kWh	Claimed Therms	Claimed SQFT	Number of Projects	kWh per Measure SQFT**	Therms per Measure SQFT	SQFT per Project
Windows							
Windows Overall	6,068,369	39,697	1,111,483	1,977	5.46	0.04	562
Upgrades	971,613	39,697	369,666	1,490	2.63	0.11	248
Retrofit	5,096,756	0	741,817	488	6.87	0	1,520
Insulation							
Insulation Overall	1,000,478	17,427	1,869,602	686	0.54	0.01	2,725
Ceiling	702,541	13,307	1,301,840	399	0.54	0.01	3,263
Floor	238,040	2,473	476,382	208	0.50	0.01	2,290
Wall	58,772	1,607	88,407	68	0.66	0.02	1,300
Knee Wall	1,125	40	2,974	11	0.38	0.01	270

**The window claimed kWh savings per square foot are relative to market baselines for window upgrades and relative to existing conditions for window retrofits contributing to higher claimed savings per square foot for retrofit windows.

2.2.2 Claimed Savings by Heating Type

A summary of the windows and insulation projects and their claimed electric and natural gas savings is presented in Table 2-2. These data provide an overview of the types of savings claimed by the program during the evaluation period (2016-2021). Window installations led to substantially more projects and claimed electricity savings than insulation projects. The per square foot savings for these projects are also presented, showing that the savings per square foot are higher for windows than insulation.

TABLE 2-2: MULTIFAMILY WEATHERIZATION CLAIMED SAVINGS AND PROJECTS BY MEASURE AND HEATING TYPE

Project Measure	Claimed kWh	Claimed Therms	Claimed SQFT	Number of Projects	kWh per Measure SQFT	Therms per Measure SQFT	SQFT per Project
Electric Heat							
Window Upgrades	967,734	0	237,580	922	4.07	0	258
Window Retrofit	5,096,756	0	741,817	488	6.87	0	1,520
Insulation	974,347	0	1,513,104	476	0.64	0	3,179
Gas Heat							
Window Upgrades	3,879	39,697	132,086	579	0.03	0.30	228
Insulation	26,131	17,427	356,498	217	0.07	0.05	1,643

The data presented in Table 2-2 indicate that sites with electric heating are responsible for the large majority of window and insulation installations and average substantially higher square footage of

installed measures per project than gas heated sites.[3] The program tracking data for gas heated installations often show lower or zero electric savings, likely associated with air conditioning and/or furnace fan savings. Note, some projects claimed both gas and electric heat, so the gas and electric rows do not sum up to match the totals presented above.

2.2.3 Claimed Savings by Building Size

Energy Trust maintains two building size categories of multifamily efficiency measures:

- Small multifamily: two to four dwelling units or a side-by-side configuration
- Large multifamily: five or more dwelling units in a stacked configuration

The efficiency measures are developed separately by building size, using different assumptions and calculations. Claimed savings varies between small and large buildings due to differences in the thermodynamics of the buildings, and therefore their energy usage. Table 2-3 presents the program tracking savings by building size. Over 75 percent of the window projects and over 90 percent of the insulation projects are installed in small buildings. The program measures also claim a vast majority of the overall natural gas savings in small buildings. The average installation size of small building projects, however, is substantially smaller than projects installed in larger buildings. The project size differential, along with the claimed kWh savings per square foot of installed window,[4] contributes to the tracking data showing that windows in large buildings account for almost 80 percent of the claimed electric window savings.

TABLE 2-3: MULTIFAMILY WEATHERIZATION CLAIMED SAVINGS BY BUILDING SIZE

Project Measure	Claimed kWh	Claimed Therms	Claimed SQFT	Number of Projects	kWh per Measure SQFT	Therms per Measure SQFT	SQFT per Project
Small							
Window Upgrades	971,613	39,697	369,666	1,490	2.63	0.11	248
Insulation	727,029	16,908	1,250,604	636	0.58	0.01	1,966
Large							
Window Retrofit	5,096,756	0	741,817	488	6.87	0	1,520
Insulation	273,449	519	618,998	51	0.44	0	12,137

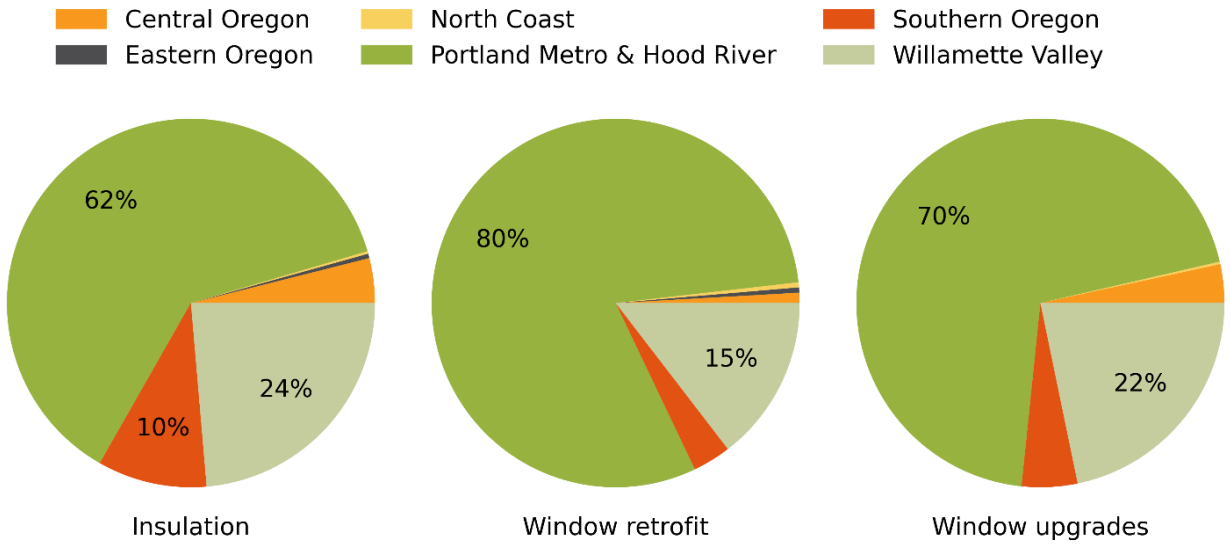
2.2.4 Claimed Savings by Energy Trust Region

[3] Window retrofits in gas heated buildings where not observed in the tracking data during this time period. This measure is only applicable in large multifamily buildings, for which gas heat is quite rare.

[4] The window claimed kWh savings per square foot are relative to market baselines for window upgrades and relative to existing conditions for window retrofits contributing to higher claimed savings per square foot for retrofit windows.

Figure 2-1 summarizes the program tracking savings by region within the Energy Trust service territory. A vast majority of claimed savings in the program are found in the Portland Metro & Hood River (between 62 and 80 percent) and the Willamette Valley regions (between 15 and 24 percent).

FIGURE 2-1: MULTIFAMILY WEATHERIZATION PERCENTAGE OF CLAIMED KWH SAVINGS BY REGION



2.2.5 Claimed Savings by Energy Trust Market Type

Figure 2-2 summarizes the program tracking claimed savings by Energy Trust Market Type. A majority of claimed savings from the program are in the market rate multifamily market segment (between 56 and 81 percent). The second highest proportion of savings varies between measure type, with window upgrades having a quarter of savings in individually owned multifamily units, and window retrofits and insulation having eight and 15 percent in homeowners' associations, respectively. Affordable multifamily is the third highest proportion of savings for both window measures, with 12 percent of the window upgrade market and six percent of the window retrofit market.

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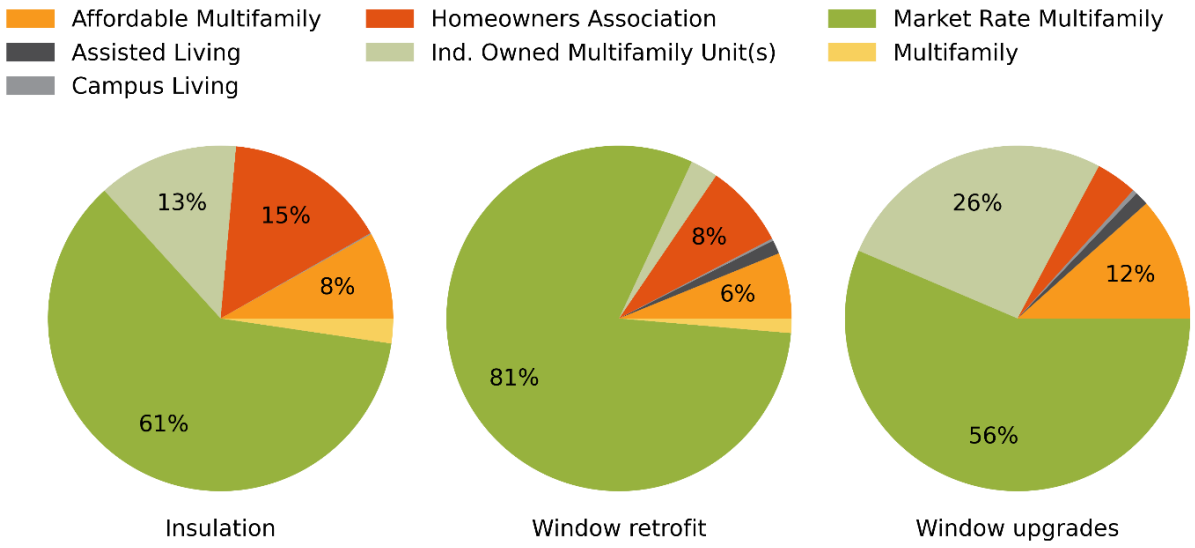
FIGURE 2-2: MULTIFAMILY WEATHERIZATION PERCENTAGE OF CLAIMED KWH SAVINGS BY MARKET TYPE



2.3 EVALUATION OBJECTIVES

The primary objective of this evaluation is to assess the aggregate program electric and natural gas savings from incentivized multifamily windows and insulation measure installations by various domains of interest. Savings are categorized by measure type (window retrofits, window upgrades, and insulation), heating fuel (electric and gas), and building size (small and large). In addition to the overall estimates listed above, other domains of interest include year installed (2016 to 2021), unit ownership (own vs. rent), heating zone (1 vs. 2), and geographic region. Energy savings and realization rates for these domains are estimated when sample sizes and available data allow.

Table 2-4 summarizes the Energy Trust's key analysis scenarios that had expected savings. Many of these scenarios had small sample sizes that were not suitable for billing analysis following data cleaning.[5] The reduction in sample size due to data quality control is described later.

[5] The electric savings for windows upgrades and insulation installed in gas heated units was not analyzed due to the small size of savings due to load.

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TABLE 2-4: KEY IMPACT ANALYSIS SCENARIOS FOR MULTIFAMILY SHELL MEASURES—EXPECTED FUEL SAVINGS BY MEASURES TYPE, HEATING FUEL, AND BUILDING SIZE

Measure Type	Heating Fuel	Building Size	Project N	Fuel Analyzed	Expected Savings / Measure SqFt (Avg. Claimed)	Evaluable?
Window retrofits	Electricity	Large	496	Electricity	6.87064	Yes
Window upgrades	Electricity	Small	1,194	Electricity	4.07330	Yes, with adj. factors
	Gas	Small	759	Electricity	0.02937	Yes, with adj. factors
				Gas	0.30054	
Ceiling insulation	Electricity	Large	26	Electricity	0.45949	No
		Small	275	Electricity	0.78017	Yes, when combined with wall and floor insulation measures
	Gas	Large	4	Electricity	0.04932	No
				Gas	0.03304	
		Small	138	Electricity	0.10536	Yes, when combined with wall and floor insulation measures
				Gas	0.05504	
Wall insulation	Electricity	Small	53	Electricity	1.11556	Yes, when combined with ceiling and floor insulation measures
	Gas	Small	51	Electricity	0.02266	
				Gas	0.04283	
Floor insulation	Electricity	Large	21	Electricity	0.42988	No
		Small	148	Electricity	0.67843	Yes, when combined with wall and ceiling insulation measures
	Gas	Large	1	Electricity	0.00143	No
				Gas	0.03000	
		Small	58	Electricity	0.00083	Yes, when combined with wall and ceiling insulation measures
				Gas	0.03525	

Note: Project N's represent the number of completed projects with a particular measure in a given scenario, not the number of multifamily sites with a specific fuel savings or with valid UCI data for that fuel. Valid N's available for analysis may be substantially lower. In addition, some projects included multiple measure types.

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3 DATA AND METHODS

3.1 DATA SOURCES

This section describes the data sources that were used for the evaluation. There were other data sources examined but were ultimately not used as part of the analysis.

3.1.1 Program Tracking Data

Energy Trust provided Verdant with a Program Tracking (PT) dataset that included participants from program years 2016 to 2023 and included information about each project's installed measures, incentives, energy savings, project address, site id, year constructed, square footage, space heating fuel and system, water heating fuel and system, number of stories, number of dwelling units, heating and cooling zone, weather station, and the installation date. These data include site information that described how multifamily sites are configured, including identifiers for properties with multiple unit buildings (campuses or structures) and individual dwelling units that are attached or located within a building. The PT data also included details about Energy Trust-funded efficiency measures installed prior to, and since, the weatherization measures were installed.

Projects in the tracking database can represent measures installed at a single unit in a multifamily complex and multiple units at a building, complex, or campus.

3.1.2 Customer Relationship Management Data

Energy Trust provided Verdant with a Customer Relationship Management (CRM) dataset. The CRM data contains information about site units in the multifamily complex that can help tie a project in the program tracking database to customer utility bills; including the property's address, utility, site id, premise id, meter number, and a net metering flag.

3.1.3 Weather Data

Energy Trust provided Verdant with daily NOAA weather data and TMYx[6] data for all the weather stations represented in the population of program units from late 2014 to early 2023. The daily NOAA data included actual daily minimum, maximum, and average temperature by weather station or heating zone.

[6] TMYx data are typical meteorological year data derived from hourly weather data through 2021 in the ISD (US NOAA's Integrated Surface Database) using the TMY/ISO 15927-4:2005 methodologies.

3.1.4 Utility Customer Information (Gas and Electric Bills)

The PT and CRM data were used to request Utility Customer Information (UCI) data, comprised of monthly electricity and gas consumption, for participants who had installed weatherization measures in multifamily buildings from 2016 into 2023. These data included monthly electric and gas usage from late 2014 through early 2023.

3.1.5 Heating Zones

Energy Trust provided Verdant with heating zones, which are geographic areas defined by the Regional Technical Forum,[7] based on the number of heating degree-days during a typical winter. Heating zone 1 represents areas of the state with relatively mild winters, such as the valleys and coastline of Western Oregon. Heating zones 2 and 3 represent areas of the state with cold winters, like the mountains and Central and Eastern Oregon.

3.1.6 Tables from the Statement of Work (SOW)

Using tables 1 through 4 provided in the project SOW, Verdant used the per square footage deemed savings values and measure information to merge building size (small or large) onto the tracking database. A "small" building is classified as "2 to 4 dwelling units or a side-by-side configuration" and a "large" building is classified as "5 or more dwelling units in a stacked configuration".

3.1.7 Files for Documentation Review

In addition to program tracking data, Energy Trust provided Verdant with several types of documents related to the program's implementation. These documents included the program implementation manuals, measure approval documents (MADs), and measure change documents. Verdant reviewed the MAD documents to better understand the development of the ex ante savings values for the various measures. The MAD documentation, previous evaluation reports, and baseline data from the Residential Building Stock Assessment were used to develop an adjustment factor to update the ex ante savings for window upgrades to be consistent with an existing conditions baseline.

3.2 ANALYSIS METHODS

To assess the electric and natural gas savings from the weatherization measures incentivized and installed in Multifamily buildings, the following steps were implemented:

- Data cleaning and quality control including aligning program tracking, billing, and weather data

[7] The RTF is a technical advisory committee to the Northwest Power and Conservation Council established in 1999 to develop standards to verify and evaluate energy efficiency savings. https://rtf.nwcouncil.org/

- Determining a unit of analysis
- Developing a matched control group
- Implementing statistical methods to estimate energy savings

3.2.1 Data Cleaning and Quality Control

Data review and cleaning are necessary to identify and resolve data quality issues in preparation for the impact analysis. Types of data cleaning included: flagging any anomalies, removing duplicate records, and properly coding and handling missing values, missing observations, and errors, among other activities. To ensure a comprehensive and accurate dataset of participating multifamily buildings, various datasets were combined. This involved: correctly determining building configurations, connecting the appropriate meters to buildings and dwelling units, and ensuring that the project and site data are aligned.

Combining Program Tracking and Customer Data

Conceptually, the objective of this task is straightforward. Each participant in the program tracking data needs to be cleanly associated with its utility monthly billing records so that it can be used in the subsequent modeling of energy savings. In practice, however, there were a variety of complications at multiple stages of this process that led to ambiguity and uncertainty, rendering a large share of the data provided unsuitable for billing analysis.

The first stage of this task was the merging of the Program Tracking (PT) data with Energy Trust's Customer Relationship Management (CRM) data, which provides the key to mapping to the utility billing data. Both PT and CRM data share a "site_id" column for merging, but the linkage was incomplete, so a substantial portion of records needed to be linked by other means, which left only the address information in the two sources. Because these fields were formatted differently – and because multifamily addresses are notoriously more varied – there was substantial effort made to clean and standardize the various address fields. The results of the merging of the PT and CRM data are presented in Table 3-1, which show that the merge could not find candidate matches for only eight site IDs from the PT data.

TABLE 3-1: MERGING TRACKING DATA TO CUSTOMER DATA

Stage	Site IDs	Percent of Total
Unique values in project tracking data	2,655	100%
- Merged to the customer population by site_id	1,949	73.4%
- Merged to the customer population by cleaned street address and zip code	690	26.0%
- Merged to the customer population by first 15 characters in cleaned street address and zip code	5	0.2%
- Merged to the customer population by first 15 characters in cleaned street address (zip did not match, but from a manual look up appeared to be the same address with bad zip code)	3	0.1%
Unable to merge	8	0.3%

The overall success of this merge, however, belies that there was still a substantial amount of uncertainty in the reliability of the matches. For example, in the PT data, there were cases where a project site had an address range (e.g. 111-119 1st Street). If we were able to merge on any of the address numbers in the range, we counted this as a successful merge, but the lack of unambiguous street and unit numbers in this process introduced substantial uncertainty about how many of the individual units or buildings at a given address were associated with the measures recorded in the PT data. Moreover, some of the tracking records with address ranges had a relatively small amount of square footage installed, implying that the listed addresses may include units or buildings that were not actually treated through the program. This issue was not limited to only tracking records with an address range. For example, there were other tracking records (mainly the "Campus" or "Structure" site types) that had over 100 units and under 100 square feet installed, implying that each unit had, on average, less than one square feet of windows or insulation installed through the program or there were some units where no windows or insulation installed through the program. The most likely case with this example is that the measure was installed in a way that impacted only a subset of the 100 units.

It is also important to note that we were unable to group units into a specific building with the tracking data that was collected for this program. For example, if a Campus had eight buildings, we did not have a way to map each unit to a specific building to be able to analyze each structure separately. Instead, the eight buildings had to be combined to be usable in the analysis.

Assessing the Customer Billing Data

The next stage of this task was the extraction of the billing records. The billing usage was pulled from the Utility Customer Information (UCI) database and then linked back to the PT data that was merged to the CRM records. There is a premise ID available in both the CRM and UCI data, but not every premise ID identified in the CRM data had a match in the UCI. Table 3-2 presents the number of site IDs where we received billing data by analysis segment.

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TABLE 3-2: MERGING CUSTOMER DATA TO UTILITY BILLS

Segment	Count in the Program Tracking Data	Count with Billing Data	Percentage with Billing Data
Site IDs with electric window savings	1,424	1,027	72%
Site IDs with gas window savings	563	433	77%
Site IDs with electric insulation savings	476	299	63%
Site IDs with gas insulation savings	176	119	68%

Note – site id is a variable from the PT data. Site id potentially has a one-to-many relationship with the utility billing data.

Note that in addition to the substantial proportion of site IDs from the program tracking data that did not have any billing data records, the identification of billing records does not necessarily mean that the available data was sufficient for use in the analysis. Data cleaning issues are discussed below.

Cleaning the Customer Billing Data

The electric and gas monthly billing records were cleaned, and attention was paid to ensuring that mapping of PT data to bills was treated correctly. Steps in cleaning the billing data included removal of all records where both the kWh and therms were either missing or zero and removal of duplicates. Additionally, there were a number of records that contained identical bill dates and consumption values for a premise that were attached to two different accounts when there was a changeover in the account number and account holder name. This indicated duplicate bills that were associated with two customers during a move-in/out at the premise. In these situations, the bills were removed for the new account (the move-in account). The cleaning also dealt with anomalies in the data, such as excessively long billing intervals.

Calendarizing the Customer Billing Data

Monthly billing records capture the consumption between two dates with an interval that is typically around, but not necessarily, 30 days. Rarely are they associated with a distinct calendar month (e.g., June 1 through June 30), and if so, it is likely by chance. Because a meter read date of, say, July 6th is more representative of the consumption for June, not July, Verdant applied a process called calendarization to the billing data so that consumption is transformed to represent calendar months. The calendarization process essentially allocates the energy consumption in a monthly billing interval to the different months represented in the bill. For example, a bill from June 7th to July 6th would have its electric or gas consumption allocated proportionally to each of those months. This allocation is sometimes done based on the number of days in each month, but Verdant has found that calendarization of weather sensitive loads (such as Multifamily housing) based on heating and cooling degree days (HDD and CDD) provides a more accurate calendarization of bills than allocating energy consumption by the proportional count of

days.[8] As a result, billing periods with start dates in winter months (November through March) had their usage allocated to each month based on the relative share of total HDD in each month covered by the billing cycle. Summer months (May through September) usage was allocated based on the relative share of total CDD. For billing cycles that started in April and October (shoulder months) the bills were allocated based on the proportional share of days rather than degree days.

Comparing the Number of Units in the Program Tracking Data to the Customer Billing Data

Aligning the records from the program tracking data to the utility billing data at the unit level led to several complications for the evaluation. First, the number of utility bills didn't always align with the number of units in the tracking data. It was not uncommon to see the number of units in the program tracking data exceed the number of utility billing premise records (implying that we may not have received all of the desired billing records). In other cases, the number of units in the program tracking data was less than the number of utility billing records (potentially implying that we received bills for buildings within a complex that were not treated or bills for common areas or central systems).

We manually compared the tracking data to the billing data to assess the alignment of the number of multifamily units in each data source. At this stage we identified that the records with a site type of "Campus" or "Structure" had more issues arise with the matched program tracking and utility data than records with the site type of "Unit." Among the issues encountered far more frequently with the "Campus" and "Structure" records were the following:

- We did not receive data for each unit for the analysis period
- Some customers moved in or out during the analysis period[9]
- Some units were vacant during the analysis period
- The tracking data did not reflect the same number of units as the bills
  - Multiple addresses in the PT data but fewer bills
  - Range of addresses in the PT data matched with too many bills

Given these data concerns, data for participants from "Campus" and "Structure" records required additional data cleaning and review to develop a measure of ex ante savings and per unit average usage. Because we had some "Campus" and "Structure" records with installations occurring across multiple units and some of the units were missing all bills or their bills were dropped in the cleaning process, we applied

[8] For the calendarization of customer usage, we used 60 degrees as the change point for HDD and CDD for all premises. This approach minimized the number of months with no HDD or CDD, limiting the proportional allocation of usage by number of days.

[9] Installations were often occurring at the point of customer turnover. The change in energy usage at these sites represented changes in customers and the weatherization measure, potentially biasing results if these records were included in the analysis.

an adjustment factor[10] to the aggregate savings to account for the missing bill(s). After applying that adjustment factor, we calculated the pre and post average annual energy consumption per unit by dividing the total usage for the Campus or Structure by the number of units in the PT data. If this appeared unreasonably high or low, we divided the total usage by the number of units with bills. If this still didn't appear reasonable, the site was dropped from the analysis. It is important to note that it is not necessarily the case that all units within the property were treated in the same way, even though we have treated them as though they were all treated the same way. Because the PT data records the total quantity of the measure installed but does not stipulate which units received a measure and in what quantity, this was what the data allowed.

3.2.2 Creating an Analysis Unit

We created an "Analysis ID" that was equivalent to the site ID for records with a site type of "Unit" and combined site IDs with similar addresses when site type was equal to "Structure" or "Campus." This results in a single Analysis ID for each installation occurring at a single unit and a single Analysis ID for all apartments within a structure or campus receiving a weatherization measure.

3.2.3 Identify Comparison Group

A comparison group is a key component to this evaluation's analysis approach. The initial evaluation plan intended to use future program participants as the control group, so that a participant in 2016 would be matched with participant from 2018 or later. For later program years, however, the ability to find matches from the dwindling pool of available future participants was resulting in excessive loss of participants. As a result, the approach was modified to use past program participants as the control for the later year participants (e.g. a 2016 participant as the control for 2018).

For the matching routine, each Analysis ID was aligned with a list of candidate Analysis IDs that were matched on heating zone, building size category, and the measure types installed. Eligible candidates were also screened for any additional projects or upgrades that could significantly impact consumption during the analysis period. The eligible candidates were ranked based on the similarity of their annual consumption for the pre-installation period and the top 15 candidates were preserved for use in the later cleaning and modeling stages. An important nuance to note in this is that some participants could appear twice in the analysis if their program participation was so far apart that it allowed for multiple discrete pre- and post-installation periods. These cases of multiple installation periods were few, but they were

[10] The adjustment factor was created by comparing the number of premises pre data cleaning to the number of premises post data cleaning. The adjustment factor is equal to the number of total premises at the property pre data cleaning divided by the number of premises post data cleaning. For example, a property with four premises pre data cleaning and three post would have an adjustment factor equal to 4/3. This factor is multiple by the sum of usage for premises that made it through the data cleaning process to create the estimate of property level usage.

retained in the analysis to maximize the use of the available data. In some cases, no control participant could be identified based on heating zone, building size category, and the measure types and were dropped from the analysis.

Another important item to note is that finding an eligible comparison candidate became increasingly difficult as the number of units within an Analysis ID increased, specifically for "Campuses" and "Structures". More units within an Analysis ID led to more chances of the data becoming unusable as participants move, units became vacant, or when a full dataset covering all units within the property was not available. As previously mentioned, in many cases we also do not know with certainty which units and buildings were treated at an Analysis ID. Given these issues, we were unable to find eligible comparison candidates for a vast majority of Analysis IDs that had more than 10 units in the program tracking data.

3.2.4 Impact Analysis

The modeling of measure savings was based on difference-in-differences (DiD) approach based on the follow stages:

1. Weather-normalization of pre- and post-installation monthly bills for all participant and control customers.
2. Regression model to remove time and customer effects from the weather-normalized consumption.
3. Standard DiD model estimation.

The second stage of analysis was important because there was no distinct period for measure installation. Instead, participants had measures installed throughout each program year, often at different times, in no particularly discernible pattern. The second stage was included to address the potential bias that can result from this staggered participation. These three stages are discussed in more detail below.

Stage 1: Weather Normalization

The weather normalization step, which represents the first formal stage in the impact estimation modeling, was the development of weather-normalized estimates of consumption for the pre- and post-installation periods for each Analysis ID. This stage used regression to model the calendarized consumption data on various cooling degree-day (CDD) and heating degree-day (HDD) permutations to determine the outdoor temperature points that best predict customer load. For HDD, the thresholds used were 50, 55, 60, and 65. For CDD, which only applied to electricity, the thresholds used were 60, 65, 70, and 75, and none (no CDD term included). For the electric models, the cooling threshold had to be greater than the heating, which was based on the notion that there is a range of temperatures where no heating or cooling is needed in a house.

Selection of the final model for each Analysis ID (either participant or the individual control candidates) and installation period first filtered for models that produced positive and statistically significant parameter estimates for the valid CDD/HDD degree-day variables. For example, a model that had statistically significant CDD and HDD parameters would be selected over others with only one or no significant parameters. The next criterion was to select those that had positive parameter estimates, whether significant or not. From these candidate models, the model which produced the highest adjusted R-squared value was selected as the final.

After selecting the final CDD and HDD thresholds for each Analysis ID, period (pre/post) and role (participant/control), we applied the parameter estimates to the appropriate TMY data to generate a monthly series of normalized consumption. As a means of quality control and validation, we saved both the actual and weather-normalized consumption values and degree-days. It is important to check for cases where normalized and actual values deviate by extreme amounts, which might indicate an error in the weather data used in either the modeling or normalization procedures.

There was attrition at this stage of the analysis as well, as not every model produced reasonable results, including models with very poor fit, negative degree-day parameters, or weather normalized estimates for pre and post periods that were too different to be believable. While a participant with such cases had to be eliminated, this was one of the reasons for retaining up to 15 control candidates for each participant. If the top control candidate(s) had bad model results, the next best match was selected as the alternate and final control group customer.

Stage 2 and Stage 3

As explained above, the staggered nature of program participation over many years can lead to potential biases, primarily from effect heterogeneity and/or the violation of assumptions of parallel trends. The former is essentially when the effect of treatment can vary over time, which could occur for any number of theoretical reasons, such as earlier participants being larger consumers. The latter is the assumption that treatment and control are both trending in the same direction and at the same rate in the dependent variable. To remedy the potential bias, the analysis employed the “did2s” package in R, which was developed specifically to address these issues. Using the weather-normalized data from stage 1, this package first executes a model to remove the time and site effects due to staggered implementation in the first stage, followed by standard DiD estimation in the second stage. The combination of the weather normalization with these later two stages is referred to as three-stage DiD.

3.2.5 Summary of Exclusion Criteria

There have been references throughout Section 3.2 to data attrition in each step of the data preparation. This section presents a complete view of the data attrition that occurred at each stage of data preparation and analysis.

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Table 3-3 presents a high-level attrition table summarizing the number of Analysis IDs that were left after each major data preparation step. In the end we were left with around 30 percent of electric heat Analysis IDs and 35 percent of gas heat Analysis IDs going into our models. We initially requested data for 1,774 Analysis IDs with electric heating and 693 Analysis IDs with gas heating. We received at least some billing data back for 1,255 Analysis IDs with electric heating and 524 Analysis IDs with gas heating, resulting in a drop of over a quarter of the Analysis IDs. Control candidates were assigned to each participant, with participants being dropped if they could not be assigned any suitable controls, resulting in a drop of around 16 percent of the Analysis IDs. The number of units were compared between the PT data and the billing data received. We assessed that the sites that had more than 10 units in the tracking data were nearly all unusable because of the mismatch in number of units for which we had bills during the analysis period or the inability to find a good control candidate; this resulted in a drop of around seven percent of the Analysis IDs. Another 14 percent of the data was removed in the billing data normalization step of the DiD model (this step checks for 12 months of pre- and post- bills). The resulting normalized data were reviewed to identify any issues that could affect the billing analysis, and another five percent of Analysis IDs were removed from the analysis in that step for reasons including low or abnormal usage. Note that some Analysis IDs had multiple projects that made it through to the DiD model, so the sample sizes reported in the models will be slightly higher than the numbers reported here.

TABLE 3-3: ATTRITION BY ANALYSIS ID

Data Processing Step	Electric Heat Analysis IDs	Percent of Electric Heat Analysis IDs Removed	Gas Heat Analysis IDs	Percent of Gas Heat Analysis IDs Removed
Requested Billing Data	1,774		693	
Received Billing Data	1,255	-29%	524	-24%
Control Group Matching	1,015	-14%	381	-21%
Mismatched Number of Units Between PT and Bills	867	-8%	367	-2%
Billing Data Normalization	603	-15%	291	-11%
Final Modeling Filters**	529	-4%	246	-6%

**The final modeling filters included items such as: insufficient billing data, bill outliers, keeping only electric bills for Analysis IDs reporting kWh savings, keeping only gas bills for Analysis IDs reporting therm savings, removing Analysis IDs with 2022 installs, and removing Analysis IDs occurring in a single unit that mapped to multiple billing data premises.

In the end we were left with around 30 percent of electric heat Analysis IDs and 35 percent of gas heat Analysis IDs going into our models. Finally, the Analysis IDs where site type is “Unit” are assigned a weight equal to one and the site types of “Campus” and “Structure” get a weight equal to the number of units in the tracking database.

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4 FINDINGS

4.1 DOCUMENT REVIEW

Verdant reviewed the program documentation provided by Energy Trust, including program implementation manuals, measure change documents, and measure approval documents (MADs). Overall, these documents provided valuable background on the program, but the MADs were the only source that were used directly in producing the results presented in this report.

The MADs, which gave key assumptions underlying the measure savings assumptions, were necessary to develop adjustments to the estimated savings for small multifamily window upgrade measures. The MAD's ex ante savings for windows installed in small buildings were based on participants installing higher efficiency windows than a market baseline U-factor. Savings estimated using a billing analysis approach, however, are estimated relative to existing conditions. The information in the MAD, along with data from the 2022 Residential Building Stock Assessment (RBSA)[11] were used to develop the necessary adjustment factors. The RBSA listed the average U-factor for multifamily housing as 0.45. Given that the windows replaced by the Multifamily Weatherization program likely represent older windows than average, we chose to use a U-factor of 0.50 to adjust the market baseline savings to existing conditions. Using the adjusted U-factor it was possible to calculate existing conditions ex ante savings values for window upgrades and calculate an evaluation realization rate for this measure. Table 4-1 presents the deemed market baseline and the adjusted existing baseline ex ante savings values.

[11] Evergreen Economics (2024). *2022 Residential Building Stock Assessment Findings Report*. Northwest Energy Efficiency Alliance.

TABLE 4-1: SMALL MULTIFAMILY WINDOW UPGRADE EX ANTE SAVINGS ADJUSTED TO EXISTING BASELINES

Small Multifamily Window Upgrade	Year	Deemed kWh/sqft	Market Baseline U-Factor*	Adjusted kWh/sqft with U = 0.5	Deemed Therm/sqft	Adjusted Therm/sqft with U = 0.5
- **U 0.30 to 0.28**	2014-2020	2.86	0.334	15.64	0.20	1.08
- **U 0.30 to 0.28**	2020-2022	1.84	0.317	15.64	0.13	1.08
- **U < 0.28**	2014-2020	6.92	0.334	19.40	0.48	1.34
- **U 0.25 to 0.27**	2020-2022	3.87	0.317	17.67	0.27	1.22
- **U < 0.25**	2020-2022	6.66	0.317	20.45	0.46	1.41

*The Market Baseline U-Factor for years 2014-2020 comes from MAD28.1 and 28.2 Residential High Performance Windows the 2020-2022 values are from MAD 28.3.

4.2 DIFFERENCE IN DIFFERENCE MODEL SAVINGS

Three-stage DiD models were estimated for Analysis IDs[12] installing window upgrades or retrofits and those installing insulation. These groups were further disaggregated into Analysis IDs with only electric savings and those with electric and gas savings. For Analysis IDs with gas heating, the gas savings were evaluated in the DiD models. The electric savings for these Analysis IDs were not evaluated, as the impacts for these were generally very small and would not be identifiable in an electric model. The DiD models include data for measures installed in Analysis IDs with up to nine units and were implemented on a per unit basis to reduce the heterogeneity of the energy usage variable (monthly kWh or therms) for Analysis IDs with multiple units that were treated. The dependent variable is the average unit level monthly usage, and the model implementation is weighted so each observation represents the number of units receiving treatment.[13] The weighted per unit savings estimated from the model are then compared to the weighted per unit ex ante claimed savings along with the square footage of the installed measures to calculate realization rates. As highlighted in the document review, we developed adjustment factors for the ex ante savings for small multifamily window upgrades to compare estimated savings to both existing conditions (adjusted ex ante) and to market baseline (unadjusted ex ante).

Table 4-2 presents the DiD model estimated savings and resulting observed and adjusted realization rates. The observed realization rates are relative to the program's ex ante savings values. The ex ante savings values for window retrofits and insulation are relative to existing conditions while window upgrades are relative to a market baseline. For window upgrade measures we calculated adjusted realization rates by adjusting the ex ante savings values to be relative to existing conditions. These realization rates are estimated using data from all program years covered by this evaluation (2016 to 2021). For window

[12] See section 3.2.2 for a description of this analysis unit.

[13] Parameter estimates and other statistics for the third stage of the DiD model are presented in Appendix C. In this appendix, we also describe how the monthly coefficient estimates, and their standard errors, were aggregated to develop the savings estimates presented in Table 4-2.

upgrades, we estimate adjusted realization rates of 34 percent and 10 percent for windows installed at Analysis IDs with electric and gas savings, respectively. For window retrofits, we estimate a realization rate of 65 percent for electric heated Analysis IDs. For insulation measures, we estimate a 67 percent realization rate for electric heated and 90 percent realization rate for gas heated Analysis IDs. For window retrofits and insulation within gas or electric heated multifamily Analysis IDs, while the estimated realization rates are less than 100 percent, their confidence intervals do include a 100 percent realization rate, implying that the ex ante savings values for these measures are not entirely inconsistent with the study's measured values.

The estimated electric energy savings per square foot for window upgrades and window retrofits are 5.61 kWh and 4.87 kWh, respectively. These savings are estimated relative to an existing conditions baseline. The similarity in the savings estimates for upgrades and retrofits implies that the two measures are achieving similar reductions in HVAC energy usage. The similarity in upgrade and retrofit window savings is consistent with the a priori assumption that new windows with similar U-Factors should achieve similar energy savings. The lower adjusted realization rate for window upgrades is from de-rating their savings consistent with the program's implementation style. For window upgrades, the program intervenes, encouraging a higher efficiency window, after the customer has identified that they are going to replace the window. The program's window upgrade savings are therefore assessed relative to a market baseline counterfactual, leading to a lower adjusted realization rate.

TABLE 4-2: ESTIMATED SAVINGS AND REALIZATION RATES SEGMENTED BY MEASURE, HEATING TYPE, AND SIZE

Energy	Measure	Building Size	Model n***	Estimated Energy Savings per Sqft Installed**	# of Months Statistically Significant at 10%	Realization Rate Observed	Realization Rate Adjusted
Electric Heat							
kWh	Window Upgrade	Small	320	5.61 ± 2.08	7	133% ± 49%	34% ± 12%
kWh	Window Retrofit	Large	100	4.87 ± 3.14	5	65% ± 42%	
kWh	Insulation	Small	140	0.45 ± 0.42	5	67% ± 63%	
Gas Heat							
therm	Window Upgrade	Small	229	0.12 ± 0.09	6	40% ± 30%	10% ± 8%
therm	Insulation	Small	35	0.04 ± 0.02	3	90% ± 47%	

**For this and other columns with the "±" following the value, the second value indicates the 90 percent confidence interval developed using the delta method.

***The "Model n" is the total number of install periods for each Analysis ID that went into the model. See section 3.2.2 for a description of Analysis ID.

The savings estimates presented above were developed using data for measures installed in Analysis IDs with up to nine units. Measures installed in Analysis IDs with 10 or more units were not included due to

the significant data issues described in Section 3.2 above. Due to substantial data attrition, the results presented above may not be representative when applied to the entire participant population and must be applied with caution.[14]

Approximately 90 percent of the window upgrade Analysis IDs, and approximately 60 percent of the ex ante savings, are associated with complexes with nine or fewer units (see Table A-1 below). This supports the use of the window upgrade model estimates for complexes with nine or fewer units. It is unclear, however, if the findings from these smaller complexes can be applied to window upgrades in complexes with 10 or more units (whose data were excluded from the model). Findings in Table A-3 below show that the average apartment square footage for window upgrade units in building with nine or fewer units was 1,069 while apartments in complexes with 10 or more units were substantially smaller, averaging 660 square feet. The substantially larger average apartment unit square footage of the nine or fewer unit complexes could bias the estimate of savings from smaller apartments upgraded in the 10 plus unit buildings. Therefore, while the modeling of window upgrade savings is based on only a subset of eligible complexes (those with nine or fewer units) and there is significant data attrition within the up to nine unit data, the team feels that the model estimate of savings for window upgrades is sound for units installed in complexes with nine or fewer units.

Ninety three percent of window retrofit savings and 44 percent of Analysis IDs are associated with complexes with 10 or more units. Given the substantial share of window retrofit savings not accounted for in the estimated savings presented in Table 4-2, it is likely that these estimates do not reflect a sound estimate of the savings for this measure and population.

Fifty nine percent of electric insulation savings and 74 percent of gas savings are associated with complexes with nine or fewer units. The electric and gas model insulation savings estimates, however, have either large confidence intervals relative to the savings estimates or are based on a small sample. Caution should be used when applying these savings estimates to the participant population.

Model results by additional domains are included in Appendix B. However, none of the results were statistically significantly different from each other, so these results just serve as a directional indicator of savings within each domain.

[14] See the attrition Table 3-3 for details. The model results presented in Table 4-2 are based on assessment of approximately 30 percent of electric heat Analysis IDs and 35 percent of gas heat Analysis IDs.

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Difference-in-Difference Model Caveats

While developing the data for the evaluation of Energy Trust's multifamily weatherization measures, we encountered multiple data quality concerns, many of which were highlighted in Subsection 3.2. Here we further discuss these concerns as they impact the interpretation of the DiD model findings.

First, for Analysis IDs where measures were installed across multiple units at the property, we were unable to consistently determine which specific units within a "Campus" or "Structure" were actually treated and instead had to rely on the assumption that all units were treated equally. Realistically, the installation square footage may have differed across units and buildings. This affected the adjusted savings when there were missing bills. Some records with multiple unit installations were missing bills or some bills were dropped in the cleaning process (due to move-in-move-out, vacancies, or other discrepancies in the data). Because we don't know the square footage installed in each unit, we applied an adjustment factor to the aggregate savings to account for the missing bill(s) that assumes all units were treated with the same square feet of windows or insulation.

Second, it is possible that the premise level energy consumption data for the campus and structure properties include untreated units (as evidence by the small amount of claimed savings and quantity on some of the records that had large number of units in the PT data), which would bias the savings and realization rate results downward.[15]

Third, for several reasons, we were not able to model savings for Analysis IDs (campuses and structures) that had 10 or more units referenced in the PT data. Our review of the PT and UCI found many mismatches in the number of units identified in the two sources as well as uncertainty surrounding the number of units with measures installed. Furthermore, there was a large share of bills that were removed during the data cleaning process and a lack of sufficient control group candidates for these participants. It should be noted that while 10+ unit campuses/structures were the minority of sites receiving MF Weatherization measures (15 percent of records in the PT data), these properties represent the majority of the program's kWh ex ante savings (80 percent of savings in the PT data). The inability to align the PT, CRM, and UCI added a level of error and uncertainty to the data such that the evaluated measure level savings installed in 10+ unit campuses/structures was deemed too unreliable to report.

[15] The realization rates for measures installed in properties where the structure is described as a unit and the number of units is one were higher for all measures other than gas windows. This finding is consistent with the likelihood that the analysis with 2-9 unit structures/campuses includes energy consumption data for units that were not treated.

Finally, note that the PT data included electric savings for measures installed in gas heated units (likely associated with air conditioning and/or furnace fan savings). We were unable to evaluate the claimed electric savings for these measures, due to the small size of the savings.

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5 CONCLUSIONS AND RECOMMENDATIONS

The confidence interval for the estimated realization rates include 1.0 or 100 percent for each of the multifamily weatherization measures except window upgrades in electric and gas heated units installed in multifamily buildings from 2016 to 2021. Window upgrades for small buildings have an adjusted realization rate of 0.34 for kWh savings and 0.10 for therms savings (when adjusted for an existing conditions baseline). Window retrofits for large buildings had a realization rate of 0.65 for kWh savings. Insulation installed in small buildings had a realization rate of 0.67 for kWh savings and 0.90 for therms savings. We were unable to estimate savings and realization rates for other measure configurations or subgroups, due to low samples sizes or high attrition.

The estimated kWh realization rates are based on participants that represent a small fraction of the total program kWh savings. Despite outsize efforts to minimize data attrition and the exploration of various alternative modeling approaches (e.g., site-specific NMEC for the larger complexes), we were unable to produce defensible estimates of savings for measures installed in 10+ unit complexes/structures (which were around 15 percent of the records in the PT data, 80 percent of the ex ante kWh savings, and 29 percent of the ex ante therm savings). Multiple data quality concerns impeded modeling. The data issues included incomplete billing data, inability to identify the treated apartment units, the lack of alignment between the PT and UCI data, and the difficulty developing controls for larger buildings. For properties with multiple units treated, the PT data contains information on the property and sparse information on which individual units were treated and individual unit installation quantities. We were able to identify billing information for units at the properties, but we were not able to identify which buildings or units were treated. To remedy these hurdles in future program years we suggest the program implementer collect the following data in the program tracking database:

- A record for each individually treated unit, including address, apartment number, the square footage of insulation or windows installed in the unit (and the square footage of the unit itself), the premise id and meter number associated with the unit (that would directly link to the billing data), an indicator to note if the unit is master-metered, the floor(s) the unit is on, and a common identifier to associate the unit with other units that are in the same building.
- For insulation measures that may affect multiple units, it would be useful to know each specific units the insulation would impact. Again, an identifier to associate all other units that are in the same building would be helpful.

- For complexes and structures that are rentals, we recommend collecting an average vacancy rate from the building owner as part of the application process. This would allow for an adjustment to claimed savings reflect vacancy rates.[16]

If linking bills to each unit in larger buildings is infeasible, we recommend sampling a portion of the participants for a metering study. This sample should stratify the units by energy savings to ensure the largest buildings that account for the largest energy savings will be included. This study could also include surveys of the building managers to better understand vacancy rates.

[16] If the analysis is undertaken on a complex where 10 percent of the apartments are vacant, the usage will be 10 percent lower than expected but the ex ante savings will reflect full occupancy. Accounting for average vacancy in the ex ante savings calculation will align the two sets of data.

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APPENDIX A ADDITIONAL MODELS ATTEMPTED

This appendix discusses the additional models that were attempted as part of efforts to incorporate more of the program tracking participants into the analysis but did not end up getting used for the final results.

A.1 NMEC MODEL

Properties with 10 or more units were affected to a greater extent by the issues faced in cleaning, finding a control group, and modeling savings using a Difference-in-Difference model approach. The more units covered under an Analysis ID the more difficult it became to find an eligible control. For electric Analysis IDs of the properties that we were able to find an eligible control the selection was very limited and after cleaning and manual review, they were found to not necessarily have data that would be able to align with the pre and post periods of the treated properties. For these reasons, we concluded that these properties could not be modeled with DiD techniques.

However, because this group of participants contributes a large portion of the kWh savings, especially for the window retrofit measure, we explored alternative methods to model these savings. Because we could not identify a control group for these participants, we attempted to analyze these properties using a traditional normalized metered energy consumption (NMEC) approach, in which savings are estimated based on a simple comparison of pre- and post-installation weather normalized savings for the individual participants. This NMEC approach is grounded in the assumption that the given analysis unit has usage that is predictable and driven in large part by weather, which is surely true of the larger buildings. Because no control groups are used, the NMEC model is not able to account for other events that may cause a substantial change in energy usage. A highly salient example is the global COVID-19 pandemic, which significantly altered how home energy was used during the years 2020 and 2021, as people increased their time at home and energy consumption. Without a control group to account for these types of effects, traditional NMEC can produce misleading results. The evaluation period for this analysis is for multifamily sites with installations between 2016 and 2021, leading to the evaluation not being able to control for this change in energy usage for installations occurring in 2019 through 2021. More importantly, NMEC models rely on model metrics that test for the measure of random error between normalization and actual data, bias, and variation. In calculating site level usage, we run weather normalization models on individual premise level data to allow for varying weather sensitivities and preferences. Statistics were calculated for these weatherization models, specifically the fractional savings uncertainty (FSU) for each premise under an Analysis ID. This is calculated as the level of estimation uncertainty divided by the savings, with lower values meaning a more precise estimate. Overall, these statistics indicated that these sites were not good candidates for NMEC analysis, as the noise associated with their billing records was too large to reliably capture the signal of program impacts. These NMEC-specific issues combined with the data

reliability issues led us to determine that these properties were not suitable for either DiD or NMEC estimation.

As stated earlier, the ex ante savings vary considerably for the 1-9 unit compared to the 10+ unit records in the PT data. Table A-1 presents the distribution of claimed savings, square feet installed, and number of Analysis IDs for the two groups by measure and building size. For window upgrades and small building insulation, the majority of participants, square feet installed, claimed kWh savings, and claimed therm savings are in the 1-9 unit group. For window retrofits, while a majority of the Analysis IDs are in the 1-9 unit group (52 percent), a majority of the square footage installed and kWh savings are in the 10+ units group (93 percent for both).

TABLE A-1: RECORDS BY MEASURE AND BUILDING SIZE 1-9 UNIT VS 10+ UNIT

Measure	Building Size	Metric	1-9 Units	10+ Units	NA Units	Total
Window Upgrade	Small	Claimed kWh Savings	57%	40%	3%	971,613
		Claimed therms Savings	63%	32%	4%	39,697
		Sq Ft Installed	59%	38%	3%	369,666
		Number of Analysis IDs	88%	6%	6%	1,432
Window Retrofit	Large	Claimed kWh Savings	6%	93%	1%	5,096,756
		Claimed therms Savings				0
		Sq Ft Installed	6%	93%	1%	741,817
		Number of Analysis IDs	52%	44%	4%	434
Insulation	Small	Claimed kWh Savings	59%	38%	3%	727,029
		Claimed therms Savings	74%	21%	5%	16,908
		Sq Ft Installed	61%	35%	4%	1,250,605
		Number of Analysis IDs	88%	7%	6%	527
Insulation	Large	Claimed kWh Savings	3%	97%	0%	273,449
		Claimed therms Savings	56%	40%	4%	519
		Sq Ft Installed	4%	96%	0%	618,998
		Number of Analysis IDs	33%	64%	2%	42

The numbers in this table were calculated based on PT data prior to merging with billing data.

A major difference between the 1-9 unit group and the 10+ group is the overwhelming prevalence of renters in 10+ unit group, while the 1-9 unit group has a mixture of owners and renters, as shown in Table A-2 below.

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TABLE A-2: PERCENT OF RENTERS IN 1-9 UNIT VS 10+ UNIT RECORDS BY MEASURE AND BUILDING SIZE

Measure	Building Size	Metric	1-9 Units % Renters	10+ Units % Renters	Overall % Renters	Total
Window Upgrade	Small	Claimed kWh Savings	56%	97%	72%	971,613
		Claimed therms Savings	36%	100%	56%	39,697
		Sq Ft Installed	49%	98%	67%	369,666
		Number of Analysis IDs	40%	99%	42%	1,432
Window Retrofit	Large	Claimed kWh Savings	57%	100%	98%	5,096,756
		Claimed therms Savings				0
		Sq Ft Installed	59%	100%	98%	741,817
		Number of Analysis IDs	31%	99%	61%	434
Insulation	Small	Claimed kWh Savings	69%	72%	70%	727,029
		Claimed therms Savings	62%	100%	68%	16,908
		Sq Ft Installed	67%	76%	69%	1,250,605
		Number of Analysis IDs	55%	94%	57%	527
Insulation	Large	Claimed kWh Savings	66%	100%	99%	273,449
		Claimed therms Savings	95%	100%	93%	519
		Sq Ft Installed	68%	100%	99%	618,998
		Number of Analysis IDs	36%	100%	76%	42

The numbers in this table were calculated based on PT data prior to merging with billing data.

Table A-3 presents some additional characteristics of the multifamily buildings by the 1-9 unit group and 10+ unit group. The age and claimed savings per square foot installed is fairly similar for the two groupings, but the size (in square feet) of the unit is generally smaller for the larger unit installation records when compared to the single-unit records.

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TABLE A-3: BUILDING CHARACTERISTICS BY 1-9 UNIT VS 10 + UNIT RECORDS

Measure	Metric	1-9 Units	10+ Units	NA Units	Total
Window Upgrades	Average Age	1972	1970	1960	1972
	Average Square Feet of Unit	1,069	660		1,202
	Average Number of Units	1.6	34.2		4
	Average Number of Floors	1.7	1.6	1.4	1.7
	Claimed kWh Savings/Sqft	2.56	2.74	2.46	2.63
	Claimed therms Savings/Sqft	0.12	0.09	0.23	0.11
Window Retrofit	Average Age	1972	1971	1950	1971
	Average Square Feet of Unit	936	825		905
	Average Number of Units	2	58.3		27
	Average Number of Floors	1.6	2.3	2.0	2.0
	Claimed kWh Savings/Sqft	6.74	6.90	4.70	6.87
	Claimed therms Savings/Sqft	0.00	0.00	0.00	0
Insulation	Average Age	1963	1967	1949	1963
	Average Square Feet of Unit	1,032	696		1,150
	Average Number of Units	1.8	41.5		6
	Average Number of Floors	1.5	1.9	1.6	1.5
	Claimed kWh Savings/Sqft	0.55	0.53	0.47	0.54
	Claimed therms Savings/Sqft	0.02	0.00	0.02	0.01

The numbers in this table were calculated based on PT data prior to merging with billing data.

A.2 STATISTICALLY ADJUSTED ENGINEERING MODEL

One concern that arose in the implementation of the three-stage DiD approach was the large number of participants that had to be dropped due to issues with the data. One of the main sources of attrition was the presence of multiple dispersed installation dates for a single unit. In these cases, a participant would have a measure installed and then, for example, six months later, have another measure installed. These additional interventions impeded the ability to identify clear post-installation periods with at least 10 consecutive months.

As a remedy to this problem, we tested using a statistically adjusted engineering (SAE) approach. In an SAE approach, ex ante savings are used directly in a panel data structure as measure-specific independent variables. Instead of interfering with the post period, additional measures installed are simply added to the ex ante savings used in the model. For example, if 10 kWh of windows were installed in January of 2018, in the DiD approach, the installation of 20 kWh of insulation in August of the same year would invalidate the post period. In the SAE approach, the new measure would just become another variable in the model. Similarly, additional windows would just lead to an increase in the expected ex ante savings.

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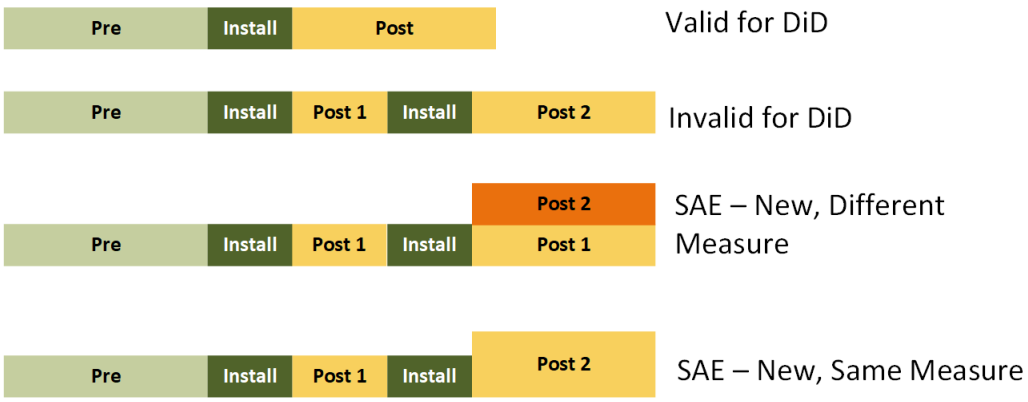
To supplement the description above, **Error! Reference source not found.** provides a visual portrayal of how the SAE approach might mitigate the data attrition due to multiple measure installations. In the top example, there is one installation with an uninterrupted post period, which is the condition needed for the DiD approach. In the next example, an additional installation breaks up the post period into two segments, neither of which is long enough to use individually (note that such cases of multiple 10+ month post periods did occur, and we did use them in the DiD modeling). The bottom two examples show how the SAE allows us to use the data in the model. In the penultimate, the case is where, say, insulation is first installed, followed by windows some months later. For this situation, the insulation ex ante savings are introduced into the model at the first installation period and continue throughout the post (if not clear, they have a value of zero prior to their installation date). After the second installation, window ex ante savings are then introduced into the model in an additional variable. In the final example, the situation is that the same type of measure is installed, in which case their savings are added to the ex ante savings (as represented by the taller segment for "Post 2."

FIGURE A-1: DID VERSUS SAE ATTRITION EXAMPLE



The SAE approach, however, also introduced additional sources of uncertainty to the modeling. First, the annual ex ante savings need to be allocated to monthly values. We did this using heating- and cooling-degree days, which, while defensible and frankly the only feasible method, certainly introduced error into the model.

The next issue with the SAE approach is that the installation dates in the program tracking data are imprecise, so the exact time that savings will be observed is unknown. With the DiD approach, we can apply an ample "dead band" around the installation dates, and then produce weather normalized data for more cleanly identified pre and post periods. With the SAE approach, we cannot exclude that quantity of data from the model without creating a highly imbalanced panel data design (what do time effects mean when a large share of participants does not have data for them?), so this introduced uncertainty from the actual installation timing into the model.

Finally, the SAE models required separate terms for different measures as well as variables for weather. These more complex specifications invariably introduce more noise than found in the DiD weather normalized series, which were also modeled separately by measure type. These are not flaws in the method, but they are differences that can result in marked differences in the modeling results.

In addition to the above sources of uncertainty, the SAE modeling data relied on monthly bills prior to normalization, which required a separate type of data cleaning routine in which it was difficult to maintain consistent exclusion criteria. After going through this cleaning process, the reduction in attrition was not substantial, which was the primary objective of trying this approach.

The SAE model produced results showing program savings, in some cases consistent with those found in the DiD modeling, but not always. This presents the problem of having two sets of results, so given that the increase in sample was not substantial and that this approach deviated from the evaluation plan, we have opted to omit them from this document.

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APPENDIX B DIFFERENCE-IN-DIFFERENCE MODEL RESULTS BY DOMAIN

The tables in this section display segmented model results for windows and insulation installations in electric and gas heated units. We only show results where the model N or number of Analysis IDs is at least 30. None of the results were statistically significantly different from the results presented above (and in the All row) or from each other, therefore, these results serve as a directional indicator of savings within each domain.

TABLE B-1: ESTIMATED ELECTRIC WINDOW UPGRADE SAVINGS SEGMENTED BY ADDITIONAL DOMAINS

Energy	Domain	Domain Segment	# Analysis ID / Installation Period	Estimated Energy Savings per Square Feet Installed	Number of Months Statistically Significant at 10%	Realization Rate Observed	Realization Rate Adjusted
kWh	All	All	320	5.61 ± 2.08	7	1.33 ± 0.49	0.34 ± 0.12
kWh	Rent/ Own	Rent	53	6.90 ± 6.55	3	1.56 ± 1.48	0.40 ± 0.38
kWh		Own	264	5.06 ± 1.91	8	1.21 ± 0.46	0.31 ± 0.12
kWh	Region	Portland & HR	262	5.22 ± 2.32	7	1.21 ± 0.54	0.31 ± 0.14
kWh		Willamette Valley	32	0.38 ± 5.31	1	0.10 ± 1.34	0.02 ± 0.35
kWh	Heating Zone	HZ1	315	5.35 ± 2.08	6	1.27 ± 0.49	0.32 ± 0.12
kWh		HZ2	5				
kWh	Year	2016	44	2.94 ± 8.03	0	0.68 ± 1.86	0.18 ± 0.48
kWh		2017	55	7.82 ± 5.35	6	1.60 ± 1.10	0.45 ± 0.31
kWh		2018	50	7.38 ± 4.20	6	1.51 ± 0.86	0.42 ± 0.24
kWh		2019	40	3.55 ± 5.30	0	0.85 ± 1.27	0.21 ± 0.31
kWh		2020	51	7.51 ± 6.63	5	1.81 ± 1.60	0.45 ± 0.40
kWh		2021	80	5.08 ± 3.00	5	1.58 ± 0.94	0.33 ± 0.19

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TABLE B-2: ESTIMATED ELECTRIC WINDOW RETROFIT SAVINGS SEGMENTED BY ADDITIONAL DOMAINS

Energy	Domain	Domain Segment	# Analysis ID / Installation Period	Estimated Energy Savings per Square Feet Installed	Number of Months Statistically Significant at 10%	Realization Rate
kWh	All	All	100	4.87 ± 3.14	5	0.65 ± 0.42
kWh	Rent/Own	Rent	11			
kWh		Own	89	6.39 ± 3.22	7	0.87 ± 0.44
kWh	Region	Portland & HR	97	4.49 ± 3.14	5	0.60 ± 0.42
kWh		Willamette Valley	2			
kWh	Heating Zone	HZ1	99	4.67 ± 3.13	5	0.63 ± 0.42
kWh		HZ2	1			
kWh	Year	2016	12			
kWh		2017	35	11.09 ± 6.41	6	1.87 ± 1.08
kWh		2018	16			
kWh		2019	9			
kWh		2020	14			
kWh		2021	14			

TABLE B-3: ESTIMATED ELECTRIC INSULATION SAVINGS SEGMENTED BY ADDITIONAL DOMAINS

Energy	Domain	Domain Segment	# Analysis ID / Installation Period	Estimated Energy Savings per Square Feet Installed	Number of Months Statistically Significant at 10%	Realization Rate
kWh	All	All	140	0.45 ± 0.42	5	0.67 ± 0.63
kWh	Rent/Own	Rent	52	0.21 ± 0.79	7	0.31 ± 1.19
kWh		Own	88	0.65 ± 0.37	9	0.95 ± 0.54
kWh	Region	Portland & HR	103	0.19 ± 0.35	3	0.27 ± 0.50
kWh		Willamette Valley	15			
kWh	Heating Zone	HZ1	140	0.45 ± 0.42	5	0.67 ± 0.63
kWh	Year	2016	17			
kWh		2017	16			
kWh		2018	9			
kWh		2019	19			
kWh		2020	37	1.10 ± 0.70	4	2.03 ± 1.29
kWh		2021	42	0.12 ± 0.55	2	0.23 ± 1.01

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TABLE B-4: ESTIMATED GAS WINDOW UPGRADE SAVINGS SEGMENTED BY ADDITIONAL DOMAINS

Energy	Domain	Domain Segment	# Analysis ID / Installation Period	Estimated Energy Savings per Square Feet Installed	Number of Months Statistically Significant at 10%	Realization Rate Observed	Realization Rate Adjusted
therm	All	All	229	0.12 ± 0.09	6	0.40 ± 0.30	0.10 ± 0.08
therm	Rent/ Own	Rent	26				
therm		Own	203	0.08 ± 0.09	2	0.27 ± 0.30	0.07 ± 0.08
therm	Region	Portland & HR	192	0.09 ± 0.11	1	0.28 ± 0.34	0.07 ± 0.09
therm		Willamette Valley	26				
therm	Heating Zone	HZ1	221	0.12 ± 0.10	4	0.38 ± 0.32	0.10 ± 0.08
therm		HZ2	3				
therm	Year	2016	19				
therm		2017	45	0.10 ± 0.14	2	0.25 ± 0.36	0.08 ± 0.11
therm		2018	23				
therm		2019	36	-0.08 ± 0.21	0	-0.24 ± 0.59	-0.07 ± 0.17
therm		2020	50	0.12 ± 0.16	0	0.42 ± 0.59	0.10 ± 0.14
therm		2021	56	0.28 ± 0.17	5	1.16 ± 0.72	0.24 ±0.15

TABLE B-5: ESTIMATED GAS INSULATION SAVINGS SEGMENTED BY ADDITIONAL DOMAINS

Energy	Domain	Domain Segment	# Analysis ID / Installation Period	Estimated Energy Savings per Square Feet Installed	Number of Months Statistically Significant at 10%	Realization Rate
therm	All	All	35	0.04 ± 0.02	3	0.90 ± 0.47
therm	Rent/Own	Rent	7			
therm		Own	28			
therm	Region	Portland & HR	29			
therm		Willamette Valley	4			
therm	Heating Zone	HZ1	35	0.04 ± 0.02	3	0.90 ± 0.47
therm	Year	2016	5			
therm		2017	5			
therm		2018	7			
therm		2019	2			
therm		2020	9			
therm		2021	7			

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APPENDIX C REGRESSION RESULTS AND CONFIDENCE INTERVAL CALCULATION

C.1 REGRESSION RESULTS

The regression results from the three-stage DiD estimations are displayed in this section, by measures and fuels. The first stage of the DiD estimation, the weather normalization of consumption, is explained in depth in section 3.2.41. This stage is necessary to remove any fluctuations from normalized consumption brought on by weather. The second and third stages of the DiD are estimated together in a single R package. These final two stages are weighted by the number of units treated at each Analysis ID. For the first part of the final two stages, the model regresses normalized monthly unit-level usage (kWh or therms) on bill date[17] and Analysis ID. This removes any variation in normalized usage caused by time and group effects. Regressing on bill date in this second stage ensures that any outstanding factors caused by time, excluding weather effects that were removed in stage one, are removed. The removal of group and time effects is necessary due to the staggered treatment within the weatherization program, ensuring that the observed changes in consumption are associated with the measures installed, and not some other factor that would bias the result. An extreme example of this would be Covid-19, which would lead to substantial bias in the findings for participants that had measures installed around the onset of the pandemic. For the third stage, the estimated second stage consumption is regressed on a treatment model binary crossed with a month indicator. The treatment model variable is a binary indicator equal to one during the post-installation period for participants and zero for all other periods for participants and all periods for control observations. We present only results from the third stage models within this section as parameter estimates from the first and second stages are not directly relevant to the study question.

Coefficients for treatment crossed with each month are displayed in Table C-1 through Table C-5. Negative estimated coefficients represent program savings while positive coefficients represent increased usage. As expected, months with statistically significant savings tend to be heating months October through April. The number of participants is reported in each table, with each participant having 12 months of pre and 12 months of post data. Additionally, there are an equal number of controls included in each model that also have 12 months of pre and 12 months of post data.

The R-squared and adjusted R-squared for each model are also reported for each analysis. One might note that these values are low for each analysis, but this is associated with the specific approach used to model impacts. The first two stages of the DiD analysis essentially remove weather specific, site specific, and

[17] The bills are calendarized to start on the first day of each month, aligning the bill date with the corresponding month and year.

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time specific variation from normalized consumption in our models, leaving only the effect of treatment to explain the remaining variation. While R-squared is a measure of the variation explained by the model, these results only reflect the final stage, so one does not see how much variability was accounted for by the first two stages of modeling. Therefore, in DiD analysis it is important to focus more on the coefficients on the treatment interaction terms, as they provide more information on the validity and magnitude of the treatment effects.

TABLE C-1: ELECTRIC WINDOW UPGRADES IN SMALL SITES REGRESSION RESULTS

Dependent Variable	Estimated Normalized Monthly Usage (kWh)	Significance	Standard Error
treatment_model = 1 x month = 1	-97.74	***	21.05
treatment_model = 1 x month = 2	-85.59	***	16.26
treatment_model = 1 x month = 3	-73.50	***	14.96
treatment_model = 1 x month = 4	-41.31	**	12.93
treatment_model = 1 x month = 5	-20.79		13.25
treatment_model = 1 x month = 6	-14.79		15.66
treatment_model = 1 x month = 7	-24.25		19.14
treatment_model = 1 x month = 8	-24.08		19.83
treatment_model = 1 x month = 9	-24.24		15.06
treatment_model = 1 x month = 10	-25.82	.	13.78
treatment_model = 1 x month = 11	-66.20	***	15.41
treatment_model = 1 x month = 12	-98.31	***	19.40
S.E. Type			Custom
Number of Participant Analysis IDs			320
R2			0.0174
Adjusted R2			0.0167

Significance codes: '***' 0.001, '**' 0.01, '*' 0.05, '.' 0.1

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TABLE C-2: ELECTRIC WINDOWS RETROFITS IN LARGE SITES REGRESSION RESULTS

Dependent Variable	Estimated Normalized Monthly Usage (kWh)	Significance	Standard Error
treatment_model = 1 x month = 1	-20.78		34.83
treatment_model = 1 x month = 2	-63.72	**	23.00
treatment_model = 1 x month = 3	-59.87	***	17.67
treatment_model = 1 x month = 4	-51.38	***	15.49
treatment_model = 1 x month = 5	-27.63		18.65
treatment_model = 1 x month = 6	-16.26		21.94
treatment_model = 1 x month = 7	-24.36		23.79
treatment_model = 1 x month = 8	-22.26		23.10
treatment_model = 1 x month = 9	-28.51		22.61
treatment_model = 1 x month = 10	-39.07	*	19.62
treatment_model = 1 x month = 11	-39.92	.	20.63
treatment_model = 1 x month = 12	-41.22		29.69
S.E. Type			Custom
Number of Participant Analysis IDs			100
R2			0.01095
Adjusted R2			0.00868

Significance codes: '***' 0.001, '**' 0.01, '*' 0.05, '.' 0.1

TABLE C-3: ELECTRIC INSULATION IN SMALL SITES REGRESSION RESULTS

Dependent Variable	Estimated Normalized Monthly Usage (kWh)	Significance	Standard Error
treatment_model = 1 x month = 1	-149.00	***	35.60
treatment_model = 1 x month = 2	-87.56	***	26.13
treatment_model = 1 x month = 3	-46.02	*	22.38
treatment_model = 1 x month = 4	-5.86		19.11
treatment_model = 1 x month = 5	4.66		20.99
treatment_model = 1 x month = 6	8.28		23.37
treatment_model = 1 x month = 7	20.31		29.78
treatment_model = 1 x month = 8	20.35		28.55
treatment_model = 1 x month = 9	13.34		24.32
treatment_model = 1 x month = 10	-6.78		19.49
treatment_model = 1 x month = 11	-77.36	**	24.83
treatment_model = 1 x month = 12	-123.9	***	32.09
S.E. Type			Custom
Number of Participant Analysis IDs			140
R2			0.02871
Adjusted R2			0.02711

Significance codes: '***' 0.001, '**' 0.01, '*' 0.05, '.' 0.1

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TABLE C-4: GAS WINDOW UPGRADES IN SMALL SITES REGRESSION RESULTS

Dependent Variable	Estimated Normalized Monthly Usage (therms)	Significance	Standard Error
treatment_model = 1 x month = 1	-1.87		1.73
treatment_model = 1 x month = 2	-2.18	.	1.26
treatment_model = 1 x month = 3	-2.26	*	0.98
treatment_model = 1 x month = 4	-2.41	**	0.86
treatment_model = 1 x month = 5	-1.77	.	0.99
treatment_model = 1 x month = 6	-0.67		1.18
treatment_model = 1 x month = 7	-0.20		1.31
treatment_model = 1 x month = 8	-0.49		1.31
treatment_model = 1 x month = 9	-0.67		1.16
treatment_model = 1 x month = 10	-2.06	*	0.96
treatment_model = 1 x month = 11	-2.05	*	1.03
treatment_model = 1 x month = 12	-2.14		1.517
S.E. Type			Custom
Number of Participant Analysis IDs			229
R2			0.00335
Adjusted R2			0.00235

Significance codes: '***' 0.001, '**' 0.01, '*' 0.05, '.' 0.1

TABLE C-5: GAS INSULATION IN SMALL SITES REGRESSION RESULTS

Dependent Variable	Estimated Normalized Monthly Usage (therms)	Significance	Standard Error
treatment_model = 1 x month = 1	-8.67	.	4.61
treatment_model = 1 x month = 2	-4.83		3.26
treatment_model = 1 x month = 3	-3.49		2.18
treatment_model = 1 x month = 4	-1.67		1.86
treatment_model = 1 x month = 5	-0.62		2.04
treatment_model = 1 x month = 6	-1.10		2.62
treatment_model = 1 x month = 7	-2.76		2.60
treatment_model = 1 x month = 8	-2.06		3.60
treatment_model = 1 x month = 9	-1.52		2.67
treatment_model = 1 x month = 10	-0.31		1.97
treatment_model = 1 x month = 11	-6.13	**	2.32
treatment_model = 1 x month = 12	-8.86	*	4.19
S.E. Type			Custom
Number of Participant Analysis IDs			35
R2			0.02483
Adjusted R2			0.0184

Significance codes: '***' 0.001, '**' 0.01, '*' 0.05, '.' 0.1

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C.2 INTERPRETTING MONTHLY REGRESSION RESULTS AND CONSTRUCTING CONFIDENCE INTERVALS

The final stage of our approach estimates monthly savings caused by the weatherization measure installations. The annual savings, which are the sum of the individual monthly coefficients, have underlying uncertainty, so it is useful to estimate confidence intervals to help interpret the results. Were the savings generated from a single model coefficient, its standard error could be used directly to calculate the confidence intervals. For this analysis, however, there are coefficients for the individual months, so these need to be aggregated to develop the overall confidence interval for the annual savings. This section describes the method used to generate these confidence intervals.

The standard errors developed to calculate the confidence intervals for these results were based on the delta method. The delta method is a statistical technique used to approximate the standard error of a function of an estimator. It leverages the principles of Taylor series expansion to transform the variance of a simple estimator into the variance of a more complex function of that estimator. Although it is particularly beneficial for nonlinear functions, it also applies seamlessly to linear functions, such as those estimated for this evaluation.

For this evaluation, the function is linear, so the variance of the annual effect is the sum of the variances of the individual monthly effects. The standard error of the annual estimate is the square root of this total variance, and this standard error is then easily constructed as we have an estimate of the standard error of the model.

CADMUS

2021-2024 Production Efficiency Greenhouse Measures Market Research

July 3, 2025

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MEMO

Date: September 8, 2025
To: Energy Trust Board of Directors
From: Kirstin Pinit, Program Manager – Industry and Agriculture
Jane Hammaker, Sr Project Manager – Evaluation

Re: Staff Response to Greenhouse Measure Research Report

Energy Trust's Production Efficiency program ("the program") commissioned Cadmus to conduct market research on greenhouse measures offered as part of the standard industrial track. The study conducted interviews with greenhouse owners and vendors to better understand the market adoption of greenhouse equipment, motivations and barriers to purchasing efficient equipment and general information on greenhouse characteristics and operational practices. We are using these results to 1) inform future program design, and 2) update measure assumptions for greenhouse measures (measure approval document [MAD] 104), greenhouse controllers (MAD 103) and condensing unit heaters for greenhouses (MAD 134) that go into effect in 2026.

Cadmus completed interviews with 12 greenhouse owners[1] who received incentives from the program for recent greenhouse equipment purchases. Most respondents operate large single- and multi-span greenhouses in the Willamette Valley. Project site sizes range from one greenhouse to 60 greenhouses per site, and the average greenhouse size is over 2,000 square feet. Participant respondents grow a variety of crops, such as perennials, annuals, vegetables, conifers, deciduous trees and shrubs, and they typically rotate crops seasonally. Cadmus also interviewed greenhouse equipment vendors to learn about purchase prices, sales and market adoption. All eight vendor respondents sold greenhouse equipment within and outside of Oregon. Both vendor and greenhouse owner respondents were recruited based on their previous engagement with Energy Trust. As a result, findings from vendors may not be representative of the broader greenhouse equipment market, and findings from greenhouse owners may not apply to smaller greenhouses less than 2,000 square feet.

The research team synthesized findings and developed recommendations with implications for greenhouse measure design and development, including:

Recommendation: Continue offering the greenhouse controller incentive; highlight the importance of managing heating and cooling systems together where applicable; increase the visibility of the multiple-sensor controller incentive; highlight the energy efficiency benefits of integrating controller systems in large greenhouses. All 12 greenhouse owners

[1] We gave respondents the opportunity to complete the survey for their single-span and multi-span greenhouses separately; three respondents completed our survey for both greenhouse types, totaling 15 responses from 12 unique greenhouse owners.

use greenhouse controllers, six of which were purchased with incentives. Controller systems include centralized, standalone and both centralized and standalone configurations. Most respondents reported controlling their systems independently as opposed to managing them together. The components integrated into central controls varied, but most systems included ventilation fans and unit heaters. When asked about components planned to be integrated into central controls, respondents reported interest in zonal humidity, temperature and wind speed ventilation. Greenhouse vendors also reported an increase in customer demand for integrated climate control solutions and provided information on purchase and installation costs.

- The program agrees that there may be untapped opportunities for energy efficiency in large greenhouses through improved coordination of equipment by controllers (the report also notes that standalone controls are best suited for small greenhouses under 5,000 square feet). The program will consider highlighting controller incentives in marketing and outreach to large greenhouse customers.

Recommendation: High sales and uptake of efficient greenhouse equipment, such as IR polyfilm and condensing unit heaters, suggest that baseline assumptions that assume zero to low adoption in the market may need to be revised. Greenhouse owners used incentives to purchase condensing unit heaters (eight out of 14 respondents) and infrared (IR) polyfilm envelope materials (five respondents) to expand their facilities. Most greenhouse owners reported using a high efficiency condensing unit heater. IR polyfilm is the most common greenhouse envelope material, but standard and IR polyfilm materials represent similar shares of vendor greenhouse envelope material sales. Vendors also reported that customers typically replace their existing envelope material with the same material. These findings suggest the program may need to revise calculations used for baseline market adoption to assume a larger share of greenhouse owners use efficient equipment for these measures.

- The program will review the analysis during the 2025 measure update process and consider revising and updating baseline assumptions accordingly.

Recommendation: Because many respondents reported purchasing equipment to support facility expansion, consider expanding eligibility for incentives limited to "replacement only" to also apply to new construction projects. The main factors customers considered when purchasing new or replacement equipment were costs (nine respondents), equipment lifetime (eight respondents) and new technology (six respondents).

- This applies to two prescriptive measures: IR polyfilm and under-bench heaters. The program will investigate if it is possible to add more applications in new construction projects.

1. 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, Cascade Natural Gas, Avista, NW Natural, 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 measures offered for greenhouses through the Production Efficiency program. The research involved collecting information from greenhouse owners and operators to update assumptions underlying Energy Trust's greenhouse measure offerings. As some of these measures (infrared [IR] film, thermal curtains, under-bench heating, condensing unit heaters, and controllers for greenhouses) are set to expire at the end of 2025, the findings from this research will help to inform potential updates and provide a better understanding of the greenhouse market.

1.1. Program Description

The Production Efficiency program is comprised of two main program tracks: Standard Industrial and Custom. The Custom track includes Custom Capital and SEM (Strategic Energy Management) sub tracks. The Standard track includes Streamlined Industrial and Lighting. Within the Standard Industrial track, Energy Trust offers greenhouse measures that are currently set to expire at the end of 2025.

1.2. Summary of Methods

Before starting work on this market research, Cadmus, along with Energy Trust's guidance, developed a work plan specifying the activities, methods, and deliverables for this study. We followed the evaluation guidelines in the *Greenhouse Measures Work Plan*, approved by Energy Trust. The activities and methods used to address research questions are summarized below and described in greater detail throughout this section.

PROGRAM PARTICIPANT SURVEYS
Cadmus conducted a census survey of greenhouse owners and operators who received incentives for energy-efficient equipment through Energy Trust's Production Efficiency program. The team collected information on greenhouse technologies, equipment uses, and operational practices. We conducted outreach by email and phone, followed by reminder emails and phone interviews to encourage participation. The survey prioritized single-span greenhouses and allowed participant respondents to answer separately for multi-span facilities when applicable.
VENDOR INTERVIEWS
Cadmus conducted one-to-one interviews and online surveys with greenhouse equipment vendors that sell or distribute products in Oregon. We gathered information on sales practices, regional demand, product availability, pricing, customer preferences, and factors influencing equipment selection and installation.

1.3. Summary of Findings

This section presents Cadmus' research findings, organized by key topic areas. The first set of findings focuses on technology-specific insights, informed by both participant and vendor respondents. The next set of findings focuses on greenhouse operations based on participant survey respondents.

Technology-Specific: Greenhouse Equipment

Several greenhouse components were commonplace among program participants who responded to the survey (n=15). Most participant respondents reported having controller systems, cooling equipment, unit heaters, and polyfilm envelopes. Boilers were also fairly common. Among those who use boilers and unit heaters, more than half of respondents reported using efficient equipment. In contrast, only two respondents said they use dehumidifiers.

Across all equipment respondents purchased through Energy Trust's program within the past four years (n=14), condensing unit heaters, greenhouse controllers, and infrared poly for greenhouses were the most common. A majority of respondents said they purchased new equipment to support an expansion, meaning the addition of new greenhouse space or infrastructure. Others replaced equipment with similar sized models. A small number replaced equipment to increase capacity, referring to upgrades that support increased production within their existing space. When deciding whether to purchase or replace equipment, nearly all respondents said cost was the most important consideration when they purchased equipment, followed closely by equipment lifetime.

Envelope Materials

Twelve participant respondents use polyfilm for their greenhouse envelopes, seven of whom use infrared (IR) polyfilm, which is the energy-efficient envelope upgrade incentivized by Energy Trust. Four of those respondents purchased IR polyfilm through Energy Trust's program in the past four years, and an additional respondent purchased IR polyfilm through the program (but did not indicate that they use the material in their envelopes currently). Respondents reported using other envelope materials as well – three use double rigid polycarbonate, two use single rigid polycarbonate, and two use transparent glass. No respondents used diffuse glass or triple-wall rigid polycarbonate.

Four vendors sold envelope materials, with all offering IR and standard polyfilm (single and double layer). Half also sold rigid polycarbonate, while individual vendors offered fiberglass, woven polyfilm, and glass. Vendors indicated that IR and standard polyfilm each accounted for up to 50% of their envelope material sales. One vendor reported that woven polyfilm made up 92% of their sales. Warranties ranged from one to five years for standard polyfilm and 10 to 15+ years for rigid polycarbonate. Vendors reported that purchases were primarily for replacement, with key decision factors being upfront cost, insulation value, and light transmission.

Boilers

Three vendors sold boilers, including high-efficiency condensing, standard, and electric models. All reported that boilers were typically purchased for system replacement or greenhouse expansion and that buyers prioritized upfront costs, long-term fuel savings, and available incentives. Vendors said

customers tend to favor high-efficiency units for performance and ease of installation and base boiler sizing on crop type, temperature setpoints (commonly 60°F to 75°F), and insulation level, with many growers incorporating redundant systems to prevent crop loss.

Heat Delivery Systems

Four vendors offered a range of heating systems, including condensing and non-condensing unit heaters, under-bench/in-floor hydronic heating, finned pipe radiators, and central air handlers. All agreed that purchases were mostly driven by replacement needs and that durability, low operating cost, and minimal maintenance were key buyer considerations. They also noted that customers use redundant systems. One vendor advocated for more rebates for hydronic heating to promote its adoption.

Curtains/Shading

Two vendors offered shade cloth, thermal curtains, and blackout systems, with both manual and automated options. They reported that nearly all systems were automated, and curtain selection was influenced by crop type, climate, and budget (including long-term cost savings).

Central Controls

Three vendors sold central climate control systems, with reported equipment costs over $2,000 and installation costs ranging from $23,000 to $100,000. These systems are suitable for any greenhouse size and typically last seven to 10 years, and desired features typically include integrated heating and ventilation control and remote access. Vendors noted key barriers included high costs, programming complexity, and network setup challenges.

Standalone Controls

Four vendors sold standalone control systems, with two reporting prices over $500. These are best suited for small greenhouses (<5,000 sq ft), used mostly for heating, and chosen for their lower cost. Vendors noted that standalone systems were infrequently replaced. Three vendors reported increasing customer demand for integrated climate control systems.

Lighting

One vendor offered lighting systems, reporting that LEDs made up 90% of sales, with the remainder being high intensity discharge (HID). LEDs typically cost $500+, while HID lights range from $200 to $499.

Ventilation/Dehumidification

Six vendors shared insights on ventilation; five reported that powered systems are more common, while one noted equal use of ventilation in powered and natural systems. Two vendors sold dehumidifiers, with Leizig and Quest named as leading brands. Vendors reported that dehumidifiers were mostly used in Cannabis cultivation.

Greenhouse Operations

Participant respondents showed different approaches to operating their heating and cooling systems. Most reported using unit heaters seasonally, particularly in winter, with average heating set points

around 56°F degrees after removing an outlier. Cooling systems were used year-round, seasonally, or based on ambient temperature limits, with set points ranging from 54°F degrees to 82°F (average: 69°F). Nearly all respondents relied on passive or fan-based ventilation systems, while only a few reported using mechanical cooling methods like chilled water or evaporative systems.

2. Introduction

Energy Trust contracted Cadmus to complete market research on greenhouse measures for its Production Efficiency program, which seeks to update its measures and offerings to more accurately reflect savings opportunities and make offerings more accessible and attractive to its greenhouse customers.

2.1. Greenhouse Participation

Cadmus conducted a census survey and interviews with greenhouse operators or owners who participated in the Production Efficiency program from 2021 to 2024.

However, after reviewing the program tracking data, we found that participation dates back to 2019. Due to the limited number of contacts, Cadmus contacted all available participants listed in the program tracking data. Table 1 and Table 2 show the distribution of projects for participants from 2019 to 2024, as well as the regions where each project was implemented.

Table 1. Greenhouse Sites, Projects, and Contact Counts by Year, 2019 to 2024

Program Year	Sites [a]	Projects	Contacts Available [b]
2019	10	14	12
2020	5	5	5
2021	8	9	7
2022	4	5	4
2023	7	11	7
2024	6	9	9
Total (unique counts)	**24[c]**	**53**	**21[d]**

[a] Some sites had multiple projects across different program years.

[b] Some projects had the same contacts for different projects/sites across different program years.

[c] Participants completed projects at 24 unique sites during the period of 2019 to 2024.

[d] There were 21 unique contacts during the period of 2019 to 2024.

Table 2. Greenhouse Sites, Projects, and Contact Counts by Region, 2019 to 2024

Energy Trust Region	Sites	Projects	Contacts Available
Central Oregon	0	0	0
Eastern Oregon	0	0	0
Portland Metro and Hood River	5	6	5
Southern Oregon	2	2	2
Willamette Valley	17	45	18
Total (unique counts)	**24**	**53**	**21**

3. Evaluation Goals and Key Research Objectives

Energy Trust identified several research questions as goals for this research. Table 3 shows the groups (participants = P and vendors = V) the Cadmus team focused on to address each of Energy Trust's research goals.

Table 3. Research Questions and Corresponding Interviews

Research Questions	P	V
Technology-Specific		
What greenhouse controllers are represented in the Oregon market, and what are their market shares (greenhouse controllers baseline, full market)? • What are the predominant features these controllers provide compared to standalone temperature controllers? • What are the typical costs of purchase and installation of each of these types of controllers? • What are common greenhouse sizes that these controllers are installed in?	■	■
What kinds of greenhouse envelope materials are represented in the Oregon market, and what are their market shares (IR poly baseline, full market)? • What is the typical measure life or common warranty on life offered for each of these kinds of materials? • What are the typical costs of purchase and installation of each of these types of materials?	■	■
What kinds of heat delivery systems (Under-bench, perimeter, finned, etc.) are represented in Oregon, and what is their market share? • What boilers are represented in the Oregon market for greenhouse applications, and what are their typical market shares? • What is the typical boiler efficiency observed in the Oregon market for greenhouses? • How are boilers sized for greenhouse operations, and are they commonly installed as replacements or to handle greenhouse expansion and/or changing crop types? What set points are used for boilers in greenhouse applications?	■	■
Greenhouse Operations		
What heating and cooling equipment do participants use in their greenhouses? • What are the hours of operation for this kind of equipment?	■	
What kinds of controllers do participants use in their greenhouses? • What are the set points or operating schedules? • Do these controllers control cooling as well as heating? What systems are controlled together versus independently? • Do participants use dehumidifiers in their greenhouses? If so, what are the makes and models of units, and what are the set points?	■	
For the equipment type that the customer purchased through the program, was this replacing equipment or adding capacity?	■	
What share of participants' greenhouses use heating, and to what set points?	■	

3.1. Research Methodology

Cadmus gathered insights from both participants and vendors to thoroughly research the greenhouse market. For participants and vendors, we collected information about greenhouse controllers, envelope materials, and heat delivery systems, including features used, costs, typical measure life, and sizing. We also collected information from participants about the heating and cooling equipment they use, the types of controllers in place, their reasons for replacing equipment through the program, and their temperature set points. All participants in our sample were greenhouse owners or operators who implemented energy efficiency equipment in their greenhouse(s) and received incentives for that equipment through the Energy Trust Production Efficiency program between 2019 and 2024.[2] To answer the research objectives, Cadmus conducted three activities:

- Reviewed program tracking data
- Interviewed and surveyed participants from 2019 to 2024
- Interviewed vendors

Program Tracking Data Review

Cadmus reviewed program documents provided by Energy Trust to gain a thorough understanding of program processes, participants, and measures. Program documents included participation data since 2019, Measure Approval Documents (MADs) for greenhouse measures, and select project documentation. The document review provided our team with a foundational understanding of the program's offerings to inform the development of the survey and interview guides.

Participant Interviews and Surveys

Cadmus conducted interviews with participants to discuss the types of greenhouse measures they installed and the measures they would like to install, set points, operating schedules, greenhouse characteristics, and other greenhouses operated. The goal of the interviews was not to understand program experience but rather to assess current operating conditions to inform future measure offerings.

Energy Trust supplied a list of participants who received rebates for energy-efficient equipment through the Production Efficiency program. Cadmus aimed to complete 18 surveys or interviews from an anticipated population of 24 participants. While Energy Trust provided a list of 24 unique sites, two sites were duplicate names, and one lacked contact information, which left 21 available contacts.

[2] The initial work plan focused on participants from 2021 to 2024. However, a review of the program tracking data showed participation began in 2019. Given the already anticipated small participant pool, the team included all identified participants from 2019 through 2024 in the outreach.

Cadmus reached out to each participant via email and phone calls to schedule and conduct interviews. We completed interviews with 12 of the 21 participants and analyzed the data (summarized in the *Findings* section). We delivered $50 gift cards via Tango for each completed survey or interview via email.

Cadmus prioritized data collection on single-span greenhouse structures for this research. A single-span greenhouse is a standalone structure with one roof, while a multi-span greenhouse connects several of these structures under one larger roof. Recognizing that many greenhouse operators manage both single-span and multi-span greenhouses, we designed the Qualtrics survey to allow respondents to complete it separately for each type. Three respondents completed the survey twice, resulting in 15 total responses included in the analysis. Respondents who completed the survey a second time for multi-span facilities were offered an additional $50 incentive.

Cadmus launched the outreach effort on February 27, 2025, which continued for about five weeks with scheduled weekly reminders. Due to lower response rates than planned after multiple reminder emails, we reached out directly to participants and conducted surveys over the phone to bolster completions. In total, we achieved 12 completed surveys for a response rate of 57%, and collected four partially completed surveys for a 19% partial response rate.

Vendor Interviews and Surveys

Cadmus conducted interviews with participating vendors who offer greenhouse measures. We drafted an interview guide with questions covering topics such as the market for greenhouse measures, vendors' roles in promoting the program and alignment with participant needs, typical costs and expected measure lives, gaps in offered incentives, installation practices, and other key details about specific technologies. Energy Trust supplied a list of 18 participating vendors from the Production Efficiency program's greenhouse measure offerings. We reached out to each vendor via email and phone calls to schedule and conduct interviews, completing phone interviews with six of the 18 vendors. We also completed an interview with Argus Controls, who was not on the original list, to help fill a gap in information related to greenhouse controllers. We analyzed the data from all vendors, which is summarized in the *Findings* section. Cadmus provided $100 gift cards via Tango for each completed interview, which were delivered immediately over email upon completion of the interview.

Cadmus began contacting vendors on April 22, 2025 and concluded the outreach at the beginning of May. We reached out to all participating vendor contacts and were able to complete eight interviews for a response rate of 37%.. Table 4 shows a summary of the evaluation activities, sample, and response rate for the greenhouse measures market research.

Table 4. Greenhouse Measures Market Research Evaluation Methodology

Activities	Evaluation Protocol or Approach	Population and Valid Record Counts	Completions Achieved [a]	Response Rate
Participant interviews	Interview participants of greenhouse measures in Production Efficiency	Population: 24 Valid Records for Survey: 21	Complete: 12 Partial: 4	Complete: 57% Partial: 19%
Vendor interviews	Interview participating vendors from the Production Efficiency program who sell greenhouse measures	Initial vendor list provided by Energy Trust: 18 Valid Records for Interview and Survey: 19 [b]	Complete: 7	Complete: 37%

[a] Partial responses are for those who started but did not complete the survey and answered at least one question included in this report.

[b] The number of valid records exceeds the initial vendor list because, in addition to the 18 participating vendors provided by Energy Trust, the team also interviewed one vendor (Argus Controls) who was not included on the original list but participated in this task. Argus was added to help fill a gap in information related to greenhouse controllers.

4. Findings

This section presents the findings of Cadmus' research, including analysis findings based on the interview and survey data.

4.1. Respondent Profile

Cadmus invited 21 program participants to take a survey assessing their experience with the program and the rebated equipment they received; 12 participants responded to the survey,[3] with eight located in the Willamette Valley, three in the Portland Metro and Hood River regions, and one in Southern Oregon.

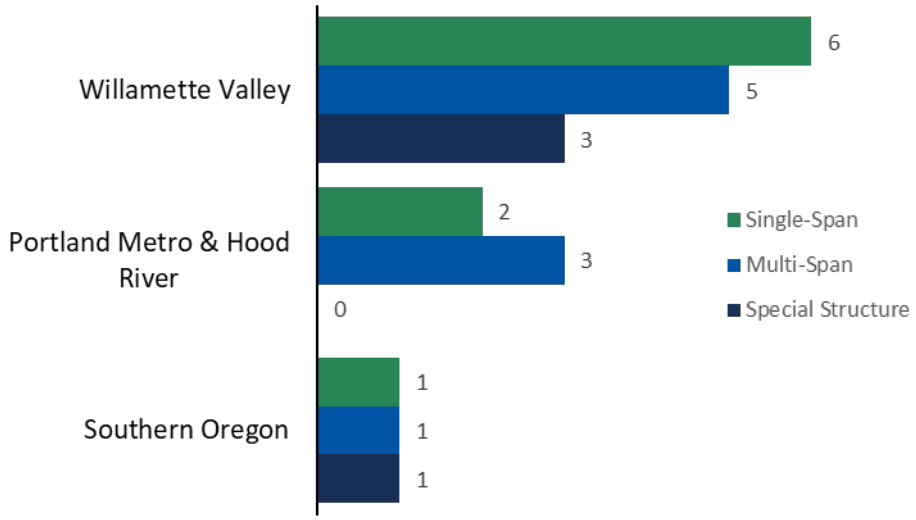
When asked whether their facility operates a single site or multiple sites, nine out of 12 participant respondents reported that their facilities operate a single site, and the remaining three reported two sites. The greenhouses managed by respondents tended to be older: five facilities were over 20 years old, five were between 16 and 20 years old, three were between six and 10 years old, and one was five years old or newer. One respondent did not know the age of their greenhouses.

When asked what type of greenhouses their site(s) operates, most respondents reported operating both single-span and multi-span greenhouses (seven respondents). Two respondents operated only single-span greenhouses, and two only operated multi-span.

As shown in Figure 1, greenhouses in the Portland Metro and Hood River regions were more likely to be multi-span than those in other regions (three respondents), whereas fewer were in Willamette Valley (five respondents) and Southern Oregon (one respondent).

[3] The survey allowed respondents who operate both single and multi-span greenhouses to answer the survey questions twice—once for their single-span greenhouses and once for their multi-span greenhouses. Three respondents chose to answer the questions twice, and the evaluation team included both responses in the analysis; therefore, the sample size for many questions is 15. Additionally, because respondents could select multiple answers for some questions, the sample sizes for some questions could be greater than 15.

Figure 1. Participants' Greenhouse Type by Region



Source: Energy Trust Greenhouse Measures Market Research, Participant Survey: Based on a cross-tabulation of Question A5. "What type of greenhouses does your site operate and how many of each" (n=12) and Energy Trust region data ("etoregion" variable) from program records.

The surveys also asked respondents how many single-span, multi-span, and special structures they operated. Single-span greenhouses were more prevalent than multi-span structures. Respondents reported operating between one and 60 single-span greenhouses (*mean* = 33.6), whereas the number of multi-span greenhouses ranged from one to nine (*mean* = 3.8).

Additionally, four respondents reported that they operate a special structure (either in addition to single or multi-span structures or on their own). Special structures included propagation buildings (two respondents), an insulated building with a retractable and translucent roof (one respondent), and a hydroponic greenhouse (one respondent).

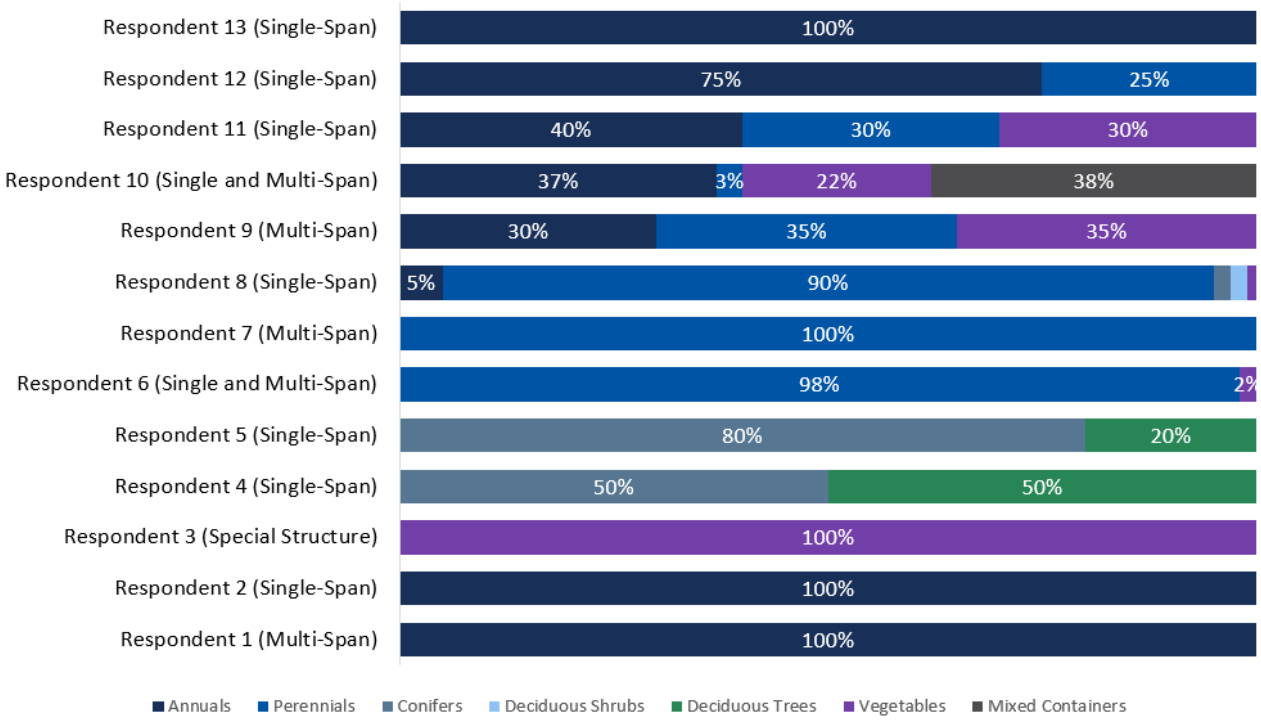
Respondents reported growing nonfood crops such as perennials and annuals, as well as vegetables, conifers, deciduous trees, and deciduous shrubs. As seen in Figure 2, five greenhouses were dedicated to growing only one type of crop. Two of those grew cannabis or hemp, which we grouped under annuals in the crop type breakdown. One greenhouse grew annuals, one grew perennials, and one grew vegetables exclusively. All other greenhouses grew two or more crop types.

Annuals and perennials were the most common crop type (eight of 13 respondents). There tended to be more annuals and fewer perennials in single-span greenhouses than in multi-span greenhouses.

Averaged across all single-span greenhouses (n=9), crop types comprised 40% annuals, 27% perennials, 15% conifers, 8% deciduous trees, 6% vegetables, and less than 1% deciduous shrubs. We reported vegetables separately from nonfood crops to represent how respondents distinguished food crops from nonfood crops. Averaged across all multi-span greenhouses (n=5), crop types comprised 48% perennials, 33% annuals, and 11% vegetables. We again reported vegetables separately from nonfood crops. One

respondent reported using the remaining proportions of both single- and multi-span greenhouses for mixed containers. None of the respondents reported growing broadleaf evergreens.

Figure 2. Percentage of Greenhouse Space Dedicated to Different Crop Types



Source: Energy Trust Greenhouse Measures Market Research, Participant Survey Question: B3. "What percentage of your greenhouse space is dedicated to the following:"
(n= 13)

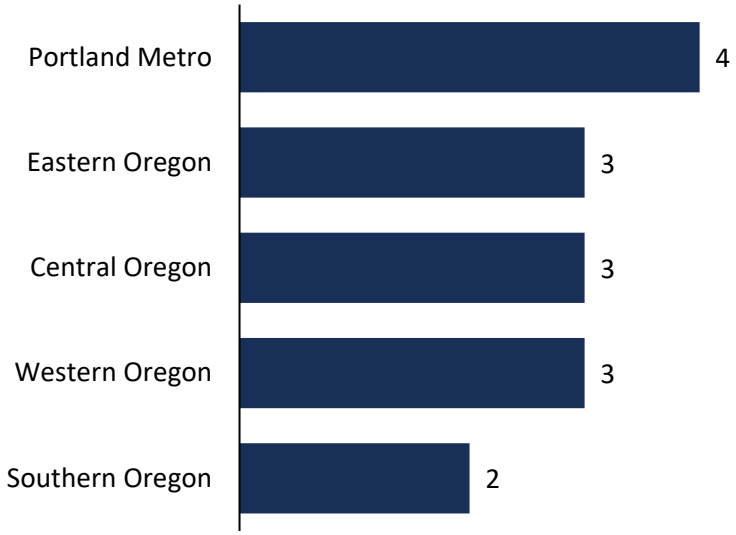
Respondents said they tend to rotate these crops according to season, maintaining crop growth during seasonally relevant times. One respondent said that they rotate crops based on disease and insect build-up and any particular species' sensitivities. Another respondent said they do not grow mature plants in their single-span greenhouse and only use it for staging new crops.

4.2. Vendor Profile

Cadmus asked vendors to describe their company. Of seven respondents, six vendors sell products from manufacturers to distributors, three vendors produce and sell their own greenhouse equipment, two vendors stock products that get shipped to regional stores, and one vendor noted that they offer rebate processing. Six vendors sell greenhouse equipment both within and outside of Oregon, and five of those vendors said that 25% of their equipment sales occur within Oregon, indicating low in-state sales across the sample. One vendor sells equipment only in Oregon.

Cadmus asked vendors what parts of Oregon their greenhouse equipment sales come from; the majority of vendors said that their sales come from the Portland Metro region (four respondents), followed by Central Oregon (three respondents), Eastern Oregon (three respondents), and Southern Oregon (three respondents). Figure 3 shows the count of vendors who conduct their sales in a given region.

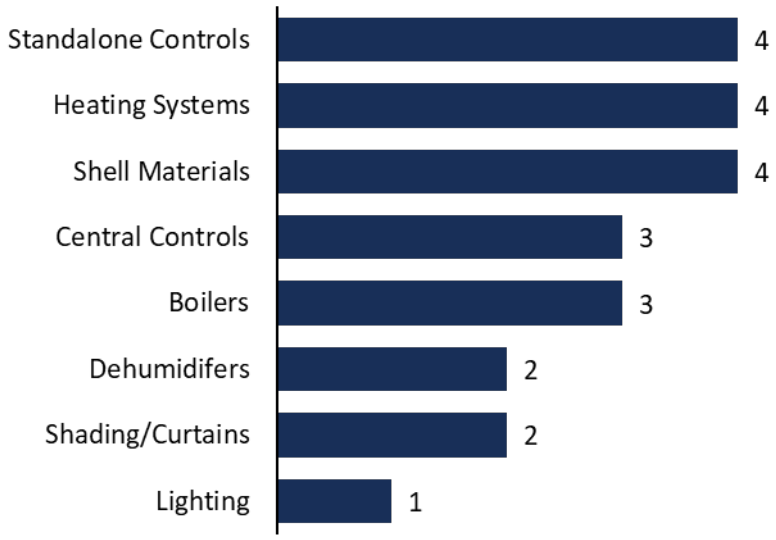
Figure 3. Vendor Sales Regions of Oregon



Source: Energy Trust Greenhouse Measures Market Research, Vendor Interview Question: B4. "What regions of Oregon account for most of your greenhouse equipment sales? Select all that apply." Options: Portland Metro; Eastern Oregon; Central Oregon; Western Oregon; Southern Oregon (n=5) Vendors could choose multiple options, so totals may exceed the sample size.

The distribution of equipment types among most vendors was fairly even, with four vendors each offering standalone controls, heating systems, and envelope materials, followed by central controls and boilers (three each), dehumidifiers and shading/curtains (two each), and lighting (one). Figure 4 shows the full breakdown of reported equipment types vendors sell.

Figure 4. Equipment Types Sold by Vendors



Source: Energy Trust Greenhouse Measures Market Research, Vendor Interview Questions: C1, D1, E1, F1, G1, H1, I1, J2. "Do you carry greenhouse equipment type?" (n=7) Some vendors sold multiple equipment types, so totals may exceed the sample size. See *Appendix B. Vendor Interview Guide* for the full survey questions and the list of answer equipment options.

4.3. Technology-Specific Research

To better understand the technologies used in Oregon's greenhouse market, the Cadmus team conducted surveys and interviews with program participants and vendors. The questions focused on three main areas: greenhouse controllers, envelope materials, and heat delivery systems. For each technology type, Cadmus gathered information on market availability, purchase and installation costs, common system features, and how these technologies are used in greenhouse operations. The findings in this section summarize what we learned through this research.

Greenhouse Characteristics

Greenhouse Sizes

Across all greenhouses in each participant respondents' facilities, the average greenhouse size tended to be large (i.e., more than 2,000 square feet for both single-span greenhouses and multi-span greenhouses). Specifically, among the single-span greenhouses, five respondents reported that the average size of their greenhouses was more than 2,000 square feet, three reported an average between 1,501 and 2,000 square feet, and only one reported an average between 1,001 and 1,500 square feet.

Similarly, for multi-span greenhouses, four respondents (all but one) reported an average of more than 2,000 square feet. None of the respondents' greenhouses were less than 1,000 square feet on average.

Envelope Materials Characteristics

Out of 15 participant respondents, almost half reported using multiple types of materials in the envelopes for their facility's greenhouses (seven respondents). Most respondents reported using standard polyfilm, infrared (IR) polyfilm (which is the energy-efficient envelope upgrade incentivized by Energy Trust), or both (12 respondents). Specifically, eight respondents said they use standard polyfilm, and seven said they use IR polyfilm. Three of those seven respondents reported purchasing IR polyfilm for their single-span greenhouses through Energy Trust's program in the past four years, and an additional respondent purchased the same for their multi-span greenhouses. Another respondent purchased IR polyfilm through Energy Trust's program but did not indicate that they use the material in their envelopes currently. All respondents who purchased IR polyfilm through Energy Trust's program did so to replace equipment of a similar size.

All respondents reported using other materials, such as double rigid polycarbonate (three respondents), single rigid polycarbonate (two respondents), or transparent glass (two respondents). No one reported envelopes made from diffuse glass or triple-wall rigid polycarbonate. Among the envelopes made with standard polyfilm, five respondents reported using thick material is (> 6mm), and three reported thin (< 6mm). Respondents also reported similar thickness for IR polyfilm envelopes, with more using thick material (four respondents) than thin (two respondents).

Eight of the respondents' greenhouse envelopes were five years old or newer. Three respondents had greenhouse envelopes between six and 10 years old, while three had greenhouses greater than 20 years old. More than half of the respondents' greenhouse roofs had arched (eight respondents), but some had triangular (three respondents), semi-gabled (two respondents), or half-arched (one respondent). Most greenhouses did not have solar shades (11 respondents) or thermal curtains (10 respondents).

Envelope Materials Market

Cadmus asked vendors if they sold envelope materials, and if so, which types, their market share, the average warranty, the typical purchase price, and the most common reasons for purchase. All vendors that sold envelope materials (n=4) sold IR polyfilm (single and double) and standard polyfilm (single and double), while two vendors sold rigid polycarbonate (single, double, and triple wall), and one vendor reported selling fiberglass panels. One vendor also noted they also sold woven polycarbonate, and another mentioned they sold glass.

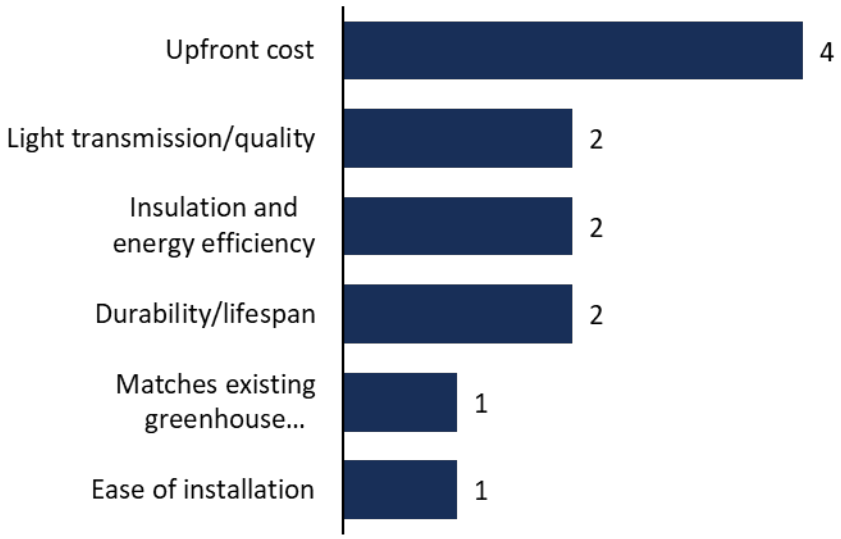
Vendors estimated that IR polyfilm (single) and standard polyfilm (single) each made up approximately 50% of their envelope material sales, followed by rigid at 30%. One vendor reported that woven polyfilm accounted for 92% of their envelope sales, and another reported glass accounted for 5% of their shell sales. IR polyfilm accounted for between 1-45% of individual vendors' envelope sales, with an average market share of 23%. Because IR polyfilm has a shorter warranty period (1–5 years), it may be replaced more frequently, and vendors noted that customers tend to repurchase the same material.

One vendor reported that woven polyfilm accounted for 92% of their envelope sales, and another reported glass accounted for 5% of their shell sales.

When asked about the most common reason that customers purchase envelope materials, all four vendors said to replace existing envelope material with the same envelope material. When asked which factors most influence customers' choices in greenhouse envelope materials, all four vendors said upfront cost was the most influential factor.

After cost, vendors were evenly split across light transmission/quality (two vendors), insulation/energy efficiency (two vendors), and durability/lifespan (two vendors). Figure 5 shows a complete breakdown of vendor responses.

Figure 5. Envelope Material Purchase Factors



Source: Energy Trust Greenhouse Measures Market Research, Vendor Interview Question C6: "Which factors most influence customers' choices in greenhouse shell materials? Select up to three." *Options: Upfront cost; Light transmission/quality; Insulation and energy efficiency; Durability/lifespan; Matches existing greenhouse materials on site; Ease of installation; Maintenance requirements; Other* (n=4). Vendors could choose multiple options, so totals may exceed the sample size.

Measure Warranties

When asked about the typical warranty periods for each envelope material they sell, all four vendors said they offered and sold standard and IR polyfilm.[4] Vendors consistently report the IR polyfilm carried a four-year warranty. For standard polyfilm, vendors reported warranties ranging from one to five years, with three of the four vendors stating a four-year warranty was the most typical. However, two vendors who offered rigid polycarbonate (single, double, and triple wall) said it had significantly longer

[4] The survey question asked vendors to report on both warranty and expected lifespan. All responses referenced warranty periods.

warranties, ranging from 10 to 15 years. One vendor reported selling woven polyfilm, which they stated typically carries a seven-year warranty. Table 5 includes a summary of the warranty period per material.

Purchase and Installation Costs

Cadmus asked vendors to provide the purchase cost per square foot of each envelope material they sold. All four vendors said IR and standard polyfilm were less expensive than rigid and woven polycarbonate. Table 5 summarizes envelope material purchase costs. Vendors were unsure of the installation costs due to not providing installation services.

Table 5. Envelope Materials Sold and Average Thickness, Warranty Period, Cost, and Market Share

Shell Material	Thickness (mm)	Warranty (years)	Cost (per square feet)	Count of Vendors (n=4)	% of Shell Sales
IR polyfilm (single)	6	4-5	$0.07-$0.2	4	1-45%
IR polyfilm (double, inflated)	6	4-5	$0.14-$0.4	4	3-10%
Standard polyfilm (single)	4-6	1-5	$0.05-$0.18	4	1-50%
Standard polyfilm (double, inflated)	4-6	1-5	$0.1-$0.3	4	3-10%
Woven polycarbonate	6	7	$0.42	1	92%
Rigid polycarbonate (single)	8	10-15+	$0.96-$2.45	2	5-10%
Rigid polycarbonate (double)	8	10-15+	$1.02-$2.45	2	5-35%
Rigid polycarbonate (triple)	8	10-15+	$2.21+	2	10%
Fiberglass panels	N/A	N/A	N/A	1	0%

Source: Energy Trust Greenhouse Measures, Vendor Interview Questions: C1-C6 about Greenhouse Shell Materials (n=4)
Respondents could choose multiple options, so totals may exceed the sample size

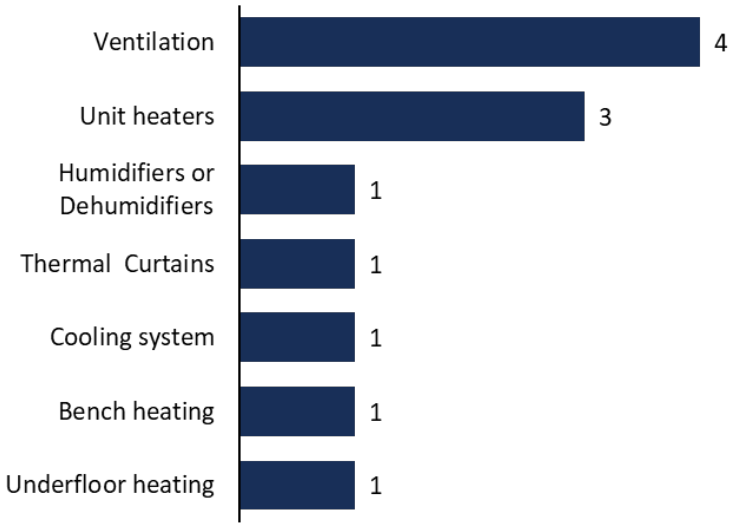
Oregon Greenhouse Controller Market

Controller Characteristics and Uses

All participant respondents reported using controllers in their greenhouses (14 respondents). Five respondents said they used central control systems, four used standalone equipment controls, and four used a mix of both. One additional respondent said they use just a thermostat control system. Most respondents programmed controllers with specific set points (11 respondents). All five respondents with large greenhouses over 2,000 square feet installed central control systems, and four of these systems were for multi-span greenhouses. In contrast, most standalone systems were installed in single-span greenhouses (three respondents) and those between 1,501 and 2,000 square feet (two respondents). All four respondents who reported using a mix of central and standalone systems typically used them in large, single-span greenhouses, with two respondents installing them in large greenhouses over 2,000 square feet.

Of the five respondents with central control systems, most are fully automated (four respondents), whereas one respondent reported manually adjusting their controls. Only four respondents with central systems described which components their systems control, as detailed in Figure 6.

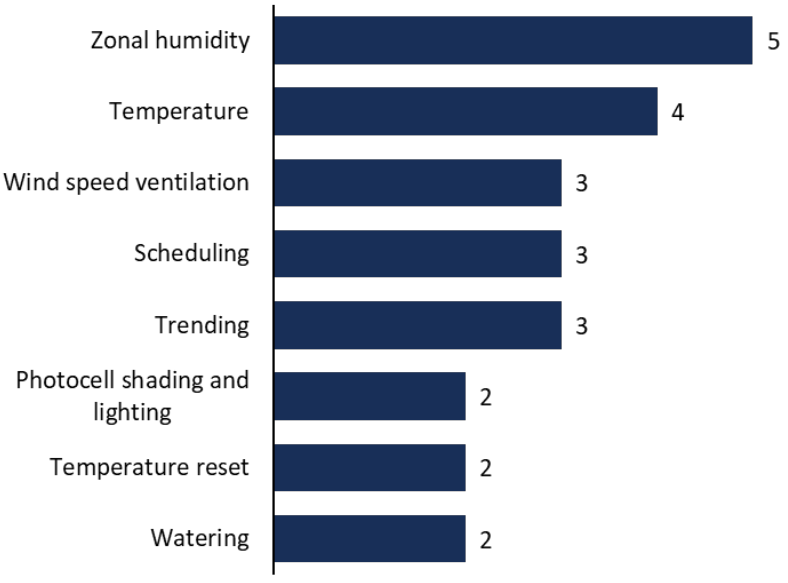
Figure 6. Count of Components Integrated into Central Controls



Source: Energy Trust Greenhouse Measures Market Research, Participant Survey Question: G2. "Which components are integrated into the central controls?" (n=4)

Five of the respondents with central systems also described which greenhouse features are controlled by these systems, as detailed in Figure 7, all of whom used their systems to control multiple greenhouse features.

Figure 7. Count of Components Integrated or Planned to be Integrated into Central Controls



Source: Energy Trust Greenhouse Measures Market Research, Participant Survey Question: G4. "Which features are currently part of your central system or are planned for future addition?" (n=5)

Eight of 14 respondents reported using control systems that manage heating and cooling independently, whereas six control heating and cooling together. Only four respondents said they routinely adjust their standalone control systems, all of whom vary their adjustment timing per crop variety and one of whom also adjusts seasonally.

Participant respondents described several components of their automated controller systems that are most valuable. Most respondents (five of six) described the benefits of climate control, but one respondent each described data and charts from sensors, customizability, remote and local access, expansion options, ventilation, and demand response and equipment integration.

Six of 14 respondents reported using LED lighting in their greenhouses, and one respondent said they use incandescent lights in addition to their LEDs. Of these six respondents, five said they use the lighting mainly for crop growth, and one respondent who uses LED lighting said they use it to complete tasks. Respondents reported a variety of ways to control lighting—two use photosensors and daylighting, and two use a timer. Only one respondent said they use a manual switch, and one respondent said they do not use lighting controls. The remaining five respondents did not report using any type of lighting.

All 14 respondents said their greenhouses use ventilation. Twelve reported using natural ventilation, such as wall vent (six respondents) or roof vents (six respondents). Among those 12 respondents who use natural ventilation, 10 use automated ventilation systems controlled by temperature, and the remaining 2 use manual controls. When asked to describe their powered ventilation fan control, two respondents reported using systems controlled by on/off switches.

Table 6. Ventilation Type and Controls by Respondent

Respondent	Ventilation Type	Ventilation Controls
Respondent 1 (Multi-Span)	Natural Ventilation - Roof	Automated Control - Temperature
Respondent 2 (Single-Span)	Natural Ventilation - Wall	Automated Control - Temperature
Respondent 3 (Special Structure)	Powered Ventilation	Automated Control - Temperature
Respondent 4 (Single-Span)	Powered Ventilation	Automated Control - Temperature
Respondent 5 (Single-Span)	Natural Ventilation - Roof	Automated Control - Temperature
Respondent 6 (Single and Multi-Span)	Natural Ventilation - Wall	Automated Control - Temperature
Respondent 7 (Multi-Span)	Natural Ventilation - Roof	Automated Control - Temperature
Respondent 8 (Single-Span)	Natural Ventilation - Wall	Automated Control - Temperature
Respondent 9 (Multi-Span)	Natural Ventilation - Wall	Manually Controlled
Respondent 10 (Single and Multi-Span)	Natural Ventilation - Roof	Automated Control - Temperature
Respondent 11 (Single-Span)	Natural Ventilation - Wall	Manually Controlled
Respondent 12 (Single-Span)	Natural Ventilation - Wall	Automated Control - Temperature
Respondent 13 (Single-Span)	Natural Ventilation - Roof	Automated Control - Temperature

Source: Energy Trust Greenhouse Measures Market Research, Participant Survey Question: I1. “What type of ventilation do you use (if any)? And I2. What best describes your ventilation controls? (n=14)

While most participant respondents reported using natural ventilation, Cadmus also asked vendors if, in their experience, powered or natural/gravity ventilation were most common in greenhouses. Six vendors responded to that question, with five indicating that powered ventilation was more common in their experience, and one indicating that both were commonly used.

For irrigation pump controls, most participant respondents said their greenhouses use variable frequency drive controls (eight respondents), and five said they use on/off switches. One respondent did not answer the question. No one reported using electronically commutated motors or cycling controls.

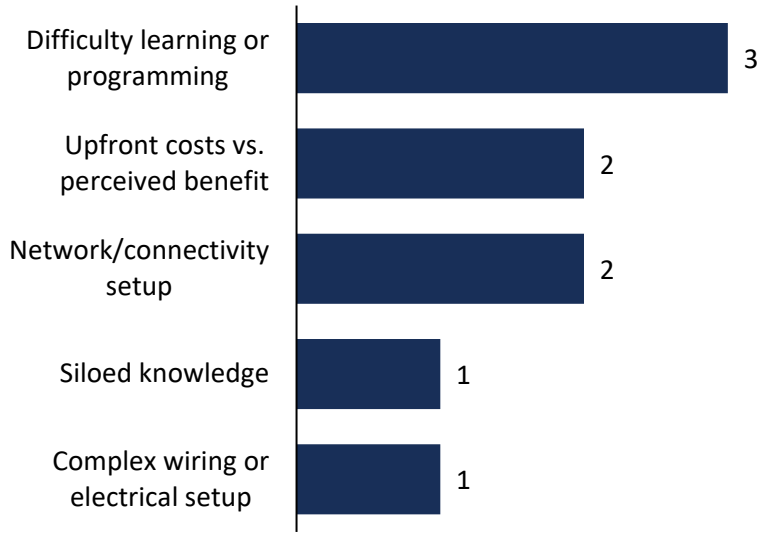
Central Controller Market

A central integrated control system centrally manages and coordinates all greenhouse components using a unified interface and interconnected sensors. Three vendors reported selling central greenhouse controllers, citing popular brands such as Argus Titan, Wadsworth, Bartlett Instruments, and Link4. All three indicated that their control systems cost over $2,000. Installation costs varied significantly: one vendor estimated a range of $23,000 to $100,000, while another stated that installation typically costs about twice as much as the equipment.

All three vendors agreed that their central controls are suitable for greenhouses of any size, and all three vendors offer central controllers with multi-room or multi-zone control from one unit. One vendor noted that their central controllers are modular, so they can be expanded upon as needed. Central controllers have long lifespans—two vendors reported typical replacement cycles of 7 to 10 years, while one noted that replacements are rare unless the system fails.

As detailed in Figure 8, all three vendors said the most sought-after feature in central controls is integrated heating and ventilation management, followed by remote monitoring and control capabilities (two vendors). All three vendors also agreed that the key challenges customers face include difficulty learning or programming the system, followed by network or connectivity setup (two vendors) and concerns about the upfront cost relative to perceived benefits (two vendors). All of the vendors also said that high equipment and installation costs as the primary barrier to the broader adoption of advanced central control systems.

Figure 8. Challenges Customers Face with Central Controls



Source: Energy Trust Greenhouse Measures Market Research, Vendor Survey Question G11: "What are the biggest challenges your customers face when using integrated controllers? Select up to three." Options: Difficulty learning or programming; Upfront costs vs. perceived benefit; Network/connectivity setup; Complex wiring or electrical setup; Sensor placement/calibration difficulties; Integration with existing systems; Other (please specify) open-ended.(n=3) Vendors could choose multiple options, so totals may exceed the sample size

Standalone Controller Market

Four vendors reported selling standalone control systems, or individual controllers that operate independently to manage specific components or zones in the greenhouse, with two indicating that their products typically cost over $500. All four vendors noted that standalone controls are best suited for small greenhouses (under 5,000 square feet). These systems are used primarily for heating, are replaced infrequently, and are often chosen over central controls due to lower cost or limited operational needs. Three vendors observed a growing shift in customer demand toward integrated climate control solutions, although they did not specify the drivers behind this trend.

Dehumidifier Use

Only two participant respondents reported having dehumidifiers in their greenhouses, which they said they use to support the growth of cannabis and green butter lettuce. One of them uses eight DryGair DG-12 dehumidifiers with a capacity of 1,080 liters per day and a relative humidity set point of 55%. The other uses a manually controlled dehumidifier with four dampers and exhaust fan manipulation with a capacity of 2,000 liters per day.

Dehumidifier Purchase and Installation Cost

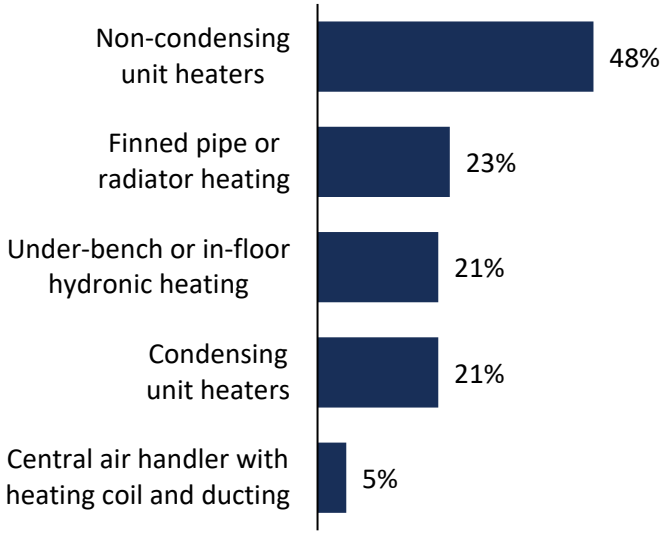
Two vendors reported selling dehumidifiers, but did not provide purchase and installation costs. They mentioned popular dehumidifier brands, including Leizig and Quest. Both vendors mentioned that dehumidifiers are mostly used for Cannabis cultivation. When asked if there are greenhouse equipment

incentives or services, they would like to see from Energy Trust, one vendor noted “dehumidifier rebates.”

Heat Delivery Systems

As seen in Figure 9, four vendors reported offering a range of greenhouse heating systems, including condensing unit heaters (four vendors), non-condensing unit heaters (three vendors), under-bench or in-floor hydronic heating (two vendors), finned pipe/radiators (two vendors), and central air handlers (one vendor). All vendors agreed that purchases are primarily driven by the need to replace aging or failed equipment. Vendors said key customer priorities when selecting heating systems include durability, low operating costs, and minimal maintenance requirements. As with boilers, they explained that customers frequently invest in redundant heating systems to safeguard against crop loss during equipment failure or power outages. One vendor expressed interest in seeing more rebates and incentives for finned pipe overhead heating to help shift customers toward fully hydronic heating systems.

Figure 9. Average Market Share of Heat Delivery Systems



Source: Energy Trust Greenhouse Measures Market Research, Vendor Interview Question: E3. “Approximately what percentage of your heating system sales does each type account for, other than boilers?” (n=4)

Boiler Market

Three vendors reported selling boilers. All three vendors sell high-efficiency condensing boilers, which account for 65% to 70% of their boiler sales, on average. Two of those vendors also reported selling standard (non-condensing) boilers, which make up 30% to 34% of their boiler sales[5]. These figures reflect the average reported shares among the vendors who sell each boiler type. One vendor reported

[5] Percentages are based on responses from two of the three vendors who reported selling non-condensing boilers. Reported shares were 30% and 34% respectively.

selling electric boilers, which account for 1% of their boiler sales. No vendors reported selling biomass (wood/pellet) boilers. Vendors mentioned Biotherm, RBI, and Raypak as popular boilers. One vendor cited greenhouse expansion as the most common reason for a new boiler purchase, while another mentioned the replacement of aging or broken equipment. Vendors also noted that customers often purchase redundant boilers as backups to prevent crop loss in the event of equipment failure.

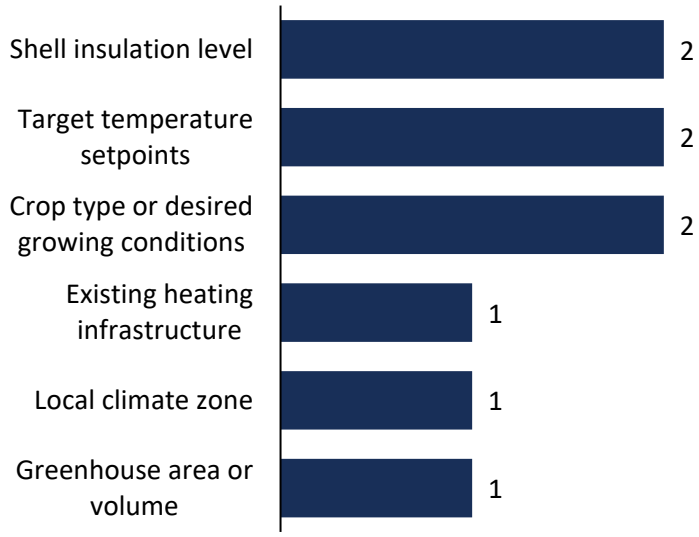
Boiler Efficiency

Nine of 14 participant respondents said their greenhouses use boilers. Five respondents reported using high-efficiency condensing boilers, three reported standard-efficiency boilers, and one respondent reported both high- and standard-efficiency boilers. Averaged across the nine respondents with boilers, heat distribution is comprised of 31% perimeter heating, 19% under-bench heating, 17% air coils, 13% finned radiators, and 10% underfloor heating. Four respondents said they operate their boilers year-round, and two of these only operate their boilers when ambient temperature gets below 54°F and 68°F. The remaining respondents operate their boilers seasonally, with winter being the most common season of operation (four respondents), followed by spring (two respondents) and fall (one respondent). Most respondents said they maintain their boilers either seasonally (four respondents) or annually (three respondents), while only one respondent reported maintaining their boilers quarterly.

Boiler Sizes

The three vendors who sell greenhouse boilers said sizing and capacity decisions hinge on a handful of key criteria. Two vendors each cited crop type or desired growing conditions, target temperature setpoints, and envelope insulation level. Additionally, one vendor apiece also mentioned greenhouse area, local climate zone, and existing heating infrastructure as factors in determining requirements (Figure 101).

Figure 10. Key Factors in Sizing a Boiler



Source: Energy Trust Greenhouse Measures Market Research, Vendor Interview Question: D13: "What are the key factors considered when sizing a greenhouse boiler? Please select up to three." Options: Greenhouse area or volume; Crop type or desired growing conditions; Local climate zone; Target temperature setpoints; Shell insulation level; Existing heating infrastructure; Other (please specify). (n=3) Vendors could choose multiple options, so totals may exceed sample size.

Two vendors reported that boiler capacity varies depending on the project: while boilers are sized for full-space heating when needed, they are more commonly designed for root-zone heating to optimize return on investment (ROI). One vendor said that boilers are sized to cover approximately 70% to 80% of the heat load and rely on supplemental unit heaters to meet any remaining demand. Table 7 and Table 8 detail the efficiencies and price ranges of high-efficiency and standard boilers by size.

Table 7. Efficiency and Price Range of High-Efficiency Condensing Boilers by Size

High-Efficiency Condensing Boilers		
Size	**Efficiency**	**Price Range**
<300 kbtuh	94-98%	$4,500-$13,500
300-1,000 kbtuh	94-96.5%	$15,000-$45,000
>1,000 kbtuh	94-97%	$46,000-$85,000

Table 8. Efficiency and Price Range of Standard (Non-Condensing) Boilers by Size

Standard (Non-Condensing) Boilers		
Size	**Efficiency**	**Price Range**
<300 kbtuh	83-86%	$5,500-$13,500
300-1,000 kbtuh	83-88%	$13,500-$65,000
>1,000 kbtuh	83-88%	$45,000-$120,000

Boiler Purchase and Installation Costs

While purchase prices for high-efficiency and standard boilers were generally similar, vendors had different views on installation costs. One vendor stated that installation costs are comparable between the two types, another reported higher costs for high-efficiency boilers, and a third said standard boilers are more expensive to install—citing the need for cold-start protection as the reason.

4.4. Greenhouse Operations Research

To better understand how greenhouse operators manage heating, cooling, and environmental controls, Cadmus conducted surveys and interviews with program participants. Cadmus gathered information on heating and cooling system types, hours of operation, and temperature and humidity set points. The findings in this section summarize participants' operational practices and equipment usage patterns based on this research.

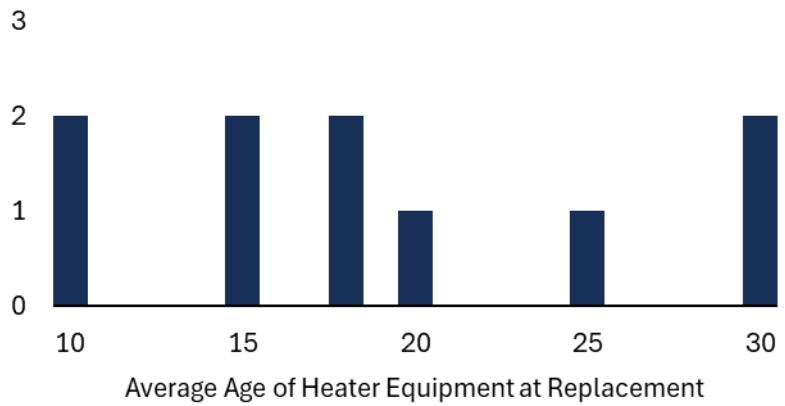
Heating and Cooling Equipment

Equipment Types

Thirteen of 14 participant respondents reported having unit heaters. Eight of these respondents had high-efficiency condensing heaters that were nine years old on average (*min age* = 3; *max age* = 25). Three respondents had hot water heaters that were 14 years old on average (*min* = 7, *max* = 25), and two respondents had power-vented heaters that were 15 years old on average (*min* = 5, *max* = 25). Only one respondent reported having separate combustion unit heaters.

Several respondents reported purchasing condensing unit heaters in the past four years through Energy Trust's Production Efficiency program (eight respondents). These respondents purchased the new heaters to either support an expansion with new equipment (five respondents), to replace equipment of a similar size (three respondents), or to replace equipment and increase capacity (one respondent). Among all types of unit heaters respondents replaced, the age of the youngest equipment at replacement was 10 years, and the age of the oldest equipment at replacement was 30 years, as shown in Figure 11. The average age of the equipment at replacement was 19.1 years.

Figure 11. Distribution of Heater Equipment Age at Replacement



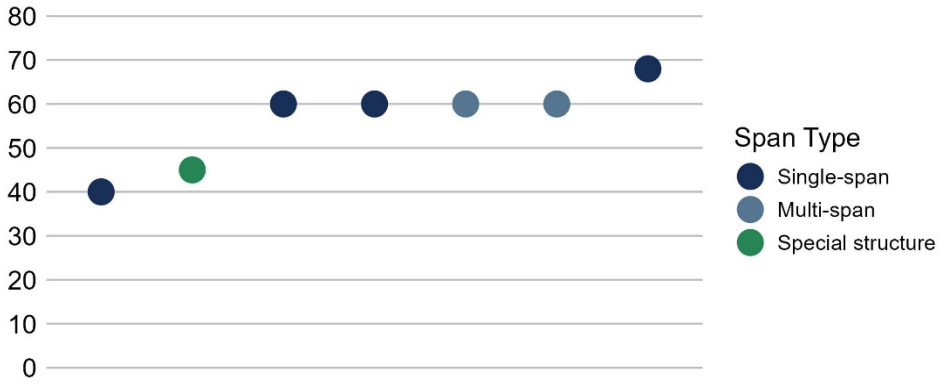
Source: Energy Trust Greenhouse Measures Market Research, Participant Survey Question: F3. "What is the average age of your unit heaters that you replaced in years, if applicable? Your best guess is fine." (n=10)

All respondents reported having cooling equipment (14 respondents), most of whom said they use multiple types of cooling equipment. Most respondents reported ventilation for their systems is done either naturally or by using an exhaust fan (12 respondents) or circulation fans (eight respondents). Three respondents had mechanical cooling through chilled water, and one respondent had cool pads, evaporative cooling, and fog systems.

Hours of Operations

Out of 13 respondents, most reported operating their unit heaters seasonally, with winter the most common (11 respondents), followed by spring (nine respondents) and fall (seven respondents). Four of those respondents said they operate their heaters below a certain ambient temperature (45°F on average). The average heating set point across all respondents' unit heaters was 88°F; however, there was an outlier of 200°F. When removed, the average heating set point dropped to 56°F.

Figure 12. Average Heating Set Points Across Respondents' Unit Heaters

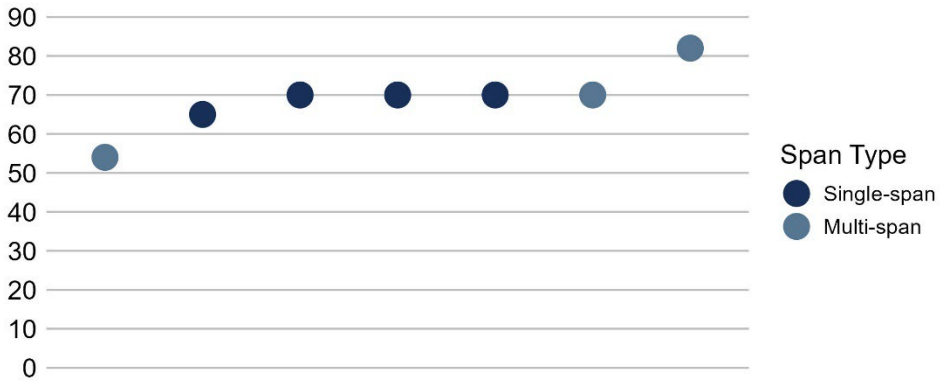


Source: Energy Trust Greenhouse Measures Market Research, Participant Survey Question: F4. "What is your heating temperature setpoint?" (n=7)

Out of 13 respondents, five reported operating their cooling systems above a certain ambient temperature (65°F on average), but four reported year-round, and four reported seasonally. The average cooling set point across all respondent coolers was 69°F, with a reported minimum of 54°F[6] and a maximum of 82°F. Two respondents reported relative humidity set points of 65% and 70%.

[6] One respondent reported a cooling set point of 54°F, which falls well below the group average of 69°F and may represent an outlier.

Figure 13. Average Cooling Set Points Across Respondents' Unit Heaters

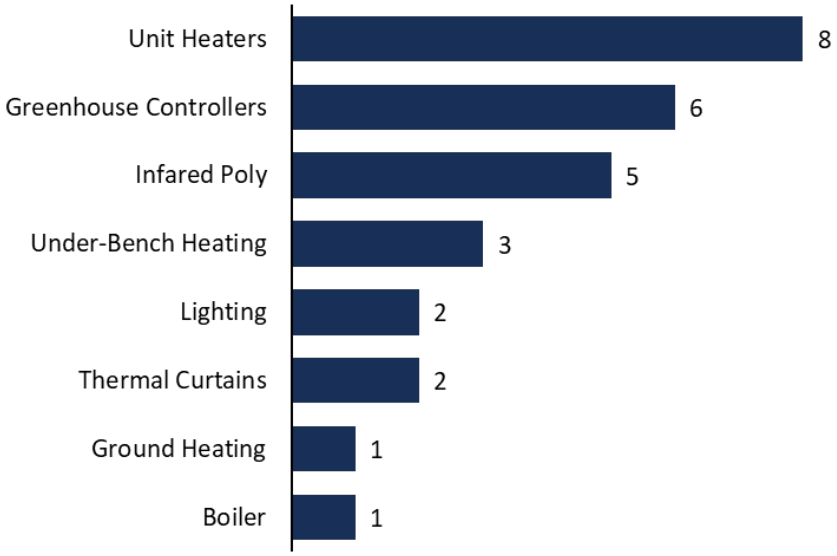


Source: Energy Trust Greenhouse Measures Market Research, Participant Survey Question: D6. "What is your average cooling setpoint across all coolers?" (n=7)

Equipment Type and Capacity

Across all the equipment participant respondents purchased through Energy Trust's program within the past four years, condensing unit heaters were the most common (eight respondents). Several respondents also purchased greenhouse controllers (six respondents) and IR poly for greenhouses (five respondents). Additionally, but to a lesser extent, respondents purchased other components, as illustrated in Figure 14.

Figure 14. Count of Components Purchased through Energy Trust's Program



Source: Energy Trust Greenhouse Measures Market Research, Participant Survey Question: B5. "What equipment did you purchase for your greenhouse(s) through Energy Trust's program within the past four years (since 2021)?" (n=14)

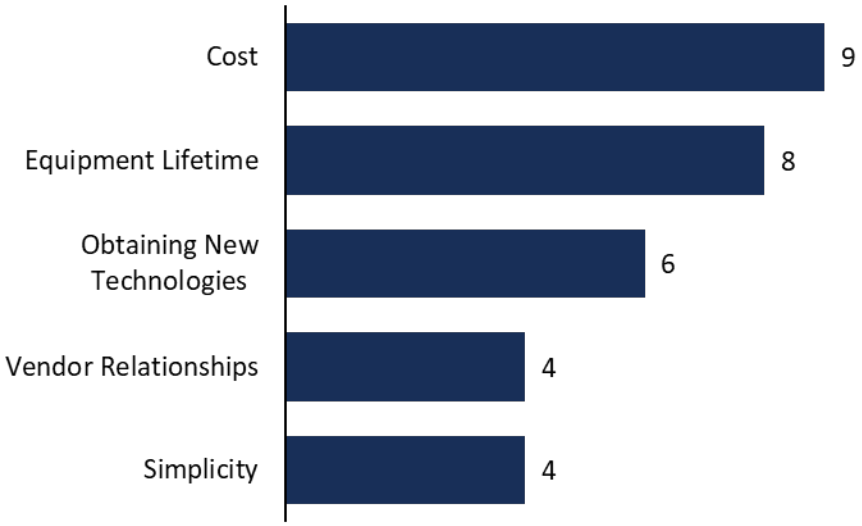
During interviews with vendors, two reported that they offer shade cloth, thermal curtains, and blackout systems, with both manual and automated options. Vendors reported that nearly all systems were automated. Curtain selection was influenced by crop type, climate, and budget (including long-term cost savings). Additionally, one vendor offered lighting systems, reporting that LEDs made up 90% of sales, with the remainder being HID. LEDs typically cost $500+, while HID lights ranged from $200–$499.

All participant respondents who purchased IR poly for greenhouses said they did so to replace equipment of a similar size, and all but one respondent who purchased greenhouse controllers did so because they needed new equipment to support an expansion. Across all equipment purchases (30 purchases), the most common reason for the purchase was to obtain new equipment to support an expansion (16 purchases). Among those who made a purchase to replace existing equipment, obtaining equipment of a similar size was far more common (12 purchases) than obtaining equipment that increased capacity (two purchases).

When asked what additional energy-efficient greenhouse equipment they would install if Energy Trust provided incentives, respondents made many suggestions. Two respondents suggested lighting incentives. One respondent each suggested equipment, such as heating systems (e.g., boilers, unit heaters), variable frequency drives for irrigation (e.g., drip irrigation, sprinklers), cooling water curtains, fans, controls, and hauling equipment (e.g., tuggers, trailers). One respondent also recommended providing incentives for microcellular insulation, explaining it could be installed under heating tubes in the floor to redirect energy back toward the crops.

When purchasing new or replacement equipment for the greenhouses, respondents said they consider several different factors. As shown in Figure 15, cost is important to all but one respondent (nine respondents), followed by equipment lifetime (eight respondents) and obtaining new technologies (six respondents).

Figure 15. Components Purchased through Energy Trust's Program



Source: Energy Trust Greenhouse Measures Market Research, Participant Survey Question: L2. “What are the main factor(s) you consider when purchasing new or replacement equipment?” (n=10)

5. Conclusions and Recommendations

Cadmus presents the following conclusions and recommendations based on findings from research conducted as part of the Greenhouse Measures market research. Our conclusions and recommendations are organized by technology-specific objectives and greenhouse operations to support targeted improvements and future program development.

Technology-Specific Objectives

Conclusion 1. Controller usage is common, is used for a variety of controls, and creates an opportunity for deeper energy savings. All participant respondents use controller systems (14 respondents), and most program their controllers with specific set points (11 respondents). Central control systems are most common, with nine respondents using either central systems or a mix of both central and standalone equipment controls. Most respondents controlled ventilation and unit heater components. Additionally, five respondents used zonal humidity controls; four used temperature; and three each used wind speed ventilation, scheduling, and trending controls. Greenhouse controller usage is common in the market but is often manually controlled with specific setpoints (11 of 14 respondents).

Four vendors sold standalone control systems, primarily used for heating, while three sold central climate control systems. All three vendors said the most sought-after feature in central controls is integrated heating and ventilation management, followed by remote monitoring and control capabilities (two vendors).

Recommendation 1. Continue offering the greenhouse controller incentive to encourage coordination of HVAC equipment scheduling and allow for night temperature setbacks to drive persistent energy savings.

Conclusion 2. A small majority of controller systems manage heating and cooling independently. This highlights a potential opportunity for Energy Trust to promote its greenhouse controller incentive and target systems that can improve calibration and energy performance. Most (eight of 14 participant respondents) controlled their systems independently as opposed to managing them together (six respondents). For controller systems that manage temperature independently, there is the potential for these systems to be out of calibration and use more energy than needed.

Vendors noted that standalone systems are generally suited for small greenhouses (<5,000 sq ft), used mostly for heating, and chosen for their lower cost. Three vendors reported increasing customer demand for integrated climate control systems, although they did not specify the drivers behind this trend.

Recommendation 2. Increase the visibility of the multiple-sensor Greenhouse Controller incentive offering and highlight the importance of managing heating and cooling systems together where applicable. This prevents conditioned air losses (e.g., heating while the ventilation system is operating or simultaneous heating and cooling) and increases the energy efficiency of the greenhouse.

Conclusion 3. Dehumidifiers do not provide a large opportunity for efficiency gains in greenhouses. Only two out of 13 participant respondents use dehumidifiers. One of them uses model DryGair DG-12 dehumidifiers with a relative humidity set point of 55%, and the other uses four dampers and exhaust fan manipulation with no set point. Similarly, two vendors reported selling dehumidifiers, but did not provide purchase and installation costs. Both vendors noted that dehumidifiers are mostly used for Cannabis cultivation.

Recommendation 3. As dehumidifiers do not represent a significant energy-saving opportunity and have a relatively low adoption rate (likely due to the types of plants being grown), this technology does not warrant further investment for greenhouse applications.

Conclusion 4. The use of IR polyfilm among surveyed participants, and its standard availability among vendors, indicates a potential shift in market adoption. Respondents' facilities often use multiple types of materials in their greenhouse envelopes (seven of 15 respondents): eight used standard polyfilm, and seven used IR polyfilm. Of the seven respondents with IR polyfilm, five received incentives through the Production Efficiency program. Among the envelopes made with standard polyfilm, the material is most often thick (> 6mm; five respondents), but some are thin (< 6mm; three respondents). Respondents reported similar thickness for IR polyfilm envelopes—more of the material is thick (four respondents) than thin (two respondents).

Four vendors sold envelope materials, with all offering IR and standard polyfilm (single and double layer). IR polyfilm accounted for between 1-45% of individual vendors' envelope sales, with an average market share of 23%. Vendors also reported that low upfront cost is a major factor in purchase decisions, which aligns with the affordability of IR polyfilm. Because IR polyfilm has a shorter warranty period (1–5 years), it may be replaced more frequently, and vendors noted that customers tend to repurchase the same material.

Recommendation 4. Continue offering the IR polyfilm incentive. Update the baseline assumptions to include an increase in IR polyfilm market share as the original baseline assumed minimal adoption.

Conclusion 5. Greenhouse efficiency could potentially be improved through boiler and heating upgrades, though the opportunities are limited. Nine of 14 participant respondents use boilers, and five of those already use high-efficiency boilers, whereas three use standard-efficiency boilers. One respondent uses both. Four out of nine respondents use boilers that are non-condensing, standard efficiency.

Averaged across the nine respondents with boilers, heat distribution is comprised of 31% perimeter heating, 19% under-bench heating, 17% air coils, 13% finned radiators, and 10% underfloor heating. There is a relatively low adoption rate of 19% for under-bench heating.

Four respondents operate their boilers year-round, two of whom only operate their boilers when ambient temperature gets below 54°F and 68°F. The remaining respondents operate their boilers seasonally.

All vendors agreed that purchases are primarily driven by the need to replace aging or failed equipment. Customers prioritize durability, low operating costs, and minimal maintenance requirements. As with boilers, vendors also reported that customers frequently invest in redundant heating systems to safeguard against crop loss during equipment failure or power outages. One vendor recommended offering rebates and incentives for finned pipe overhead heating to help shift customers toward fully hydronic heating systems.

Recommendation 5a. Continue to offer boiler incentives even though opportunities are limited. Because boiler upgrades represent a relatively high capital cost, boilers are generally replaced upon burnout, delaying upgrades to high-efficiency condensing boilers. However, these upgrades represent a real energy savings opportunity for Energy Trust.

Recommendation 5b. Conduct additional research to understand why under-bench heating has lower adoption rates. This technology represents an energy savings opportunity for facilities with hydronic heating systems and unit heaters. Under-bench heating reduces natural gas consumption when compared to unit heaters because the greenhouse setpoint temperature can typically be reduced. This is due to under-bench heating being a more efficient means of keeping plant root zones at the desired temperature.

Greenhouse Operations

Conclusion 6. Use of unit heaters is widespread across greenhouses, and unit heaters purchased through Energy Trust's Production Efficiency program are typically obtained to support an expansion. All but one out of 14 participant respondents have unit heaters, eight of which are high-efficiency condensing heaters. This suggests a shift in the market baseline for this type of equipment, likely driven by the Production Efficiency incentive offerings.

Heaters are typically operated seasonally, with winter the most common (11 respondents), followed by spring (nine respondents) and fall (seven respondents). The average heating set point is 56°F (after removing an outlier of 200°F).

Recommendation 6. Continue offering incentives for high-efficiency condensing unit heaters. Update the baseline assumptions to include an increase in high-efficiency unit heater market share as the original baseline assumed minimal adoption.

Conclusion 7. Cooling equipment is common and there is an almost even split on when cooling equipment is operated. All 14 participant respondents reported having the equipment, and most respondents use multiple types of cooling equipment. The most common systems are ventilation done either naturally or by using an exhaust fan (12 respondents) or circulation fans (eight respondents). Only four of 14 respondents reported using mechanical cooling, including chilled water, cool pads, evaporative systems, or fog systems. Additionally, five respondents operate their cooling systems above a certain ambient temperature (65°F on average), but four respondents operate their systems year-round, and four operate their systems seasonally. There is also a wide range of cooling set points—the average set point is 69°F, with a minimum of 54°F and a maximum of 82°F.

Recommendation 7. Do not expand the greenhouse incentive to include mechanical cooling since the majority of respondents do not use it. However, as all respondents reported using fans for ventilation or cooling, increasing marketing visibility of these existing offerings, such as incentives for variable-frequency drives—motor controllers and high-efficiency fan motor upgrades could drive additional energy-saving opportunities.

Conclusion 8. Respondents reported cost (nine respondents) and equipment lifetime (eight respondents) as their primary motivators for participating in the Production Efficiency program. Across all equipment purchases (30 total), the most common reason was to support facility expansions (16 purchases). When replacing existing systems, operators tend to prefer equipment of a similar size (12 purchases) as opposed to equipment to increase capacity (two purchases). Additionally, single-span and multi-span greenhouses tend to be large, with nine of 15 across all types at over 2,000 square feet, and none of the respondents' greenhouses less than 1,000 square feet. Operators of these larger greenhouses accounted for the majority of energy efficiency measures, including condensing unit heaters (four purchases), greenhouse controllers (four purchases), and IR polyfilm (four purchases).

Recommendation 8a. Encourage large greenhouse operators to pursue bundled or comprehensive energy efficiency upgrades. Many respondents implemented multiple measures, which suggests that larger facilities are a good fit for combined upgrades that could improve greater energy savings and streamline implementation.

Recommendation 8b. Explore expanding eligibility for incentives limited to "replacement only" so they also apply to new construction projects. Since many respondents reported purchasing equipment to support facility expansions, broadening eligibility could simplify participation and increase overall energy savings.

Appendix A. Participant Survey Guide

Please double-click on the icon below to view the Participant Interview Guide.

Participant Survey.pdf

CADMUS

Appendix B. Vendor Interview Guide

Please double-click on the icon below to view the Vendor Interview Guide.

Vendor Interview Guide.pdf

EM&V REPORT: NW NATURAL BEHAVIORAL ENERGY EFFICIENCY PROGRAM

SUBMITTED TO:

NW NATURAL

SUBMITTED BY:

ADM ASSOCIATES, INC.

SUBMITTED DATE:

MARCH 10, 2025

ADM

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This evaluation was conducted with regular coordination with staff at NW Natural, who provided quick feedback and turnaround to the requests of the evaluation team as well as open and forthright insights into the operations of their programs.

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3 EXECUTIVE SUMMARY

This report is a summary of the impact evaluations for NW Natural's Behavioral Energy Efficiency Program in Washington.

Table 1-1 summarizes the programs included in the evaluation effort and ADM Associates, Inc. (herein referred to as the "Evaluators") impact evaluation tasks and impact methodology for each program.

Table 1-1 Impact Evaluation Activities by Program

Program Type	Program	Database Review	Impact Methodology	Program Years
Energy Efficiency	Behavioral	✓	Randomized Control Trial (RCT)	PY2024

3.1 Program Design

To facilitate understanding of the Behavioral program design, the Evaluators developed a draft logic model (see Figure 1-1). This draft was synthesized from the Evaluator's experience with similar programs. The Evaluator sought to create a model that could be viewed as a "living document" that could assist program staff, implementation staff, and evaluators in understanding the program's underlying operations.

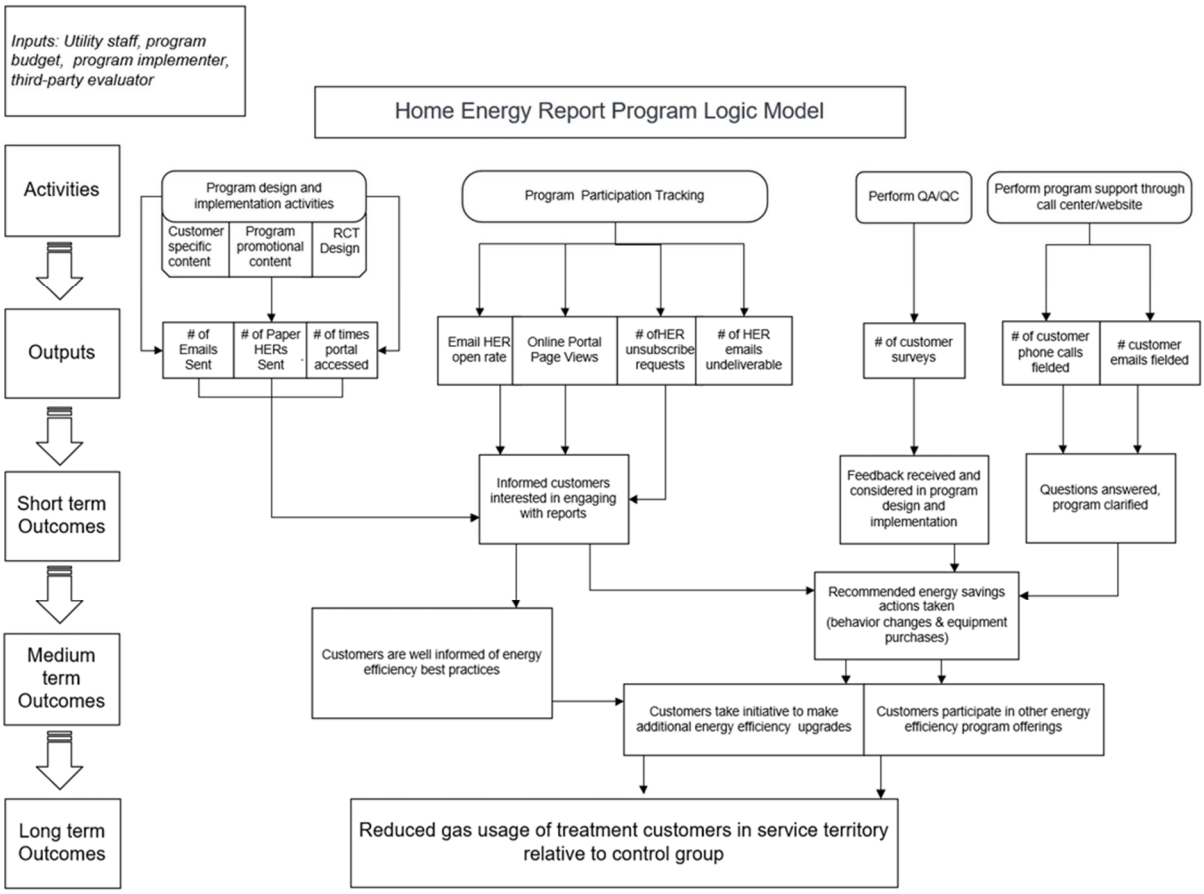

Figure 1-1 Behavioral Program Logic Model

NW Natural launched the program in Q4 of 2023 and it was implemented with an opt-out, randomized control trial (RCT) design. Behavioral programs are typically designed to provide information to residential customers intended to encourage behavioral changes that result in reduced billed energy consumption. The household receives personalized information about their own natural gas consumption and comparison to a group of neighboring households energy consumption. Also typically included in the reports is information on other NW Natural energy efficiency programs to encourage additional home improvements towards reduced energy usage. This normative information on gas usage and targeted tips on energy saving behaviors is aimed at reducing the participant household's energy consumption.

Table 1-2 summarizes the cohorts implemented in the Behavioral program within the NW Natural Washington service area.

Table 1-2 Summary of WA Behavioral Cohort

Cohort	RCT Date	Treatment Group Size			Control Group Size		
		Original Treatment Customers	Number at Start PY2024	Number at EOY PY2024	Original Control Customers	Number at Start PY2024	Number at EOY PY2024
WA	10/20/2023	48,062	47,225	44,408	13,910	13,659	12,783

The Evaluators estimated savings for the Behavioral Program using non-participant residences in NW Natural's service territory selected from the Randomized Control Trial (RCT) and analyzed each of the cohorts treated during PY2024. Table 1-3 describes the evaluation period for each cohort and reporting period.

Table 1-3 Summary of Cohort Organization

Cohort	RCT Date	Pre-Period	Post-Period
WA	10/20/2023	6/2/2022-10/19/2023	PY2024: 1/1/2024 - 12/31/2024

3.2 Summary of Data Provided

The implementer Bidgely provided the following data to support the analysis:

- Pre- and post-treatment monthly gas billing data for participants and non-participants. The data started in June of 2022 and ended January 3, 2025.
- Behavioral program customer information, including date of first sent paper and email. Behavioral report by Bidgely, opt-out date, and treatment or control group assignment.
- Residential downstream program data, including customer information, completed measures, and associated annual household Therms savings.

3.3 Verified Savings

The Evaluators' analysis yields an estimate of gross verified Therms savings for the program, as shown in the table below. The total program gross verified savings were 197,373 Therms in PY2024.

Table 1-4: Behavioral Program Savings Summary

Cohort	Annual Savings Per Home (Therms/year)	5% CI Annual Savings Per Home (Therms/year)	95% CI Annual Savings Per Home (Therms/year)	Annual Adjusted Savings Per Home[1] (Therms/year)	Total Program Verified Savings (Therms)
WA	4.51	3.73	5.30	4.40	197,373

3.4 Conclusions and Recommendations

The following section details the Evaluators' conclusions and recommendations for the Behavioral program.

Conclusion: Behavioral Program verified annual savings of 197,373 Therms for PY2024 are positive and statistically significant at the 90% level for the Washington cohort.

- The evaluated WA cohort had a valid control group which suggests that the creation of the original RCT cohort by the implementer was done in accordance with industry standards.
- The evaluated cohort displayed average annual gas savings of 0.66 percent of annual billed use in PY2024. In the Evaluators' experience, typical behavioral programs display average annual gas savings between 0.25 percent and 2 percent. This is the first program year for the WA cohort, and behavioral program savings often increase in later program years.
- Downstream and upstream double counted savings were 4,870 Therms for PY2024. The double counted savings were removed from the estimated savings from the regression results. The double counted savings represent two percent of program savings before double counting, therefore, the impact on final program savings was insignificant in percentage terms. The observed double counted savings is expected, as Uplift's percentage of program savings is typically between 1 percent and 3 percent.
- The annual attrition rate in PY2024 is roughly 6 percent for the WA cohort for both the treatment and control groups.

Recommendation: Save and store historical billing data for all customers in each wave to ensure future analyses will have one year of billing data prior to the RCT start date for each customer, as well as complete billing data after the intervention.

Conclusion*:* The post-period was defined as 12 months and a measure life was not defined for the program.

Recommendation: Assume a 1 year measure life for ongoing Behavioral programs or change the cohorts each year to claim a longer measure life for savings.

[1] These savings are adjusted to remove double counted savings caused by Behavioral program induced Uplift. Uplift increases participation in other Energy Efficiency programs for Behavioral program treatment customers relative to Behavioral program control customers.

3.5 Report Organization

From this point, the remaining report chapters include:

- Chapter 2: General Evaluation Methodology
- Chapter 3: Impact Evaluation Results
- Chapter 4: Conclusions and Recommendations

4 GENERAL EVALUATION METHODOLOGY

The Evaluators completed an impact evaluation for the program/s summarized in the Executive Summary. Our activities estimate and verify annual savings and provide energy savings from a single source, aimed at providing guidance for continuous program improvement.

4.1 Glossary of Terminology

As a first step to detailing the evaluation methodologies, the Evaluators have provided a glossary of terms to follow:

- **Verified Savings** – Savings estimates after the impact analysis and energy impact evaluation has been completed.
- **Gross Savings** – The change in energy consumption directly resulting from program-related actions taken by participants in an efficiency program, regardless of why they participated.
- **Pre-Period –** The period prior to the treatment intervention, typically set to equal a one-year period.
- **Post-Period –** The period after to the treatment intervention, typically set to equal a one-year period.
- **Cohort –** The group of treatment and control customers defined by a Randomized Control Trial (RCT); often referred to as a wave in behavioral programs.
- **HDD –** Heating degree days (HDD) are a measurement used to estimate the amount of energy required to heat a building or space during a specific period, typically a day or a month. It is primarily used in regions with cold climates to assess the demand for heating and to evaluate energy consumption.
- **Dummy Variable -** A dummy variable, also known as an indicator variable or binary variable, is a categorical variable that takes on one of two values to represent the presence or absence of a characteristic or condition. It is commonly used in statistical analysis and regression modeling to represent qualitative factors and typically takes the value of 0 or 1, where 0 represents the absence or reference category, and 1 represents the presence or alternative category.

4.2 Impact Evaluation Approach

4.2.1 EVALUATION APPROACH

The Evaluators estimated verified savings for the Behavioral Energy Efficiency Pilot Program for Program Year 2024.

The work effort was divided into three categories:

1. Estimate monthly and annual billed consumption differences between treatment and control groups via regression modeling;
2. Estimate joint savings from other programs; and

3. Conduct an attrition analysis.

The Evaluators utilized participant and control group billing data in the pre-period (before the household starts receiving home energy reports) and in the post-period (after household starts receiving home energy reports) to estimate program persistence of savings for each cohort. The Evaluators also estimated joint savings from other downstream energy efficiency programs offered to NW Natural residential customers. No upstream programs were provided by NW Natural to customers in 2024, therefore, no adjustment for uplift from upstream programs was needed. The joint savings were removed from the regression analysis results to estimate verified persistence savings due to the Behavioral Energy Efficiency Pilot Program.

The following research questions were addressed in the evaluation and presented in the report:

- What are the household-level impacts across participants due to receiving the behavioral reports?
- What is the attrition rate for this first wave of cohorts?
- What is the magnitude of double counted savings for participants in the treatment and control groups, respectively?
- Is the implementer's program design consistent with standard behavioral program designs?

4.2.1.1 Billing Analysis Methods

The Evaluators utilize different impact evaluation approaches for the persistence savings evaluation of behavioral EE programs. The final approach utilized is determined during the impact evaluation. Each approach involves panel linear regression models to estimate energy savings for the treatment group. One of the methods requires a designated control group to be created by the Evaluators in instances where the control group as designed does not pass equivalency checks (which may occur as the result of customer attrition).

Both approaches are recommended by the National Renewable Energy Laboratory (NREL) in the Uniform Methods Project (UMP) as a viable regression framework that can be applied to long-term participation and persistence of savings. These proposed methods require monthly or bi-monthly billing data for the program participants[2].

The following types of regression models were explored during the evaluation of this program: Difference in Difference (D-in-D) and Post-Program Regression (PPR). The Uniform Methods Project (UMP) by the National Renewable Energy Laboratory (NREL)[3] recommends D-in-D and PPR regression models as they use data from the treatment and control groups during the pre- and post-period and therefore obtain more precise savings estimates. The PPR model is a panel regression model that calculates the differences between treatment and control consumption in the post-program period. However, it includes controls on lagged energy use for the same calendar month of the pre-period to include in the model any small systematic differences in pre-treatment usage trends between the participant and control customers.

[2] https://www.nrel.gov/docs/fy17osti/68569.pdf
[3] https://www.nrel.gov/docs/fy21osti/77435.pdf

The Evaluators present the following two methodologies:

1. Method 1: D-in-D or PPR billing analysis with RCT
2. Method 2: D-in-D or PPR billing analysis with post-hoc control group

The first method requires the RCT for the cohort remains statistically valid. Validity is determined by examining average usage in the pre-treatment period for customers in the treatment and control group (after having accounted for program attrition). Each monthly read is tested for statistically significant differences (using a *t*-test). The second requires the Evaluators to create a quasi-experimental control group to compare against participant billing data if the cohort RCT is no longer valid. Both methods utilize a fixed effects panel regression controlling for weather to estimate energy savings.

To gather the most reliable results, it is ideal to have a randomized control trial (RCT). However, some RCTs may become no longer viable due to changes in implementation or significant attrition. The Evaluators test the validity of each RCT by completing *t*-tests for the average daily gas usage of each of the pre-period months between the treatment group and the control group. If the pre-period average daily usage rejects the null hypothesis at the 90% confidence interval for three or more of the 12 pre-period months, the RCT is considered invalid[4]. In cases where the control group is no longer valid, the Evaluators utilize a method for producing post-hoc control groups via quasi-experimental methods (e.g., propensity score matching).

The Evaluators present savings estimates in three formats for each program year:

- Daily and annual energy savings per home
- Annual percent savings per home
- Program-level savings

The percentage savings per home is calculated by dividing the average annual energy savings estimated in the treatment group by the average annual energy consumption from the control group for each program year. The program-level savings are calculated by multiplying the average annual household persistence estimate by the number of program participants in the treatment group and after removing double counted savings, by program year.

4.2.2 DATA REQUIREMENTS

The Evaluators estimated the Behavioral Energy Efficiency Pilot Program energy savings through a billing analysis. The following data was provided by NW Natural and the program implementer Bidgely:

- Participant and nonparticipant customer information;
- Treatment and control customer monthly billing data in pre-period through post-period; and,
- Tracking data from NW Natural downstream energy efficiency programs in each evaluated program year.

[4] Statistically significant differences in usage for three or more pre-period months is very unlikely to occur randomly with an alpha of 0.05 for each t-test (probability < 0.05). However, statistically significant differences in usage does occur for one or two pre-period months regularly (probability > 0.4 with an alpha of 0.05 for each t-test), but this does not indicate that a cohort is statistically invalid.

4.2.3 DATA PREPARATION

The Evaluators utilized participant and non-participant billing data in the pre-period (before intervention of the behavioral reports) and participant and non-participant billing data in the post-period (after intervention of the behavioral reports) in a fixed-effects panel regression model to predict average annual household gas savings, as detailed in the UMP behavioral chapter.

The following steps were taken to prepare data:

- Identify homes in the billing data that were assigned to the treatment or control group in the original RCT design
- Exclude homes without sufficient billing history
- Exclude homes without sufficient post-period billing data
- Exclude homes with consumption data indicating it is an outlier
- Verify if remaining RCT control households are still a valid comparison for the remaining treatment households

The Evaluators examined data for outliers using multiple accepted identification techniques. These include simple Z-scores, Bonferroni Outlier Test, Grubbs Test for Outliers (G-test). The Evaluators aim to remove error reading rather than remove high and low users, as these subgroups contribute real behaviors to the average savings estimate.

The Evaluators report parameters necessary to portray model accuracy and significance such as coefficient p-values, adjusted R-squared values, and measure-level savings at 90% confidence intervals. Program year savings estimates at the monthly- and annual-level were also reported for the measure.

4.2.4 METHOD 1: BILLING ANALYSIS WITH RCT

The approach indicated under Method 1 utilizes the control group created during the RCT design in either a D-in-D or PPR model. This requires a successful validation test between the cohort's treatment and control group. This approach is detailed in the UMP as a preferred method for evaluation of opt-out behavioral programs. The following sections summarize the two model specifications we will explore during analysis under Method 1.

4.2.4.1 Difference-in-Difference Model Specification

The fixed-effects model specification contains customer-specific dummy variables to account for exogenous heterogeneity that cannot be explicitly controlled for and is not relevant to the estimation of program savings. The specification of customer specific effects allows the model to capture much of the baseline differences across customers while obtaining reliable estimates of the treatment effect of the report.

The Evaluators included independent variables such as Heating Degree Days (HDD) to improve model confidence. The Evaluators utilized a fixed effects panel regression model to estimate weather-dependent daily consumption differences between treatment and control households.

Equation 2-1: Fixed-Effects Difference-in-Difference (D-in-D) Panel Regression Model Specification

$$ADC_{it} = \alpha_0 + \beta_1(Post)_{it} + \beta_2(Treatment)_{it} + \beta_3(HDD)_{it} + \beta_4(Post \times HDD)_{it} + \beta_5(Post \times Treatment)_{it} + \beta_6(Post \times HDD \times Treatment)_{it} + \varepsilon_{it}$$

Where,

ADC_{it} = Estimated average daily consumption (dependent variable) in home *i* during period *t*

$Post_{it}$ = Dummy variable indicating whether period *t* was in pre- or post- retrofit

$Treatment_i$ = Dummy variable indicating whether household *i* was in treatment group or control group

HDD_{it} = Average heating degree days during period *t* at home *i*

ε_{it} = Customer-level random error

α_0= The model intercept for home *i*

β_{1-6} = Coefficients determined via regression

The coefficients β_5 and β_6 represent the average change in daily weather-related consumption between the groups in the post-period. HDD was calculated from local weather data and was estimated using a temperature base point set to 65 degrees.

4.2.4.2 Post-Program Regression Model Specification

The post-program regression (PPR) model combines both cross-sectional and time series data in a panel dataset. This model uses only the post-program data, with lagged energy use for the same calendar month of the pre-program period acting as a control for any small systematic differences between the participant and control customers. In particular, energy use in calendar month *t* of the post-program period is framed as a function of both the participant variable and energy use in the same calendar month of the pre-program period. The underlying logic is that systematic differences between participants and controls will be reflected in differences in their past energy use, which is highly correlated with their current energy use. The version we estimate includes monthly fixed effects and interacts these monthly fixed effects with the pre-program energy usage. These interaction terms allow pre-program usage to have a different effect on post-program usage in each calendar month.

The model specification is as follows:

Equation 2-2 Fixed-Effects Post-Program Regression (PPR) Model Specification

$$ADC_{it} = \alpha_0 + \beta_1(Treatment)_i$$
$$+\beta_2\ (PreUsage)_i$$
$$+\beta_3\ (HDD)_{it}$$
$$+\beta_4(Month)_t$$
$$+\beta_5(Month \times PreUsage)_{it}$$
$$+\beta_6(HDD\ \times Treatment_{)it}$$
$$+\varepsilon_{it}$$

Where,

i = the *i*th household

t = the first, second, third, etc. month of the post-treatment period

ADC_{it} = Average daily usage for reading *t* for household *i* during the post-treatment period

$Treatment_i$ = Dummy variable indicating whether household *i* was in the treatment or control group

$Month_t$ = Dummy variable indicating month-year of month *t*

$PreUsage_i$ = Average daily usage across household *i*'s available pre-treatment billing reads

HDD_{it} = Average heating degree days during period *t* at home *i*

ε_{it} = Customer-level random error

α_0= The model intercept for home *i*

β_{1-6} = Coefficients determined via regression

The coefficients β_1 and β_6 represent the average change in consumption between the pre-period and post-period for the treatment group.

4.2.5 METHOD 2: BILLING ANALYSIS WITH QUASI-EXPERIMENTAL CONTROL GROUP

Due to complications in program implementation or design (or as the result of significant participant attrition), RCT groups may at some point become invalid. When this occurs, the Evaluators estimate savings through a quasi-experimental control group.

The Evaluators verify if each cohort has a valid experimental design by reviewing pre-period billed energy consumption between the treatment and control groups for each cohort. If randomization testing proves the treatment and control groups are no longer a valid match for a wave or if a randomized controlled trial (RCT) was not conducted for a cohort, the Evaluators create a valid post-hoc control group from nonparticipant billing data via quasi-experimental methods. Quasi-experimental methods are required when the control group has not been randomly assigned as it would be in a RCT.

The Evaluators create a statistically similar control group using propensity score matching (PSM), a method that finds the most similar household based on the customers' billed consumption trends in the pre-period and verified with statistical difference testing. A propensity score is a metric that summarizes several dimensions of household characteristics into a single metric that can be used to group similar households.

To create a post-hoc control group, the Evaluators must compile billing data for a potential control group to compare against treatment households via quasi-experimental methods.

The variables typically matched on include, but are not limited to:

1. Seasonal or monthly pre-usage
2. Household zip code.

The PSM method ensures to the extent feasible that average characteristics of the treatment and comparison groups are similar, resulting in minimal bias within a non-RCT design.

The Evaluators ensure the control group is statistically similar to the treatment group by conducting a hypothesis t-test for each month in the pre-period between each group. If the post-hoc control group

passes the *t*-test for the majority of pre-period months, and the groups are validly balanced, the Evaluators continue with the linear fixed effects D-in-D or PPR model presented in Equation 2-1 and Equation 2-2.

4.2.6 REMOVE DOUBLE COUNTED SAVINGS

After regression models have been finalized, the Evaluators estimated and removed double counted savings found from the customers in the treatment group from other NW Natural energy efficiency programs.

The NW Natural Behavioral Energy Efficiency Pilot Program reports may increase the customer's propensity to participate in other programs. This additional participation is known as uplift. The behavioral reports sent to customers may include information about other NW Natural incentives and programs, which may lead to customers adopting more energy efficient upgrades for their home. When a household participates in an efficiency program because of this encouragement, the utility might count their savings twice: once in the regression-based estimate of behavioral program savings and again in the estimate of savings for the other energy efficiency program. Although uplift rarely displays a statistically significant difference between the treatment and control groups, the UMP recommends removing uplift from each group at the household level.

The Evaluators estimated savings from program uplift and subtracted it from the efficiency program portfolio savings. To achieve this, the Evaluators gathered information on the total natural gas Therms saved in "other programs". The double count savings were calculated at a per-household level for each treatment group in each cohort as follows:

Equation 2-3 Double Count Specification

$$Double\ Counting = \left(\frac{OP\ Therms}{Household}_{Treatment} - \frac{OP\ Therms}{Household}_{Control}\right) \times \#\ Accounts_{Treatment}$$

Where,

$$\frac{OP\ Therms}{Household}_{Treatment} = Other\ program\ Therms\ per\ household\ in\ the\ treatment\ group$$

$$\frac{OP\ Therms}{Household}_{Control} = Other\ program\ Therms\ per\ household\ in\ the\ control\ group$$

$$\#\ Accounts_{Treatment} = Total\ accounts\ in\ the\ treatment\ group$$

The double counted savings, whether positive or negative, were subtracted from a cohort's gross savings estimates from the regression analysis to get total verified persistence savings.

Often, this difference is not statistically significant at the 95% level. Nevertheless, it is standard practice to deduct double counted savings from the estimated savings for a behavioral program.

The following section details our methodology for removing double counted savings for downstream programs.

4.2.6.1 Downstream Programs

Downstream programs traditionally track installed measures at the customer level. This information usually contains available unique customer IDs, customer names, and customer addresses, which are easily correlated with behavioral program data. For downstream measures, NW Natural provided customer-level tracking data with energy savings from other programs NW Natural offers to customers in the behavioral program.

The following steps were taken to estimate behavioral program savings from downstream program uplift:

1. Match the behavioral program treatment and control group customers to the utility energy efficiency program tracking data using customer identifiers,
2. Calculate the savings per treatment group subject from efficiency uplift as the difference between treatment and control groups in average efficiency program savings per subject; and,
3. Multiply that difference by the number of treatment group subjects.

The Evaluators summarized and removed program uplift for each cohort and treatment status for each of the other residential program offerings.

4.2.7 ATTRITION ANALYSIS

The number of treatment and control households in the program can be affected by either move-outs or opt-outs (known collectively as 'attrition'). If a household's final bill was the end of the evaluated post-period, it was considered a move out and bills occurring after moveout were removed from the analysis. The Evaluators reported the cumulative level of both treatment and control move outs over the program life by monthly period, cohort, and treatment/control status for each program year. This information can be useful for NW Natural for the potential need for future wave expansions for the pilot.

5 IMPACT EVALUATION RESULTS

This section provides the results of each portion of the impact evaluation. The Evaluators calculated the percent savings per home by dividing the average annual energy savings estimated in the treatment group by the average annual energy consumption from the control group for each program year. That value is then adjusted for uplift from downstream measures. The program-level savings were calculated by multiplying the average annual household impact estimate by the number of active program participants in the treatment group and after removing double counted savings, by program year.

Program savings summarized in Table 3-1 and Table 3-2 are discussed in detail in the following sections.

Table 3-1: Behavioral Program Savings Summary

Cohort	Annual Savings Per Home (Therms/year)	5% CI Annual Savings Per Home (Therms/year)	95% CI Annual Savings Per Home (Therms/year)	Annual Adjusted Savings Per Home[5] (Therms/year)	Total Program Verified Savings (Therms)
WA	4.51	3.73	5.30	4.40	197,373

Table 3-2: Behavioral Program Savings by Month

Cohort	Month	HDD	Unadjusted Savings Per Customer (Therms)
WA	Jan 2024	814	0.68
	Feb 2024	634	0.54
	Mar 2024	560	0.50
	Apr 2024	423	0.40
	May 2024	310	0.33
	June 2024	128	0.20
	Jul 2024	21	0.13
	Aug 2024	33	0.14
	Sep 2024	88	0.17
	Oct 2024	334	0.35
	Nov 2024	552	0.49
	Dec 2024	686	0.59
	Total	**4,583**	**4.51**

[5] These savings are adjusted to remove double counted savings caused by Behavioral program induced Uplift. Uplift increases participation in other Energy Efficiency programs for Behavioral program treatment customers relative to Behavioral program control customers.

5.1 Data Preparation and Cleaning

The Evaluators prepared and cleaned billing data provided by NW Natural and Bidgely prior to running regressions. The following table represents the unique number of customers in the treatment group and the control group throughout the billing cleaning stages.

Table 3-3 Treatment and Control Customers After Restrictions

Cohort	Restriction Detail	Treatment Customers	Control Customers
WA	Start	48,060	13,910
	Keep first wave assignment	48,060	13,910
	After removing bills that occur after inactive date	48,048	13,908
	Remove outliers (>17 Therms/day)	48,048	13,908
	After removing bills that occur before pre-period	48,048	13,908
	Restrict to pre-period and post-period in program year	44,834	12,982
	Restrict to customers with at least 9 months pre and 6 months post	44,834	12,982

The Evaluators conducted calendarization adjustments for each monthly bill. The resulting dataset contained adjusted monthly bill reads with associated consumption and bill duration for each month the customer remained active.

After data preparation and cleaning, the Evaluators performed validity testing for the cohort. The details of this step are provided in the next section.

5.2 Validity Testing Results

After billing preparation and cleaning, the remaining customers were tested for statistically significant differences in usage between the treatment and control groups for each of the 17 pre-period months between June 2022 and October 2023. As shown in the tables below, all waves had valid control groups.

Table 3-4 details differences and statistical significance between each wave's treatment and control groups for each of the 12 months in the pre-period.

Table 3-4 T-Test Results, WA

Pre-Period Month	Treatment Group Average Daily Usage (Therms/day)	Control Group Average Daily Usage (Therms/day)	Average Daily Usage Difference (Therms/day)	P-value	Statistically Significant Difference
Jun-22	0.64	0.64	0.00	0.55	-
Jul-22	0.57	0.57	0.00	0.76	-
Aug-22	0.52	0.52	0.00	0.80	-
Sep-22	0.57	0.57	0.00	0.87	-
Oct-22	1.35	1.35	0.00	0.93	-
Nov-22	3.23	3.23	0.00	0.98	-
Dec-22	3.90	3.90	0.00	0.94	-
Jan-23	3.61	3.61	0.00	0.95	-
Feb-23	3.72	3.72	0.00	1.00	-
Mar-23	3.21	3.21	0.00	0.93	-
Apr-23	2.13	2.13	0.00	0.92	-
May-23	0.94	0.94	0.00	0.94	-
Jun-23	0.66	0.67	-0.01	0.65	-
Jul-23	0.55	0.55	0.00	0.71	-
Aug-23	0.53	0.52	0.01	0.73	-
Sep-23	0.65	0.65	0.00	0.81	-
Oct-23	1.36	1.36	0.00	0.91	-

5.3 Uplift Analysis Results

Participants in both the treatment and control groups participate in other NW Natural energy efficiency programs. The double counted savings, defined in the methodology, whether positive or negative, are subtracted from the wave's gross savings estimates from the regression analysis to get total verified savings. This section summarizes the results of the double counting analysis for downstream programs.

NW Natural delivered tracking data for the residential programs included in the double counting analysis, including the New Homes Program, Existing Single-Family Program, Existing Multifamily Washington Program, and Products Program.

The Evaluators identified and summarized the average treatment customer, average control customer, and average incremental savings attributed to the residential programs.

Table 3-5 displays the verified double-counted savings to be subtracted from the treatment group's annual program savings for PY2024.

Table 3-5: Double-Counted Savings in Residential Programs

Cohort	Average Treatment Household Daily Savings (Therms/year)	Average Control Household Daily Savings (Therms/year)	Average Uplift Household Daily Savings (Therms/year)	Treatment Customers	Program Uplift Savings	Program Uplift % of Annual Savings
WA	1.37	1.26	0.11	44,834	4,870	2%

PY2024 displays a total of 4,870 Therms in double-counted savings. The uplift double counting values are subtracted from the regression model results.

5.4 Linear Regression Modeling Results

This section details the regression results of the evaluated cohort using its original RCT control group.

Table 3-6 displays the annual Therms savings per treatment customer prior to any double counting adjustments. The savings are positive and statistically significant at the 90 percent level.

Table 3-6: WA Cohort Annual Savings per Household

Cohort	Model	Program Year	Estimate	5% CI	95% CI
WA	PPR	PY2024	4.51	3.73	5.30

Table 3-7 displays the complete list of regression coefficients, including all covariate interactions, for PY2024 for the selected PPR model.

Table 3-7: WA Cohort PY2024 PPR Regression Results

Coefficient	Estimate	Std Error	P-Value	5% CI	95% CI
Intercept	0.946	0.02	0.00	0.91	0.98
Treatment	-0.004	0.00	0.11	-0.01	0.00
Feb	-0.264	0.01	0.00	-0.28	-0.25
Mar	-0.297	0.01	0.00	-0.31	-0.28
Apr	-0.476	0.01	0.00	-0.49	-0.46
May	-0.466	0.01	0.00	-0.49	-0.44
Jun	-0.692	0.02	0.00	-0.72	-0.66
Jul	-0.861	0.02	0.00	-0.89	-0.83
Aug	-0.867	0.02	0.00	-0.90	-0.83
Sep	-0.779	0.02	0.00	-0.81	-0.75
Oct	-0.144	0.01	0.00	-0.17	-0.12
Nov	-0.256	0.01	0.00	-0.27	-0.24
Dec	-0.185	0.01	0.00	-0.20	-0.17
Pre-period Usage	0.951	0.00	0.00	0.95	0.95
HDD	-0.025	0.00	0.00	-0.03	-0.02
Pre-period Feb Usage	-0.139	0.00	0.00	-0.14	-0.14
Pre-period Mar Usage	-0.254	0.00	0.00	-0.26	-0.25
Pre-period Apr Usage	-0.229	0.00	0.00	-0.23	-0.23
Pre-period May Usage	0.007	0.00	0.11	0.00	0.01
Pre-period Jun Usage	-0.066	0.01	0.00	-0.07	-0.06
Pre-period Jul Usage	-0.106	0.01	0.00	-0.12	-0.10
Pre-period Aug Usage	-0.018	0.01	0.00	-0.03	-0.01
Pre-period Sep Usage	-0.019	0.01	0.00	-0.03	-0.01
Pre-period Oct Usage	-0.322	0.00	0.00	-0.33	-0.32
Pre-period Nov Usage	-0.182	0.00	0.00	-0.19	-0.18
Pre-period Dec Usage	-0.183	0.00	0.00	-0.19	-0.18
Treatment × HDD	-0.000687	0.00	0.00	0.00	0.00

The Evaluators ran 2 different regression models and selected the best fitting PPR model. The PPR model was a good fit, as seen by the Adjusted R-squared in Table 3-8.

Table 3-8: WA Cohort PPR Model Fit

Cohort	Model	Adjusted R2	F-Statistic	Number of Observations	Number of Treatment Customers
WA	PPR	0.906	254,260	685,874	44,834

The ex-post gross gas savings of the Behavioral program for WA are summarized below. The number of customers used to calculate total ex-post gas savings is the number of treatment customers in the post-period.

Table 3-9: WA Gross Annual Gas Savings, PY2024

Annual Unadjusted Savings Per Home (Therms/yr)	5% CI Annual Unadjusted Savings Per Home (Therms/yr)	95% CI Annual Unadjusted Savings Per Home (Therms/yr)	Annual Double Counted Savings Per Home (Therms/yr)	Annual Adjusted Savings Per Home (Therms/yr)	Annual Control Group Usage Per Home (Therms/yr)	Annual Percent Savings Per Home
4.51	3.73	5.30	0.11	4.40	668.76	0.66%

The Behavioral program displayed 0.66 percent of annual household savings for PY2024. The average annual household savings for treated customers in WA was 4.40 Therms in PY2024. Household savings estimates were extrapolated using the number of treatment customers active in the post-period. The Evaluator found the cohort to display 197,270 Therms in savings for the PY2024 evaluation period. In addition, the 90 percent confidence interval for adjusted annual savings after the double count adjustment is displayed below.

Table 3-10: Total Gross Annual Gas Savings, PY2024

Cohort	Annual Adjusted Savings Per Home (Therms/yr)	Number of Treatment Customers	Total Program Verified Savings (Therms)	5% CI Total Program Verified Savings (Therms)	95% CI Total Program Verified Savings (Therms)
WA	4.40	44,834	197,270	162,272	232,597

5.4.1 DIFFERENCE-IN-DIFFERENCE MODEL RESULTS

The Evaluators ran a difference-in-difference regression model in addition to the PPR model discussed above. This model was not used to extrapolate savings due to the PPR model's higher Adjusted R-squared value compared to that of the difference-in-difference model displayed in Table 3-13. Nevertheless, Table 3-11 provides the estimated annual savings per treatment customer prior to any double counting adjustments.

Table 3-11: Difference-in-Difference Model Annual Savings per Household

Cohort	Program Year	Estimate	5% CI	95% CI
WA	PY2024	4.34	2.13	6.56

Table 3-12 displays the complete list of regression coefficients, including all covariate interactions, for PY2024 for the difference-in-difference model.

Table 3-12: Difference-in-Difference Regression Results

Coefficient	Estimate	Std Error	P Value	5% CI	95% CI
(Intercept)	0.288	0.00	0.00	0.283	0.293
Treatment	0.000	0.00	0.93	-0.005	0.006
Post	-0.063	0.01	0.00	-0.072	-0.055
HDD	0.129	0.00	0.00	0.129	0.130
Treatment × Post	-0.003	0.01	0.60	-0.013	0.007
Treatment × HDD	0.000	0.00	0.68	0.000	0.000
Post × HDD	-0.001	0.00	0.00	-0.002	-0.001
Treatment × Post × HDD	-0.001	0.00	0.09	-0.001	0.000

Table 3-13: WA Cohort Difference-in-Difference Model Fit

Cohort	Model	Adjusted R2	F Statistic	Number of Observations	Number of Treatment Customers
WA	Difference-in-difference	0.608	368,044	1,664,251	44,834

5.4.2 PPR MODEL RESULTS (Q1/Q2 PY2024 VERSUS Q3/Q4 PY2024)

Table 3-14 displays PPR model results when the post-period regression data is restricted to the first half of PY2024 and the second half of PY2024, and regressions are run separately for each post-period interval. The purpose of this split is to explore whether estimated savings are higher for the latter half of PY2024. The regression results for each half of PY2024 were extrapolated to a full year of weather data to allow for the treatment effect to be compared under the same weather conditions. Based on the results below, savings do not appear to increase as the 2024 program year progresses.

Table 3-14: PPR Model Annual Savings per Household

Cohort	Post-Period Months Included	Estimate	5% CI	95% CI	P-Value	Adjusted R2
PPR Model	Jan 2024-Jun 2024	4.69	3.48	5.90	0.00	0.91
PPR Model	Jul 2024-Dec 2024	4.67	3.49	5.86	0.00	0.89

5.5 Attrition Analysis Results

Table 3-15 summarizes the moveout rates for both the treatment group and control group.

Table 3-15: Customer moveouts for Treatment and Control Groups

Cohort	Treatment or Control Group	Treatment Customers Start PY	Treatment Customers End PY	Moveouts	Moveout Percent
WA	Treatment	47,225	44,408	2,817	5.97%
	Control	13,659	12,783	876	6.41%

6 CONCLUSIONS AND RECOMMENDATIONS

The following section details the Evaluators' conclusions and recommendations for the Behavioral program.

Conclusion: Behavioral Program verified annual savings of 197,373 Therms for PY2024 are positive and statistically significant at the 90% level for the Washington cohort.

- The evaluated WA cohort had a valid control group which suggests that the creation of the original RCT cohort by the implementer was done in accordance with industry standards.
- The evaluated cohort displayed average annual gas savings of 0.66 percent of annual billed use in PY2024. Typical behavioral programs display average annual gas savings between 0.25 percent and 2 percent. This is the first program year for the WA cohort, and behavioral program savings often increase in later program years.
- Downstream and upstream double counted savings were 4,870 Therms for PY2024. The double counted savings were removed from the estimated savings from the regression results. The double counted savings represent two percent of program savings before double counting, therefore, the impact on final program savings was insignificant in percentage terms. The observed double counted savings is expected, as Uplift's percentage of program savings is typically between 1 percent and 3 percent.
- The annual attrition rate in PY2024 is roughly 6 percent for the WA cohort for both the treatment and control groups.

Recommendation: Save and store historical billing data for all customers in each wave to ensure future analyses will have one year of billing data prior to the RCT start date for each customer, as well as complete billing data after the intervention.

Conclusion*:* The post-period was defined as 12 months and a measure life was not defined for the program.

Recommendation: Assume a 1-year measure life for ongoing Behavioral programs or change the cohorts each year to claim a longer measure life for savings.

EM&V REPORT: NW NATURAL 2010-2022 LOW-INCOME ENERGY EFFICIENCY PROGRAMS

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SUBMITTED BY:

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1 EXECUTIVE SUMMARY

This report is a summary of the impact and process evaluations for both of NW Natural's Low-Income Energy Efficiency programs: the Oregon Low-Income Energy Efficiency Program (OLIEE) and the Washington Low-Income Energy Efficiency Program (WALIEE). These Low-Income energy efficiency programs are designed to support housing stabilization for Low-Income Oregon and Washington NW Natural customers by providing energy bill payment assistance and weatherization services to effectively reduce energy costs and improve health.

NW Natural has requested separate impact analyses and evaluations conducted for the Low-Income energy efficiency programs every four years, since the last impact evaluation report in 2010. Therefore, ADM Associates, Inc. (herein referred to as the "Evaluators") have evaluated the following evaluation periods, by program:

Table 1-1: OLIEE and WALIEE Evaluation Periods

Program	Program Years	Impact Evaluation	Process Evaluation
OLIEE	PY2010-PY2013	✓	
	PY2014-PY2017PY2014-PY2017	✓	
	PY2018-PY2022	✓	✓
WALIEE	PY2010-PY2013	✓	
	PY2014-PY2017PY2014-PY2017	✓	
	PY2018-PY2022	✓	✓

1.1 Verified Savings and Process Findings

The Evaluators' analysis yields two estimates of gross savings for each project: an expected gross Therms savings estimates (as reported in the project documentation and program tracking system) and the verified net Therms savings estimates developed through our verification and evaluation procedures. Realization rates for each program are found by taking the ratio of these values. In addition to these impact estimates, the Evaluators conducted process evaluations resulting in several conclusions and recommendations. Lastly, cost-effectiveness testing was performed to estimate net program cost and benefits.

1.1.1 OREGON LOW-INCOME ENERGY EFFICIENCY PROGRAM (OLIEE)

Below, are expected and verified savings for each evaluated program year of the OLIEE program, conclusions and recommendations based on the process evaluations, and cost-effectiveness results from the same periods.

1.1.1.1 OLLIE Impact Results

Table 1-2 and Table 1-3 shows expected and verified savings by program year and program evaluation period for the OLIEE program. The Evaluators note that the first two evaluation periods cover 4 program years each, while the last evaluation period covers 5 program years. For example, evaluation period

PY2010-PY2013 includes program years 2010, 2011, 2012, and 2013. The year of the project completion date was used to define a project's program year.

Table 1-2: Verified Impact Savings by Program Year, OLIEE

Program Year	Number of Participant Homes	Average Number of Installed Measures	Expected Therms Saved	Verified Therms Saved	Realization Rate	Total Incentives and Agency Costs ($)
2010	561	3.2	219,489	52,224	24%	3,448,712
2011	332	3.1	96,895	30,906	32%	2,223,775
2012	268	3.5	76,989	24,948	32%	2,738,388
2013	149	3.3	35,682	13,871	39%	1,024,954
2014	189	3.4	50,778	20,673	41%	1,430,164
2015	182	3.3	42,701	19,907	47%	1,533,943
2016	248	4.0	53,697	27,126	51%	1,970,200
2017	287	4.1	69,094	31,392	45%	2,605,351
2018	295	4.2	97,583	35,046	36%	3,128,583
2019	262	3.9	79,394	31,125	39%	2,738,720
2020	248	3.4	66,745	29,462	44%	2,105,700
2021	176	3.8	55,348	20,909	38%	2,164,725
2022	189	3.8	57,521	22,453	39%	2,916,969
Total	**3,386**	**3.6**	**1,001,916**	**360,042**	**36%**	**30,030,184**

Table 1-3: Verified Impact Savings by Program Evaluation Period, OLIEE

Program Evaluation Period	Evaluation Period Homes	Average Number of Installed Measures	Expected Therms Saved	Verified Therms Saved	Realization Rate	Total Incentives and Agency Costs ($)
PY2010-PY2013	1,310	3.3	429,055	121,949	28%	9,435,829
PY2014-PY2017	906	3.8	216,270	99,098	46%	7,539,658
PY2018-PY2022	1,170	3.9	356,591	138,995	39%	13,054,697
Total	**3,386**	**3.6**	**1,001,916**	**360,042**	**36%**	**30,030,184**

Verified savings from 2010 to 2022 for the program are 360,042 Therms, 36 percent of Expected Savings. One reason for the low realization rate was due to the Expected Therms savings provided in the project tracking data. The Evaluators observed that total Expected Therms savings was high because savings in the project tracking data were not uniquely calculated for each project associated with a customer and reflected cumulative savings across multiple projects. Program costs were also affected by the same issue. However, the Evaluators were not able to obtain the number of projects associated with the Expected Therms savings and program costs and therefore could not provide adjustments to reflect project-level values. The Evaluators noted this issue applied to all program years and program evaluation periods.

In addition, the Evaluators requested measure-level savings from NW Natural to determine how Expected Therms savings were being calculated for the program, however, this data was not available. This prevented the Evaluators from recreating project-level savings to determine whether there were any issues with the calculations of project-level savings in the project tracking data.

1.1.1.2 OLLIE Cost-Effectiveness Results

The Evaluators estimated cost-effectiveness for the most recent evaluation periods (PY2014-PY2017 and PY2018-PY2022). The results of cost-effectiveness testing showed the program was cost-effective for the TRC, which is the primary cost test for NW Natural energy efficiency programs.

The participant cost test (PCT) is N/A because participants did not incur any costs from the program and were provided the benefits of the program free of charge. As with most Low-Income programs, the UCT and RIM are lower because the utility assumes the full cost of measure installation and equipment.

Table 1-4: Cost-Effectiveness Testing Results OLLIE, PY2014-PY2017

Evaluation Period	TRC	UCT	RIM	PCT	SCT
PY2014-PY2017	2.08	0.25	0.20	N/A	2.34
Overall	**2.08**	**0.25**	**0.20**	**N/A**	**2.34**

Table 1-5: Cost-Effectiveness Testing Results OLLIE, PY2018-PY2022

Evaluation Period	TRC	UCT	RIM	PCT	SCT
PY2018-PY2022	2.31	0.23	0.19	N/A	2.60
Overall	**2.31**	**0.23**	**0.19**	**N/A**	**2.60**

1.1.2 WASHINGTON LOW-INCOME ENERGY EFFICIENCY PROGRAM (WALIEE)

Below, are expected and verified savings for each evaluated program year of the WALIEE program, conclusions and recommendations based on the process evaluations and cost-effectiveness results from the same periods.

1.1.2.1 WALIEE Impact Results

Table 1-6 and Table 1-7 shows expected and verified savings by program year and program evaluation period for the WALIEE program.

Table 1-6: Verified Impact Savings by Program Year, WALIEE

Program Year	Number of Participant Homes	Average Number of Installed Measures	Expected Therms Saved	Verified Therms Saved	Realization Rate	Total Incentives and Agency Costs ($)
2010	16	3.4	6,393	2,598	41%	122,685
2011	11	2.9	3,634	1,786	49%	99,938
2012	8	3.5	2,517	1,299	52%	53,447
2013	20	3.5	7,684	3,248	42%	148,111
2014	10	2.8	3,050	1,624	53%	89,045
2015	9	3.2	3,219	1,462	45%	88,833
2016	17	3.5	6,409	2,761	43%	182,308
2017	13	2.9	6,148	2,111	34%	312,530
2018	16	3.7	7,605	2,598	34%	216,246
2019	22	4.4	20,214	3,573	18%	347,843
2020	8	2.1	1,136	1,299	114%	27,854
2021	14	2.5	3,598	2,273	63%	84,683
2022	11	2.6	703	1,786	254%	71,938
Total	**175**	**3.3**	**72,310**	**28,418**	**39%**	**1,845,461**

Table 1-7: Verified Savings by Program Evaluation Period, WALIEE

Program Evaluation Period	Evaluation Period Homes	Average Number of Installed Measures	Expected Therms Saved	Verified Therms Saved	Realization Rate	Total Incentives and Agency Costs ($)
PY2010-PY2013	55	3.3	20,228	8,931	44%	424,181
PY2014-PY2017	49	3.1	18,826	7,958	42%	672,716
PY2018-PY2022	71	3.3	33,256	11,529	35%	748,564
Total	**175**	**3.3**	**72,310**	**28,418**	**39%**	**1,845,461**

Verified savings from 2010 to 2022 for the program are 28,418 Therms, 39 percent of Expected Savings.

One reason for the low realization rate was due to the Expected Therms savings provided in the project tracking data. The Evaluators observed that the sum of total Expected Therms savings was high because savings in the project tracking data were not uniquely calculated for each project associated with a customer and reflected cumulative savings across multiple projects. Program costs were also affected by the same issue. However, the Evaluators were not able to obtain the number of projects associated with the Expected Therms savings and program costs and therefore could not adjust them to reflect project-level values.

In addition, the Evaluators requested measure-level savings from NW Natural to determine how Expected Therms savings were being calculated for the program, however, this data was not available. This prevented the Evaluators from recreating project-level savings to determine whether there were any issues with the calculations of project-level savings in the project tracking data.

1.1.2.2 WALIEE Cost-Effectiveness Results

The Evaluators estimated cost-effectiveness for the most recent evaluation periods (PY2014-PY2017 and PY2018-PY2022). The results of cost-effectiveness testing showed the program was cost-effective for the TRC, which is the primary cost test for NW Natural energy efficiency programs.

The participant cost test (PCT) is N/A because participants did not incur any costs from the program and were provided the benefits of the program free of charge. As with most Low-Income programs, the UCT and RIM are lower because the utility assumes the full cost of measure installation and equipment.

Table 1-8: Cost-Effectiveness Testing Results WALLIE, Evaluation Period PY2014-PY2017

Evaluation Period	TRC	UCT	RIM	PCT	SCT
PY2014-PY2017	1.37	0.23	0.19	N/A	1.57
Overall	**1.37**	**0.23**	**0.19**	**N/A**	**1.57**

Table 1-9: Cost-Effectiveness Testing Results WALLIE, Evaluation Period PY2018-PY2022

Evaluation Period	TRC	UCT	RIM	PCT	SCT
PY2018-PY2022	2.08	0.33	0.25	N/A	2.38
Overall	**2.08**	**0.33**	**0.25**	**N/A**	**2.38**

1.1.3 CONCLUSIONS AND RECOMMENDATIONS

The following section details the Evaluators' conclusions and recommendations for the Low-Income programs.

1) **Conclusion 1: NW Natural's Low-Income program utilizes lenient qualification criteria and provides comprehensive measure coverage.** Stakeholders from across the interview groups – program staff, CAP Agency and CBO staff, and trade allies – remarked on NW Natural's comprehensive measure coverage and willingness to expand eligibility for services they can provide. Not only did NW Natural modify the qualification criteria from 200% Federal Poverty Level (FPL) to 80% area median income (AMI) in response to requests by the CAP Agency, but they also expanded health and safety qualifying measures, allowing for more holistic coverage and home updates for customers. CAP agency and CBO staff noted that NW Natural's program has some of the most lenient and flexible qualification criteria – as compared to other similar programs – and participating trade allies indicated that the measures covered are thorough. Furthermore, the program passed the TRC, showing that the program is assisting customers cost-effectively.
2) **Conclusion 2: Most participants and eligible non-participants participate in the CAP Agencies and CBO energy related bill assistance programs. Waitlist times for the program vary across agencies.** One CBO representative explained that they avoid waitlists by making their program invite-only, while other CBO representatives and CAP agency staff indicated their wait list times range from a few months to over a year.

3) **Conclusion 3: Non-participants respondents explained that the cost of equipment upgrades was the main factor preventing them from engaging in this type of program**, suggesting awareness of NW Natural's assistance for Low-Income is limited and many eligible customers do not realize they may qualify for free weatherization and heating equipment updates.

    Recommendation 1: Although wait lists for some of the weatherization and HVAC programs can be lengthy, CAP agency and CBO staff should continue to enroll existing clients into this program to ensure comprehensive energy assistance, as more than half of all non-participant respondents expressed interest in making energy efficient improvements to their home.

4) **Conclusion 4: Workforce development issues limit program expansion**. Some CAP Agency representatives explained that workforce issues are their largest barrier to increased engagement. These representatives indicated that funds are available to help more customers, but they struggle to find qualified contractors. Representatives from across the CAP agencies and CBOs remarked that their existing auditors and contractors have been involved in the weatherization business for many years, but that they are concerned about the future longevity of the program due to the lack of new contractors and auditors. One CAP agency representative mentioned an internship program offered by Oregon Training Institute as a possible solution to this issue but noted the state needs more contractors.

    Recommendation 2: NW Natural should consider partnering with the Oregon Training Institute and other similar organizations to help offer more workforce development and training opportunities for future contractors and trade allies.

5) **Conclusion 5: CBO representatives underscored the importance of leveraging existing relationships in communities when promoting the program.**

Recommendation 3: NW Natural can continue to strengthen their program by expanding their presence in the communities they serve through attendance at and sponsorship of community events. One of the CBO representatives also noted that having a formal contract and master services agreement has also been very helpful in ensuring the program remains funded.

6) **Conclusion 6: Satisfaction across stakeholder groups – CAP agency and CBO staff, contractors, and participants – was high.** Interview respondents highlighted NW Natural's communicativeness and willingness to answer questions, while most survey respondents indicated they would recommend the program to others and that they believe NW Natural is a very or extremely trustworthy source of information regarding energy savings in the home.

7) **Conclusion 7: Reported program costs and Expected Therms savings in program tracking data was not unique for each project associated with a customer.** A primary reason for the low realization rate was due to the Expected Therms savings provided in the project tracking data. The Evaluators observed that total Expected Therms savings were high because savings in the project tracking data were not uniquely calculated for each project associated with a customer and reflected cumulative savings across multiple projects. Program costs were also affected by the same issue.

   Recommendation 4: NW Natural should require implementers to report costs and expected savings uniquely for each project associated with a customer to ensure accurate accounting of expected savings and cost data utilized in cost-effectiveness testing.

8) **Conclusion 8: Incomplete or missing project documentation for sampled projects that were part of document-based verification.** For OLIEE, the Evaluators found 25 percent of projects had incomplete, missing, duplicate, or other project documentation issues. For WALIEE, the Evaluators found most projects, 91%, had incomplete, missing, duplicate, or other project documentation issues.

   Recommendation 5: NW Natural should collect all application forms, supporting customer or contractor invoices, certificates, project installation photos, and any other associated project-level documents specific to each program for every project.

9) **Conclusion 9: Project documentation for sampled projects from documentation-based verification were missing measure specifications.** The Evaluators found that many specifications were missing from the project documentation such as insulation square footage[1], window/door quantities, and model information for furnaces and water heaters. Measures such as furnace tune-ups and direct vent space heaters did not provide any specification information. Furthermore, there were additional measures in the documentation that were not accounted for in the project tracking data for many customers.

[1] Insulation square footage differs from whole-home square footage and refers to the square footage of the installed insulation from insulation measures such as ceiling/attic insulation, floor insulation, and wall insulation.

Recommendation 6: NW Natural should collect additional measure information including installed square footage, baseline measure efficiency, retrofit measure efficiency, measure quantities, and make/model information for each project to aid verification efforts. In addition, all measures should be listed in the project tracking data for each project.

10) **Conclusion 10: Measure-level savings for each program were not available from the implementer or NW Natural.** The Evaluators requested measure-level savings from NW Natural to determine how Expected Therms savings were being calculated for the program, however, this data was not available.

    Recommendation 7: NW Natural should maintain a list of measures for the program with measure-level savings. This will allow for the recreation of Expected Therms savings by Evaluators for each project to determine if savings are being properly calculated and to identify potential issues with project data.

11) **Conclusion 11: The Evaluators found statistically significant savings for each program evaluation period.** For OLIEE, the Evaluators estimated savings between 93.1 and 118.8 Therms annually per customer across all cohorts. This results in percent savings between 16.6 percent and 19.2 percent compared to the counterfactual control customers. For WALIEE, the Evaluators note that the savings are near the upper end of the expected savings range normally observed for a weatherization program. The Evaluators estimated savings of 162.39 Therms annually per customer, a 25.2 percent savings compared to the control customers.

    Recommendation 8: The billing analysis results show the program is effectively reducing energy consumption for program participants. NW Natural should keep targeting the same customers and continue with the same general program implementation used in prior program years to continue providing positive energy savings to their customers.

12) **Conclusion 12: The Evaluators found statistically significant reductions in arrears for program participants.** The Evaluators estimated a $213 reduction in annual arrears for participants compared to the counterfactual control customers. The Evaluators found no statistically significant changes in disconnects or disconnection notices for participants.

    Recommendation 9: The Evaluators recommend NW Natural include a Non-Energy Benefit adder of $21.3 per participant for arrears when performing cost-effectiveness testing for the program.

1.2 Report Organization

From this point, the remaining report chapters include:

- Chapter 2: General Evaluation Methodology
- Chapter 3: OLIEE Program Impact Results
- Chapter 4: WALIEE Program Impact Results
- Chapter 5: Low-Income Program Process Results

- Appendix A: Cost-Effectiveness Testing
- Appendix B: Unit Energy Savings
- Appendix C: Data Collection Recommendations
- Appendix D: Survey Collections Instruments

2 GENERAL EVALUATION METHODOLOGY

The Evaluators completed an impact evaluation for each of the programs summarized in the Executive Summary. Our activities estimate and verify annual savings, conduct cost-effectiveness testing and provide energy savings from a single source, aimed at providing guidance for continuous program improvement.

2.1 Glossary of Terminology

As a first step to detailing the evaluation methodologies, the Evaluators have provided a glossary of terms to follow:

- **Deemed Savings** – An estimate of an energy savings outcome (gross savings) for a single unit of an installed energy efficiency measure. This estimate (a) has been developed from data sources and analytical methods that are widely accepted for the measure and purpose and (b) are applicable to the situation being evaluated.
- **Measure –** Energy saving device, unit, or service.
- **UES –** Unit Energy Savings are a single unitized savings estimate (e.g., savings per motor, savings per hp) that represent an average or weighted average of similar savings measures. UES measures are also known as deemed savings measures.
- **Expected Savings** – Calculated savings used for program and portfolio planning purposes.
- **Verified Savings** – Savings estimates after the updated unit-level savings values have been updated and energy impact evaluation has been completed, integrating results from billing analyses and appropriate RTF UES values.
- **Gross Savings** – The change in energy consumption directly resulting from program-related actions taken by participants in an efficiency program, regardless of why they participated.
- **Free Rider** – A program participant who would have implemented the program measure or practice in absence of the program.
- **Net-To-Gross** – A factor representing net program savings divided by gross program savings that is applied to gross program impacts to convert them into net program load impacts.
- **Net Savings** – The change in energy consumption directly resulting from program-related actions taken by participants in an efficiency program, with adjustments to remove savings due to free ridership.
- **Non-Energy Benefits** – Quantifiable impacts produced by program measures outside of energy savings (comfort, health and safety, reduced alternative fuel, etc.).
- **Non-Energy Impacts** – Quantifiable impacts in energy efficiency beyond the energy savings gained from installing energy efficient measures (reduced cost for operation and maintenance of equipment, reduced environmental and safety costs, etc.).

- **Pre-Period –** The period prior to installation of energy efficient equipment or upgrade, typically set to equal a one-year period.
- **Post-Period –** The period after installation of energy efficient equipment or upgrade, typically set to equal a one-year period.
- **HDD –** Heating degree days (HDD) are a measurement used to estimate the amount of energy required to heat a building or space during a specific period, typically a day or a month. It is primarily used in regions with cold climates to assess the demand for heating and to evaluate energy consumption.
- **TMY –** A Typical Meteorological Year (TMY) is a synthesized set of weather data representing the long-term climatic conditions for a specific location. It is constructed using historical weather data collected over several years (e.g., 15 or 30 years), typically obtained from weather stations in the vicinity of the location of interest. The purpose of a TMY is to provide a standardized dataset that represents the "typical" weather conditions for a particular location. The Evaluators utilized the latest available years of data from TMYx (2009-2023) to reflect the most recent historical weather data available.
- **Dummy Variable -** A dummy variable, also known as an indicator variable or binary variable, is a categorical variable that takes on one of two values to represent the presence or absence of a characteristic or condition. It is commonly used in statistical analysis and regression modeling to represent qualitative factors and typically takes the value of 0 or 1, where 0 represents the absence or reference category, and 1 represents the presence or alternative category.

2.2 Impact Evaluation Approach

The Evaluators used the following approaches to calculate energy impact defined by the International Performance Measurement and Verification Protocols (IPMVP) and the Uniform Methods Project (UMP):

- Database review
- Simple verification (document-based, survey-based)
- Deemed savings
- Whole building billing analysis (IPMVP Option C)

The table below summarizes the impact evaluation activities by program.

Table 2-1: Impact Evaluation Activities by Program

Program	Program Evaluation Period	Database Review	Document Verification	Survey Verification	Gas Impact Methodology
OLIEE	PY2010-PY2013	✓	✓	✓	IPMVP Option C: Billing analysis with comparison group
	PY2014-PY2017	✓	✓	✓	IPMVP Option C: Billing analysis with comparison group
	PY2018-PY2022	✓	✓	✓	IPMVP Option C: Billing analysis with comparison group
WALIEE	PY2010-PY2013	✓	✓	✓	IPMVP Option C: Billing analysis with comparison group*
	PY2014-PY2017	✓	✓	✓	IPMVP Option C: Billing analysis with comparison group*
	PY2018-PY2022	✓	✓	✓	IPMVP Option C: Billing analysis with comparison group*

*Due to low participation in the WALIEE Program, the Evaluators conducted a billing analysis for all 12 years combined, with weather-adjusted annual household savings extrapolated to actual 4-year evaluation period participants.

The Evaluators employed two major approaches to determining net savings for NW Natural's Low-Income programs:

- **A *Deemed Savings*** approach involves using stipulated savings for energy conservation measures for which savings values are well-known and documented. These prescriptive savings may also require an adjustment for certain measures, such as incorporation of in-service rates, in which an adjustment is made to reflect the proportion of measures verified to be installed on-site.
- **A *Billing Analysis*** approach involves estimating energy savings by applying a linear regression to measured participant energy consumption utility meter billing data. Billing analyses may also include billing data from nonparticipant customers. This approach does not require primary data collection or adjustments such as in-service rates, as the observed energy reductions inherently incorporate these adjustments. This approach aligns with the IPMVP Option C.

2.2.1 IMPACT EVALUATION FRAMEWORK

The Evaluators approach the impact evaluation was from the frame of mind that final M&V methodologies should be determined by approaches feasible with the given historical data and participation rates as well as the relative contribution of a given program to the overall energy efficiency impacts. The Evaluators reviewed relevant information on infrastructure, framework, and guidelines set

out for EM&V work in several guidebook documents that have been published over the past several years. These include the following:

- Northwest Regional Technical Forum (RTF)
- Technical reference manuals, such as the Energy Trust of Oregon or NW Natural Technical Reference Manuals
- National Renewable Energy Laboratory (NREL), United States Department of Energy (DOE) The Uniform Methods Project (UMP): Methods for Determining Energy Efficiency Savings for Specific Measures, April 2013[2]
- International Performance Measurement and Verification Protocol (IPMVP) maintained by the Efficiency Valuation Organization (EVO) with sponsorship by the U.S. Department of Energy (DOE)[3]

The Evaluators kept data collection instruments, calculation spreadsheets, and survey data available for NW Natural records.

2.2.2 DATA UTILIZED

For each of the programs and measures evaluated, the Evaluators obtained the following datasets from NW Natural:

- Program tracking data for each of the measures offered through OLIEE and WALIEE, completed between July 1, 2010 and June 30, 2022
- Participant monthly gas consumption data between July 1, 2009 and December 31, 2023
- Nonparticipant monthly gas consumption data between July 1, 2009 and December 31, 2023
- Project-level documentation, including application forms, equipment specification documents, equipment invoices, and project installation documents
- Customer contact information
- Trade ally contact information and number of projects completed in each program year
- Community Action Partnership staff contact information
- NW Natural staff contact information
- Typical Meteorological Year (TMY) X weather data (2018-2023), TMY3 weather data, and NOAA weather data for each evaluated program year.

To evaluate each of the measures, the Evaluators conducted primary data collection activities. The Evaluators performed the following data collection activities:

- Stratified sampling plan that achieves 90/10 confidence precision goals
- Surveyed a random subset of participating customers to collect information pertinent to validating associated energy impacts

Further details of measure-specific sampling plans and data collection activities are described in Section 2.2.4 below.

[2] Notably, The Uniform Methods Project (UMP) includes the following chapters authored by the Evaluators. Chapter 9 (Metering Cross- Cutting Protocols) was authored by Dan Mort and Chapter 15 (Commercial New Construction Protocol) was Authored by Steven Keates.
[3] Core Concepts: International Measurement and Verification Protocol. EVO 100000 – 1:2016, October 2016.

The Evaluators used the data provided by NW Natural to first conduct a database review for each measure. The Evaluators then conducted a detailed document review for a sample of projects. The purpose and methods for these activities are described in the subsections below.

2.2.3 DATABASE REVIEW

At the outset of the Low-Income energy efficiency program impact and process evaluations, the Evaluators reviewed Low-Income program databases to ensure that they conform to industry standards, have a standardized and documented data dictionary, and adequately track key data relevant to the implementation and evaluation of the program.

The Evaluators recognize that failure to develop and maintain a sufficient tracking system can add significantly to the cost of implementation, monitoring, verification and evaluation; reduce confidence in results; and increase the variance in estimates of savings. Therefore, we make this a high priority in our iterative review of each program over the course of all evaluation periods of interest.

2.2.4 DOCUMENT-BASED VERIFICATION

In addition to an aggregate tracking database review, the Evaluators requested rebate and project documentation for a randomly selected subset of participating Low-Income customers in each of the programs, for each evaluation period of interest. Documentation for this task included application forms, supporting customer or contractor invoices, AHRI certificates, project installation photos, and any other associated project-level documents specific to each program.

For each project sampled, the Evaluators verified quantities and efficiencies for upgraded equipment or weatherization specifications according to the invoices and associated applications and documents. Deviations between tracking data and project documentation values were noted and summarized.

The Evaluators developed a sampling plan that aimed to achieve a sampling precision of ±10% at 90% statistical confidence – or "90/10 precision" – for net realized savings estimates at the measure category level for all significant measures during document-based verification for each program.

That is, at each state and program level, statistical precision and confidence will meet 90/10 precision at minimum. In a generalized form, simple random samples for a statistically infinite population are developed as follows:

$$n = \left(\frac{1.645 * cv}{rp}\right)^2$$

Where,

n = sample size

1.645 = *z* score reflecting 90% confidence for a two-tailed distribution

cv = Coefficient of Variation, defined as standard deviation / mean

rp = Required Precision, 10% for 90/10 sampling

Standard practice is to assume a CV of .50 for homogenous programs (such as residential programs). In this instance, the required sample for 90/10 is $(1.645 * .5 / .1)^2 = 68$. For programs with limited participation, this sample is adjusted as follows:

$$n_0 = \frac{n}{1 + \frac{n}{N}}$$

Where,

n_0 = Finite-population adjusted sample

n = Sample for a statistically infinite population

N = total population size

Thus, for a population of 400, the required sample to meet ±10% precision at 90% confidence is:

$n_0 = 68 / [1+ 68/400)] = 58.12$, rounding up to 59.

The Evaluators utilized the sample sizes for each program summarized in Table 2-2 for the OLIEE and WALIEE programs, by evaluation period.

Table 2-2: Document-Based Verification Sample Design for OLIEE and WALIEE

Program	Program Evaluation Period	Population of Homes	Sample of Homes	Precision
OLIEE	PY2010-PY2013	1,310	64	90% ± 9.93%
	PY2014-PY2017	906	63	90% ± 9.95%
	PY2018-PY2022	981	63	90% ± 9.98%
	Total	**3,197**	**192**	**90% ± 5.75%**
WALIEE	PY2010-PY2013	55	30	90% ± 9.86%
	PY2014-PY2017	49	28	90% ± 9.73%
	PY2018-PY2022	60	32	90% ± 9.83%
	Total	**164**	**84**	**90% ± 5.67%**

2.2.5 SURVEY-BASED VERIFICATION

This section describes the Evaluators' general methodology for conducting survey-based verification for NW Natural's Low-Income energy efficiency programs. In addition to the document-based verification summarized above, the Evaluators verified tracking data by surveying a sample of participant customer households.

A sample of participants were surveyed to confirm that the measure was installed and is still currently operational and whether the measure was a new construction, early retirement, or replace-on-burnout, if applicable to the measure. Although survey verification is not necessary for weatherization measures, which are unlikely to be removed, uninstalled, or fail, this verification effort is especially relevant for the non-weatherization measures, such as gas furnaces and gas tank water heaters.

This survey effort helped Evaluators develop in-service rates, or the percentage of projects in which the measure is still currently operational and installed. This in-service rate acts as an adjustment to deemed savings estimates to reflect verified savings in the service territory. The selected sample participants were offered a $10 gift card incentive to participate in the verification survey.

The Evaluators combined survey-based verification efforts with the survey-based process evaluation efforts to maximize the quality and quantity of data collected toward multiple deliverables while minimizing customer response fatigue. The findings from these activities will primarily serve the impact evaluation to:

- Verify measure was installed
- Verify measure is functional

Because this evaluation effort also includes a process evaluation of the Low-Income energy efficiency programs, the Evaluators included these verification questions in the overall process evaluation efforts, further defined in Section 2.3.3.

These verification surveys also serve an additional purpose: when billing analysis is infeasible, this simple verification will help the Evaluators more accurately estimate measure-level impacts using engineering algorithms while accounting for unforeseen new equipment failures or removed installations.

The Evaluators utilized the sample sizes for survey-based verification efforts in Table 2-3. The most recent program year was utilized for participant surveys to ensure participants would be able to recall their experiences with the program. Due to the low participation in the programs in 2023 and the similarity of measure offerings, the OLIEE and WALIEE programs were combined for this survey effort.

Table 2-3: Survey-Based Verification Sample Design for OLIEE and WALIEE

Program	Program Year	Population of Homes	Target Survey Response Goal	Assumed Response Rate	Target Responses
OLIEE /WALIEE	2023	186	50	10-15%	17-28

2.2.6 IMPACT EVALUATION METHODS

In this section, the Evaluators define the approach used to complete impact evaluation activities for NW Natural's Low-Income programs. As previously mentioned, the Evaluators define two major approaches to determining net savings for the OLIEE and WALIEE programs:

- Deemed Savings (for Deemed Measure List)
- Whole Building Billing Analysis (IPMVP Option C)

In the following sections, we summarize the general guidelines and activities the Evaluators will follow to conduct each of the above analyses.

2.2.7 IMPACT ANALYSIS WITH BILLING ANALYSIS

ADM evaluated NW Natural's Low-Income energy efficiency programs utilizing a billing analysis. The Evaluators explored multiple regression analyses using monthly gas consumption data. These model

specifications are recommended in the National Renewable Energy Laboratory (NREL) Uniform Methods Project (UMP)[4].

The regression models included a counterfactual control group, which is useful for estimating net energy savings – that is, participating homes are compared against nonparticipating homes. The nonparticipating homes represent the observed market baseline and equipment efficiencies demonstrated by NW Natural's actual customer base. Therefore, results from this analysis utilizing a counterfactual control group represent net energy savings. NW Natural could not identify non-participant homes that were also Low-Income customers, however, having any control group greatly improves the impact estimates.

The Evaluators understood that NW Natural wished to evaluate verified savings at the measure level for the most recent program year for both OLIEE and WALIEE. Therefore, as part of the billing data steps, the Evaluators explored analyses in which the households utilized in the analysis consist only of homes that have isolated measure participation to estimate measure-level savings within the most recent program year. This ensures that natural gas furnace savings are not included in the estimation of attic insulation projects, and vice versa. For all other program evaluation periods, the Evaluators explored whole-home billing analyses with participants of any measure included in the analysis.

2.2.7.1 Regression Model Specifications

The Evaluators explored two different regression models to estimate energy savings for the study: 1) Difference-in-Difference (D-n-D) with Fixed Effects; 2) Post Period Regression (PPR). The model specifications and required data are summarized in the table below.

For the purposes of this proposal, the "treatment group" is the group of participants that have received participated in the OLIEE or WALIEE Programs, while the "control group" is a group of non-participant residential homes displaying similar energy usage behaviors as the treatment group.

To create a matched control group of Low-Income households, the Evaluators utilized customers that did not participate in the Low-Income programs. Working with NW Natural, the Evaluators determined that NW Natural does not track Low-Income households in its customer database and that exact matching participants and non-participants on Low-Income status was not possible. However, utilizing a control group with similar energy usage characteristics after Propensity Score Matching greatly improves impact estimates. While bias can be introduced if economic, social, or other factors cause differential impacts to energy consumption for Low-Income households compared to non-participant households, this is an issue regardless of whether Low-Income households are exactly matched to other Low-Income households.

[4] https://energy.gov/sites/prod/files/2015/02/f19/UMPChapter17-residential-behavior.pdf

Table 2-4: Regression Models

Model	General Regression Equation	Quasi-Experimental Control Group
Difference-in-Difference with Fixed Effects (D-n-D)	Average Daily Usage ~ (Customer, Month, Post, Treatment, HDD, Post*Treatment, HDD*Post*Treatment	✓
Post-Program Regression (PPR)	Average Daily Usage ~ (Month, Treatment, Average Pre-period Spring Usage, Average Pre-period Winter Usage, Average Pre-period Summer Usage, Average Pre-period Fall Usage, HDD, HDD*Treatment, Month*Average Pre-period Spring Usage, Month*Average Pre-period Winter Usage, Month*Average Pre-period Summer Usage, Month*Average Pre-period Fall Usage)	✓

Each of the models has different methods of controlling for household-level differences and provide reliable estimates of savings, assuming participation is sufficient. In addition, all models have interaction terms between treatment and weather (or month) to provide seasonal and overall estimates of energy savings. The Evaluators provide further details for each model below:

1. The D-n-D with Fixed Effects regression model controls for individual differences through a variable that is equal to the customer's average daily energy use that has been averaged across the pre- and post-treatment period.
2. The PPR model uses post-period data, with lagged energy use for the same calendar month of the pre-program period, integrating the underlying logic is that systematic differences between participants and controls will be reflected in differences in their past energy use, which is highly correlated with their current energy use.

As part of regression modeling, the Evaluators' data scientists checked variable correlations and performed sensitivity testing. The Evaluators then extrapolated energy savings estimates to the weather data observed over the 4-year evaluation periods, for each program.

The selected regression model was based on model fit, the ability of the model to control for autocorrelation, and model performance during sensitivity testing.

2.2.7.2 Billing Data Preparation

The Evaluators prepared consumption data for each cohort's billing analysis tasks. The following steps were taken to prepare consumption data for each cohort analysis:

2. Identify homes in the consumption data that were participants in OLIEE and WALIEE, separately;
3. Exclude homes without sufficient pre- and post- consumption data (at least 9 months of valid consumption data in each period);
4. Exclude homes with consumption data indicating it is an outlier[5];

[5] The Evaluators examined data for outliers using multiple accepted identification techniques: simple Z-scores, Bonferroni Outlier Test, Grubbs Test for Outliers (G-test), or others as appropriate. The Evaluator aims to remove

5. Identify and remove duplicate records,
6. Calendarize the gas billing data;
7. Identify customers with isolated measure installs;

We report the number of retained customers in the analysis groups, after each step to identify issues or possible sources of bias.

2.2.7.3 Propensity Score Matching

To estimate the most reliable and unbiased results, it is ideal to estimate program impacts with a randomized control trial (RCT). However, RCTs are not viable due to the design of many programs, including NW Natural's Low-Income energy efficiency programs, which would require programs to turn away a portion of customers that sign up for the program, to use as a control group. There exists, however, methods for producing a control group via quasi-experimental methods. In this section the Evaluator further describes the steps required for cleaning billing data and creation of the counterfactual control groups.

The Evaluators created a statistically similar control group using propensity score matching (PSM), a method that allows us to find the most similar household based on the customers' billed consumption trends in the pre-period and verified with statistical difference testing. The Evaluators utilized this method because it is likely to have more meaningful results than a treatment-only analysis. The integration of a control group in a regression analysis allows the Evaluators to eliminate bias and outside influence as much as possible. Some examples of outside variables that a control group can sufficiently control for are changes in economies and markets, large-scale social changes, or impacts from weather-related anomalies such as flooding or hurricanes. A propensity score is a metric that summarizes several dimensions of household characteristics into a single metric that can be used to group similar households.

To create a post-hoc control group, the Evaluators compiled billing data for a control group to compare against treatment households via quasi-experimental methods. The Evaluators utilized billing data from customers that have not participated in NW Natural's Low-Income energy efficiency programs or in other energy efficiency programs. With this information, the Evaluators created a statistically valid control group via PSM, matching on seasonal pre-period usage.

Although quasi-experimental methods may result in selection bias (the possibility that those who are chosen in the treatment group are systematically different from those who did not participate), the PSM method ensures to the extent feasible that average characteristics of the treatment and comparison groups are similar, resulting in minimal bias within a non-RCT design.

2.2.7.4 Validity Testing

The Evaluators checked that the quasi-experimental control group was statistically similar to the treatment group by conducting the Welch's Two-Sample T-test for each month in the pre-period between each group. If the post-hoc control group passes the t-test for most pre-period months (at least

error readings rather than remove high and low users, as these subgroups contribute real behaviors to the average savings estimate.

9 of the 12 pre-period months), and the groups are validly balanced, the Evaluators continued with the regression models summarized in the sections above. This validity test is conducted to ensure that control and treatment groups are not statistically different at the 90% confidence interval. This method was completed separately for each of the 4-year evaluation periods, for both OLIEE and WALIEE.

2.2.8 DEEMED SAVINGS (UNIT ENERGY SAVINGS) APPROACH

The Evaluators created a deemed measure list based on current program offerings. The Evaluators completed the validation for specific measures across each program using applicable Regional Technical Forum (RTF) baseline assumptions, where applicable. Verified impact estimates depend on variables included but not limited to the following:

- Verify household type (SF, MF, MH, etc.)
- Verify space heating system type
- Verify cooling system type
- Verify water heating system type
- Verify heating and cooling zone
- Verify equipment sizing (tonnage, gallons)

Using this method, the Evaluators estimated deemed verified savings using region-based research conducted by the utilities in the region. The goal was to ensure that the proper measure unit savings are utilized in verified savings.

In addition, the Evaluators utilized the most recent 4-year evaluation of whole home projects, as well as the most recent year annual measure-level savings of offered individual measures to create an expected unit energy savings value for each of the measures offered through the program. These deemed measure values were weather adjusted for a typical meteorological year (TMYx) to assess future-looking expected program savings for each OLIEE and WALIEE.

The Evaluators reviewed program application documents for a sample of incented measures to verify the tracking data accurately represents the original program documents. This sample met 90/10 precision goals. The Evaluators ensured the home installed measures that meet or exceed program efficiency standards.

The Evaluators applied verification adjustments to these UES values if deviations were found between tracking data and document-based verification, and if in-service rates deviated from 100% reported in survey responses.

2.3 Process Approach and Methodology

The Evaluators conducted a thorough process evaluation of the OLIEE and WALIEE Programs to identify program strengths as well as areas for potential program improvement in each of the respective NW Natural programs. As detailed below, the process evaluation addressed the objectives identified in the RFP and covered all elements of a successful program, including design, staffing, marketing, implementation, delivery, and customer response. An important part of this evaluation was to identify market barriers that impede the program's reach into all parts of NW Natural's Low-Income residential Oregon and Washington markets. The Evaluators evaluated the most recent program year of activities,

as customers from earlier program years may not remember the upgrades completed in years prior.

The following subsections present overviews of our approach to process evaluation, followed by information on how we identified and answered important research questions, our data collection approaches, interview and survey implementation, and the timing and cadence of process evaluation activities.

2.3.1 PROCESS EVALUATION OVERVIEW

Our approach to process evaluation for the NW Natural Low-Income energy efficiency programs addressed the overall effectiveness of program activities in overcoming barriers and provides strategic guidance to assist program improvement. Data collection activities provided information on the effectiveness of program processes and procedures, including how well the program works with key stakeholders to optimize program operations. To this end, the Evaluators:

- Reviewed program documentation and interviewed program and implementer staff to understand program goals, rules, and processes - including any coordination with delivery of gas utility programs - as well as to reveal any issues or concerns to be investigated through other process evaluation data collection;
- Interviewed applicable market actors about their experiences with the program to shed light on the effectiveness of program processes, the communication between NW Natural and the CAP Agencies it partners with, its implementers, marketing activities, customer decision-making, and participation barriers;
- Surveyed program participants about their experiences, including satisfaction with the program, and their decision-making process; and
- Surveyed nonparticipants to reveal the level of program awareness and identify barriers to participation.

From the information obtained from the process evaluation, the Evaluators identified what the programs are doing well and what factors may be preventing the programs from achieving their goals or doing so more cost-effectively. The information will help NW Natural and the CAP Agencies better understand the impact evaluation results and make related management decisions.

The Evaluators used process evaluation best practices, which include:

- Allocating process evaluation resources based on each program's contribution to overall energy savings; evidence of evaluation need (e.g., failure to meet savings goals, feedback from CAP Agencies, or unsolicited feedback from customers or trade allies); changes in program design or implementation; and the recency with which these programs had a detailed process evaluation.
- Designing all data collection instruments to address specific research questions, ensuring that all needed information is collected, and none is collected that will not or cannot be used.
- Presenting the process evaluations results clearly and efficiently, identifying how each interview or survey finding addresses a specific research question. NW Natural will not have to sort through lengthy descriptions of every survey response trying to figure out the meaning of the

results.

- Providing meaningful high-level conclusions, which will form the basis for clear, actionable recommendations for process improvements where identified.

Where possible, we sought to achieve the standard level of 90% confidence of 10% precision (90/10) for participant surveys. We note, however, NW Natural's recognition that such a level of confidence and precision is not always feasible, particularly in programs with relatively small participant populations. In the case of market actors, such as contractors, retailers, and distributors, the choice of data collection approach was driven by the size of the relevant market actor population and the nature of the data to be collected.

Table 2-5 summarizes our preliminary proposed data collection approaches for each program, for the most recent program year. We discuss sample size and confidence/precision issues in more detail in the sections below.

Table 2-5: Summary of Process Evaluation Sources, by Program

Programs	Document & Data Review	Staff / Implementers	Trade Allies	CAP Agencies	Participants	Non-participants
OLIEE	Reviewed all program documentation, (e.g., marketing plans and materials, implementation plans, applications) and project files.	Individual or group interviews with program and implementer staff of each program in each state	Omnibus online survey and/or phone interviews	Omnibus online survey and/or phone interviews	Multi-mode surveys, targeting 90/10 confidence/ precision	Multi-mode survey, with 90/10 confidence/ precision
WALIEE						

2.3.2 IDENTIFYING AND ANSWERING THE IMPORTANT PROCESS QUESTIONS

The Evaluators used the various information sources – program documentation review, staff, CAP Agency staff, and implementer interviews, and customer surveys – to provide convergent information to address the identified research questions. We made maximally effective use of each source by identifying which sources provide the most applicable information to each question, as shown in Table 2-6. For example, while program and implementer staff interviews did not touch on most or all research questions, we relied more heavily on feedback from CAP Agency staff, participants, and nonparticipants to assess customer service and market barriers. Market actors and program participants provided important input into most questions relating to program implementation but were not major sources of information regarding management tools or cost management. Our assessment of nonparticipants' awareness of the program offerings and reasons for nonparticipation provide important information relating to program marketing, participation information, measure offerings, health and safety issues, and customer service as well as participation barriers.

Table 2-6: Data Sources to Answer Process Evaluation Research Questions

Process Evaluation Research Question	Document and Data	Staff	CAP Agencies	Market Actors	Participants	Nonparticipants
Are programs run per design and efficiently/effectively?	✓	✓	✓	✓	✓	
Is staffing/organization sufficient and appropriate?		✓	✓			
Is customer service of high quality, timely, and effective?			✓	✓	✓	✓
Are marketing plans implemented per design and effective?	✓	✓		✓	✓	✓
Are quality assurance procedures appropriate and effective?	✓	✓	✓	✓	✓	
Are management and implementation tools appropriate and effective?	✓	✓	✓			
Are implementation contractors running programs effectively?		✓	✓	✓	✓	
Are program materials effective and complete?	✓	✓	✓	✓	✓	✓
Are costs managed properly and efficiently?	✓	✓	✓			
Are contractors effectively capturing appropriate opportunities and ensuring comprehensive services?		✓	✓	✓	✓	
Are rebates/incentives appropriate for meeting program goals?		✓	✓	✓	✓	✓
What are the market barriers that impede program reach?			✓	✓	✓	✓
Is the program reaching the intended hard to reach customers?		✓	✓	✓		✓
Are there remaining customers that qualify for the program have issues or barriers with participating in these programs?		✓	✓	✓		✓

The key to delivering a truly valuable process evaluation is refining and specifying the research questions by reviewing previous evaluation findings and thoughtfully interviewing program and implementer staff. Another aspect of identifying and answering the important questions is understanding what is and is not meaningful in evaluation results. In preparing reports, the Evaluators sought to prioritize the dissemination of information that can lead to material and beneficial changes or insight for NW Natural Low-Income program managers and stakeholder groups.

2.3.3 DATA COLLECTION APPROACHES: CORE PROGRAMS

The following provides details on the process evaluation data collection approaches utilized.

2.3.3.1 Document and Data Review

The Evaluators reviewed available program documents, including program manuals, program logic models, contractor training materials, CAP Agency marketing materials and plans, and application forms to better understand how the program operates and to inform the evaluation design. The review also

served as process evaluation input, by helping us identify opportunities for program improvement, such as potentially overlooked marketing channels or tactics, or opportunities to streamline or expand application forms to collect needed data.

Reviewing NW Natural's Low-Income energy efficiency program logic models helped ensure our understanding of each program's objectives and how the program's activities are expected to achieve those objectives.

We also reviewed project tracking data, which is a valuable resource for understanding how the program is performing and the market response. A review of the data system also verified that the data is sufficient and complete enough to support program management and evaluation.

2.3.3.2 Program and Implementer Interviews

We conducted in-depth interviews (IDIs) with program management staff to fill out our understanding of program design, goals, processes, and marketing strategies; to assess communication and coordination between NW Natural and its implementers, CAP agencies, and hard-to-reach communities; to get NW Natural's input on its implementer performance; to gain insight into quality control and assurance processes; to identify challenges that the programs have encountered and how those challenges have been addressed; and to clarify evaluation goals and research questions. Because these programs revolve around hard to reach (HTR) customers and their unique barriers to program participation and unique energy needs, the Evaluators developed a unique battery of questions for this target demographic that focuses on energy burden, program satisfaction, program communication methods, and additional energy needs. This is prioritized as a part of the evaluation objectives due to the equity objectives in the Clean Energy Transformation Act (CETA), present in the state of Washington. Senior evaluation team members conducted the IDIs using semi-structured interview guides (see Instrument Development, below).

2.3.3.3 Market Actor, Participant, and Nonparticipant Surveys

We conducted telephone or web surveys with market actors, program participants, and nonparticipants. We anticipated conducting surveys as telephone, web, or mixed-phone/web surveys due to the demographics of these programs' customers.

The selection of survey type depended on the nature of the target audience, the anticipated challenges in reaching customers by various methods, and the nature of the information to be collected. Decreasing response rates to residential phone surveys over the past several years have made web surveys a more cost-effective approach for residential target audiences. Response to web surveys also have declined in recent years; thus, we considered and recommended other modes as appropriate.

2.3.3.4 Market Actors

In the case of market actors, such as contractors, retailers, and distributors, the choice of data collection approach was driven by the size of the relevant market actor population and the nature of the data to be collected.

2.3.3.5 Participants

The Evaluators conducted a survey of Northwest Natural's Low-Income Program participants from program year 2023 to gather feedback about customers' engagement with and experience of the program. The most recent program year was utilized for participant surveys to ensure participants would be able to recall their experiences with the program. Due to the low participation in 2023, participants from OLIEE and WALIEE were combined into a single survey, as shown in Table 2-7.

Table 2-7: Participant Survey Sample

Program	Program Year	Population of Homes	Sample of Homes	Precision
OLIEE/WALIEE	2023	186	35	90% ± 13.9%

2.3.3.6 Nonparticipants

The Evaluators conducted a nonparticipant survey of likely Low-Income residential customers in both Washington and Oregon, targeting 90/10 confidence/precision. As with participant surveys, we anticipated a mix of online and phone surveys, possibly including mailed recruitments to take the online survey. However, email surveys were performed and exceeded the required survey target.

2.3.4 INTERVIEW AND SURVEY IMPLEMENTATION

The Evaluators conducted all interviews and surveys using in-house resources. In the sections below, we detail our interview and survey instrument development and implementation.

2.3.4.1 Instrument Development

We developed all interview guides and survey instruments to address research questions identified in the RFP, during project initiation, or in staff and implementer interviews and with a mind to the analysis to be performed. Table 2-6 documents the research questions specific to each data source, which guided the process for developing each instrument. This ensured that the research questions for each instrument were vetted and discussed with NW Natural.

We provided a crosswalk between the vetted research questions and each interview or survey item when we submitted the draft instruments to NW Natural. This ensured that there is no question or confusion about the purpose of any given item. Providing NW Natural staff with a clear understanding of the purpose of each item in the instrument enabled them to provide focused feedback on those items. We revised each item as needed based on the feedback received.

2.3.4.2 Survey Programming and Testing

The Evaluators programmed all surveys, both phone and web, using an industry-standard survey platform, Qualtrics. The platform is widely used by professional survey research and evaluation firms and supports web, telephone, and dual-mode survey administration. It offers sophisticated programming features for developing user-friendly interfaces and offers a range of options for response validation and display logic. It also provides controls for preventing duplicate or ineligible submissions

and allows the option of completing surveys in multiple sessions. It provides the ability to allow respondents to select the survey language as well as the ability to embed screener questions in email invitations.

We tested each survey to ensure that all questions and responses are included and worded correctly, and all input and display logic works correctly. The program lead assessed the look and feel of the survey (size of font, amount of white space, location of page breaks, and so forth) and provided suggestions for improvement, when needed.

Once each survey was programmed, we carried out a soft launch of a small subsample as a second check to ensure the survey programming was correct as well as to determine whether any questions were not well understood or needed to be revised for any other reason.

2.3.4.3 Survey Recruitment

We prepared telephone and email recruitment scripts to deploy to participant and nonparticipant customers as a call to action to participate in the survey. These materials included several well-known elements, such as personalizing the message, stating the intended use of the responses and the importance of everyone's response, making a personal appeal, and so forth. They provided the name of the Evaluators evaluation staff contract to answer questions about the survey. We also provided NW Natural contact information to provide *bona fides* or answer questions. Email recruitment also provided a call-in number for customers who wanted to complete the survey by phone.

Survey recruitment was accomplished through multiple modes of recruitment, specifically:

- Initial email invitation
- Two reminder email invitations, three business days apart
- Telephone-based surveys for customers without email addresses

In recruiting for both phone and email surveys, we followed additional protocols to attempt to maximize response rates and reduce customer burden. We carried out multiple recruitment attempts but spaced them to provide adequate opportunity to respond to each one before sending another.

The Evaluators provided $10 incentives for survey completions.

2.3.5 COORDINATED EFFORTS

The Evaluators coordinated efforts with NW Natural staff regarding customer contact and conducted research to minimize the time impact on NW Natural's customers participating in this evaluation. We endeavored to facilitate a strong sense of coordination and collaboration with our clients through multiple avenues, including:

- Client review of interim and final work product: We included NW Natural into the review process for recruitment email and telephone messaging, survey instrument development, site-level M&V plans, and interim and final reporting. Messages included contact information for the customer call center, along with contact information for a senior project manager at the Evaluators.
- Involved NW Natural staff in the Quality Assurance (QA) process for data collection.

- The Evaluators involved NW Natural staff by allowing client staff to participate in and audit telephone surveys, including client to receive a survey and experience it from a program participant's perspective, and other potential methods as the opportunities present themselves.

The Evaluators worked with NW Natural to instruct their call centers on answering customer inquiries regarding the Evaluators' role as the EM&V contractor to ensure transparency and reliability to customers and to preserve NW Natural's customer relations with residential customers. The Evaluators maintained a 'do not contact' list for customers that expressed a desire to be removed from call lists for future EM&V work. For many residential programs, however, maintaining a 'do not contact' list does not compromise the impact evaluation process.

2.4 Cost-Effectiveness Testing

The Evaluators calculated each program's cost-effectiveness, avoided energy costs related to infrastructure capacity, commodity and transport/storage, environmental compliance, and risk reduction, and implementation costs for the most recent program year using the Evaluators-developed cost-effectiveness tool. Similar to other Low-Income evaluations completed by the Evaluators in the region, the Evaluators determined the economic performance with the following cost-effectiveness tests:

- Total Resource Cost (TRC) test;
- Utility Cost Test (UCT);
- Participant Cost Test (PCT);
- Rate Impact Measure (RIM) test; and
- Societal Cost Test (SCT).

2.4.1 NON-ENERGY BENEFITS

The Evaluators conducted a literature review to quantify non-energy benefits (NEBs) for Low-Income residential programs with established values where available.

The Evaluators also worked with NW Natural staff to identify a listing of NEIs and NEBs that were of interest for each program. Additionally, the Evaluator recognized there may be additional health and safety benefits for programs that target hard to reach communities. The Evaluators worked with NW Natural to prioritize the identification of such additional NEIs and NEBs for these programs as they are designed and rolled out.

Inputs and methods for cost-effectiveness testing are provided in Appendix A: Cost-Effectiveness Testing.

2.4.1.1 Disconnections and Arrearages

NW Natural provided information on arrears, service disconnection notices, and service disconnections for participants and non-participant customers during the analysis period (2010-2023). The Evaluators estimated a quantified impact of the program on customers' capability to stay current on their gas bills by comparing arrears and disconnections for participants and non-participants in the pre- and post-periods. The Evaluators utilized matched control customers from the billing analysis to estimate net

impacts for arrears and disconnections and to control for factors including differences in payment plans and other household characteristics.

Utilizing the data provided from NW Natural, the Evaluators calculated the following outcomes:

1. Annual arrearage reduction per participant,
2. Annual disconnection reduction per participant; and
3. Annual disconnection notice reduction per participant.

3 OLIEE IMPACT RESULTS

Since 2002, the OLIEE program has been offered to provide equitable access to DSM by funding high-efficiency equipment and weatherization measures to Low-Income homes. The program consists of two parts: The Community Action Program (CAP), and the Open Solicitation Program (OSP). OLIEE funding is used to improve the efficiency of NW Natural's Low-Income customers' homes through the installation of high efficiency equipment and weatherization measures. The program is delivered by ten Community Action Agencies (Agencies) within NW Natural's Oregon service territory.

OLIEE program was redesigned from paying prescriptive amounts for the installation of specific measures, to paying for all energy efficiency measures deemed cost-effective when analyzed at the whole-house level. The OLIEE pilot's new "whole house" perspective was adopted in conjunction with a series of annually escalating agency targets.

In the following tables, the Evaluator summarizes the number of historical homes treated through the OLIEE program, as well as expected Therms saved, verified Therms saved, and measure counts.

Table 3-1: OLIEE Program Measure Counts by Evaluation Period

Measure	Count of Measures (PY2010-PY2013)	Count of Measures (PY2014-PY2017)	Count of Measures (PY2018-PY2022)
Ceiling Insulation	723	519	631
Direct Vent Space Heater	86	2	5
Duct Insulation	463	363	505
Duct Sealing	588	449	616
Faucet Aerators	1	0	9
Floor Insulation	679	500	619
Furnace Tune-Up	83	47	66
HE Water Heater	20	15	22
HE Windows	236	115	179
High Efficiency Furnace	292	450	710
Hot Water Pipe Insulation	3	5	12
Infiltration	708	625	779
Thermal Doors	53	14	51
Wall Insulation	327	304	318
Totals	**4,262**	**3,408**	**4,522**

Table 3-2: Verified Impact Savings by Program Year, OLIEE

Program Year	Number of Participant Homes	Average Number of Installed Measures	Expected Therms Saved	Verified Therms Saved	Realization Rate	Total Incentives and Agency Costs ($)
2010	561	3.2	219,489	52,224	24%	3,448,712
2011	332	3.1	96,895	30,906	32%	2,223,775
2012	268	3.5	76,989	24,948	32%	2,738,388
2013	149	3.3	35,682	13,871	39%	1,024,954
2014	189	3.4	50,778	20,673	41%	1,430,164
2015	182	3.3	42,701	19,907	47%	1,533,943
2016	248	4.0	53,697	27,126	51%	1,970,200
2017	287	4.1	69,094	31,392	45%	2,605,351
2018	295	4.2	97,583	35,046	36%	3,128,583
2019	262	3.9	79,394	31,125	39%	2,738,720
2020	248	3.4	66,745	29,462	44%	2,105,700
2021	176	3.8	55,348	20,909	38%	2,164,725
2022	189	3.8	57,521	22,453	39%	2,916,969
Total	**3,386**	**3.6**	**1,001,916**	**360,042**	**36%**	**30,030,184**

Table 3-3: Verified Impact Savings by Program Evaluation Period, OLIEE

Program Evaluation Period	Evaluation Period Homes	Average Number of Installed Measures	Expected Therms Saved	Verified Therms Saved	Realization Rate	Total Incentives and Agency Costs ($)
PY2010-PY2013	1,310	3.3	429,055	121,949	28%	9,435,829
PY2014-PY2017	906	3.8	216,270	99,098	46%	7,539,658
PY2018-PY2022	1,170	3.9	356,591	138,995	39%	13,054,697
Total	**3,386**	**3.6**	**1,001,916**	**360,042**	**36%**	**30,030,184**

3.1 Database Review and Document-based Verification

Before conducting the impact analysis, the Evaluators conducted a database review for the OLIEE Program. The Evaluators selected a subset of rebate applications to cross-verify tracking data inputs, summarized in Section 2.2.4.

The Evaluators reviewed each measure's number of units, efficiency, square footage, capacity and insulation values where available. During the review, the Evaluators found there were some projects with incomplete, missing, duplicate, or other documentation issues, as summarized in Table 3-4.

Table 3-4: Project Documentation Summary, OLIEE

Project Documentation Status	Number of Participants	% of Participants
Complete	146	75%
Incomplete	18	9%
Missing	25	13%
Duplicate	2	1%
Other	3	2%
Total	**194**	**100%**

The Evaluators found 18 customers that had project documentation, but this documentation lacked the necessary information to successfully complete the database review. For example, many of these customers provided the NW Natural CAP Program Improvement Analysis Report but they did not provide an invoice for the work that was performed or information on the efficiency of the equipment or upgrade completed. Therefore, the Evaluators could not confirm these measures were upgraded.

The Evaluators did not receive any project documentation for 25 out of 194 customers. Lastly, there were three customers with documentation that did not match the names and addresses in the provided tracking data and one customer with two duplicate rows but different account/request ID numbers.

The Evaluators also found that many specifications were missing from the documentation such as insulation square footage, window/door quantities, and model information for furnaces and water heaters. Measures such as furnace tune-ups and direct vent space heaters did not provide any specification information. The Evaluators were not able to perform database review for these measures. Furthermore, there were additional measures in the documentation that were not accounted for in the raw tracking data for many customers. The required information necessary to complete verification activities and proper expected savings calculations are measure installed square footage values for insulation measures, measure quantities for window/door measures, and make/model information for Water Heaters/Furnaces to calculate precise savings.

3.2 Verification Survey

The Evaluators randomly selected a subset of participant customers to survey for simple verification of installed measures. The Evaluators included questions such as:

- Was the program equipment detailed in program records received?
- Are the received program measures installed and working?

The responses to this verification survey were used to calculate ISRs for the measures offered in the OLIEE Program. All survey respondents for each measure described equipment as currently functioning, leading to a 100% ISR.

3.3 Billing Analysis

The results of the billing analysis for the OLIEE Program are provided in this section. The methodology for the billing analysis is provided in Section 2.2.7.

Table 3-5 provides the number of customers and the evaluation period for the whole-home billing analyses performed for OLIEE.

Table 3-5: Whole-home Cohorts, OLIEE

Level of Analysis	Evaluation Period	Number of Participants
Whole-Home	PY2010-PY2013[6]	1,310
	PY2014-PY2017	902
	PY2018-PY2022	1,255

Table 3-6 displays customer counts for customers considered for measure-level billing analysis and identifies measures that met the requirements for a billing analysis. The Evaluators require at least 75 isolated projects in order to be sufficient for billing analysis estimates, depending on expected magnitude of measure savings. Of the eleven single measures installed, only the High Efficiency Furnace measure had sufficient participation to move forward with a measure-level billing analysis.

Table 3-6: Measures Considered for Billing Analysis, OLIEE Program Evaluation Period PY2018-PY2022

Measure	Measure Considered for Billing Analysis	Number of Customers w/ Isolated-Measure Installations	Sufficient Participation for Billing Analysis
Ceiling Insulation (OR)	✓	4	
Direct Vent Space Heater (OR)	✓	2	
Duct Insulation (OR)	✓	2	
Duct Sealing (OR)	✓	1	
Floor Insulation (OR)	✓	4	
Furnace Tune Up (OR)	✓	1	
HE Water Heater (OR)	✓	1	
HE Windows (OR)	✓	1	
High Efficiency Furnace (OR)	✓	123	✓
Infiltration (OR)	✓	12	
Wall insulation (OR)	✓	7	

The Evaluators were provided with a considerable pool of control customers to draw upon. Before matching treatment and control customers, both the treatment group and pool of control customers

[6] Although the earliest cohort initially included 1,310 customers, pre-period billing data was not available, and therefore the evaluation period was modified to 2011-2013, with 2010 set as the pre-period.

were restricted to customers with at least nine months of pre-period and post-period calendarized billing data. Additionally, customers were required to have billing data from all four seasons of the pre-period year. Once these restrictions were satisfied, the Evaluators used nearest neighbor matching with a 1-to-1 matching ratio. Matching with replacement was utilized, which allowed a control customer to be matched with more than one treatment customer. The final number of customers in each the treatment and control group are listed in Table 3-7 and Table 3-8.

The Evaluators performed three tests to determine the success of PSM:

1. *t*-test on pre-period usage by month
2. Joint chi-square test to determine if any covariates are imbalanced
3. Standardized difference test for each covariate employed in matching

All tests confirmed that PSM performed well for each measure and the Evaluators conducted a linear regression using the matched participant and nonparticipant monthly billing data.

Table 3-7: Treatment Group Counts After Data Restrictions, OLIEE

Cohort	Starting Number of Treatment Customers	Customers with Calendarized Billing Data	Customers with Pre-Period and Post-Period Billing Data	Customers with Sufficient Seasonal Pre-period Data	Customers After PSM Matching
Whole Home (PY2010-PY2013)	1,310	1,298	838	838	834
Whole Home (PY2014-PY2017)	902	899	590	589	587
Whole Home (PY2018-PY2022)	1,255	1,254	752	751	749
High Efficiency Furnace Measure (PY2018-PY2022)	123	123	66	66	66

Table 3-8: Control Group Counts After Data Restrictions, OLIEE

Cohort	Starting Number of Control Customers	Customers with Calendarized Billing Data	Customers with Pre-Period and Post-Period Billing Data	Customers with Sufficient Seasonal Pre-period Data	Customers After PSM Matching
Whole Home (PY2010-PY2013)	14,151	14,151	2,904	2,904	623
Whole Home (PY2014-PY2017)	14,151	14,151	3,457	3,454	504
Whole Home (PY2018-PY2022)	14,151	14,151	4,835	4,835	647
High Efficiency Furnace Measure (PY2018-PY2022)	14,151	14,151	4,834	4,834	63

Table 3-9 provides verified annual Therms savings per customer for each evaluated cohort. Model 2 (PPR) was selected as the final model for all cohorts as it provided the highest adjusted R-squared among the regression models. Regression Model 1 (D-n-D) provided similar estimates of whole-home savings, but with a lower model fit (adjusted R-squared). The Evaluators estimated savings between 93.1 and 118.8 Therms annually per customer across all cohorts. This results in percent savings between 16.6 percent and 19.2 percent compared to the control customers.

Table 3-9: Billing Analysis Results, OLIEE

Cohort	Number of Treatment Customers	Average Number of Installed Measures	Verified Annual Therms Savings per Customer	90% Confidence Interval	Average Annual Therms Usage for Control Customers	Percent Savings of Annual Therms Usage	Adjusted R-Squared
Whole Home (PY2010-PY2013)	834	3.3	93.1	(87.1, 99.1)	559.7	16.6%	0.96
Whole Home (PY2014-PY2017)	587	3.8	109.4	(102.3, 116.5)	587.3	18.6%	0.83
Whole Home (PY2018-PY2022)	749	3.9	118.8	(111.5, 126.1)	652.4	18.2%	0.98
High Efficiency Furnace Measure (PY2018-PY2022)	66	1.0	116.9	(82.8, 151.1)	610.1	19.2%	0.66

3.4 Program-Level Results

Table 3-10 and Table 3-11 shows expected and verified savings by program year and program evaluation period for the OLIEE program.

Table 3-10: Verified Impact Savings by Program Year, OLIEE

Program Year	Number of Participant Homes	Average Number of Installed Measures	Expected Therms Saved	Verified Therms Saved	Realization Rate	Total Incentives and Agency Costs ($)
2010	561	3.2	219,489	52,224	24%	3,448,712
2011	332	3.1	96,895	30,906	32%	2,223,775
2012	268	3.5	76,989	24,948	32%	2,738,388
2013	149	3.3	35,682	13,871	39%	1,024,954
2014	189	3.4	50,778	20,673	41%	1,430,164
2015	182	3.3	42,701	19,907	47%	1,533,943
2016	248	4.0	53,697	27,126	51%	1,970,200
2017	287	4.1	69,094	31,392	45%	2,605,351
2018	295	4.2	97,583	35,046	36%	3,128,583
2019	262	3.9	79,394	31,125	39%	2,738,720
2020	248	3.4	66,745	29,462	44%	2,105,700
2021	176	3.8	55,348	20,909	38%	2,164,725
2022	189	3.8	57,521	22,453	39%	2,916,969
Total	**3,386**	**3.6**	**1,001,916**	**360,042**	**36%**	**30,030,184**

Table 3-11: Verified Impact Savings by Program Evaluation Period, OLIEE

Program Evaluation Period	Evaluation Period Homes	Average Number of Installed Measures	Expected Therms Saved	Verified Therms Saved	Realization Rate	Total Incentives and Agency Costs ($)
PY2010-PY2013	1,310	3.3	429,055	121,949	28%	9,435,829
PY2014-PY2017	906	3.8	216,270	99,098	46%	7,539,658
PY2018-PY2022	1,170	3.9	356,591	138,995	39%	13,054,697
Total	**3,386**	**3.6**	**1,001,916**	**360,042**	**36%**	**30,030,184**

Verified savings from 2010 to 2022 for the program are 337,589 Therms, 36% of Expected Savings. Drivers of non-100% realization which are specific to the OLIEE program are:

- Verified Therms savings as a percentage of annual usage ranged from 16% to 20% across program evaluation periods; however, expected Therms savings as a percentage of annual usage ranged from 40% to 60%. Therefore, the expected Therms savings per customer are too high for the program, likely due to lack of project-level energy savings estimates in the tracking data. The Evaluators typically see whole-home retrofit savings for Low-Income programs fall between 10% and 20% of annual usage. The Evaluators observed that the expected savings in the tracking data for each customer may have represented savings for multiple projects.

4 WALIEE IMPACT RESULTS

In 2009, NW Natural launched a revised Low-Income program identified as WALIEE. Modeled after Oregon's Low-Income CAP program, the WA-LIEE program reimburses administering agencies for installing weatherization measures that are cost-effective when analyzed at the whole-house level. In Washington, two agencies co-administer the program. The program is informed by input from NW Natural's Energy Efficiency Advisory Group (EEAG).

Homes with gas in SW Washington tend to be newer construction with less of a need for weatherization, and only 2% of NW Natural's customers in Washington qualify as Low-Income. Therefore, barriers such as these limit participation and the participation rates for the WALIEE program are lower than the participation rates for OLIEE program.

In the following tables, the Evaluator summarizes the number of historical homes treated through the WALIEE program, as well as expected Therms saved, verified Therms saved, and measure counts.

Table 4-1: WALIEE Program Measure Counts by Evaluation Period

Measure	Count of Measures (PY2010-PY2013)	Count of Measures (PY2014-PY2017)	Count of Measures (PY2018-PY2022)
Ceiling Insulation	43	44	48
Direct Vent Space Heater	1	0	0
Duct Insulation	34	33	46
Duct Sealing	3	1	0
Faucet Aerators	0	0	0
Floor Insulation	22	36	45
Furnace Tune-Up	1	0	21
HE Water Heater	0	0	2
HE Windows	0	0	0
High Efficiency Furnace	7	1	5
Hot Water Pipe Insulation	14	4	17
Infiltration	34	21	43
Thermal Doors	0	0	0
Wall Insulation	25	14	9
Totals	**184**	**154**	**236**

Table 4-2: Verified Impact Savings by Program Year, WALIEE

Program Year	Number of Participant Homes	Average Number of Installed Measures	Expected Therms Saved	Verified Therms Saved	Realization Rate	Total Incentives and Agency Costs ($)
2010	16	3.4	6,393	2,598	41%	122,685
2011	11	2.9	3,634	1,786	49%	99,938
2012	8	3.5	2,517	1,299	52%	53,447
2013	20	3.5	7,684	3,248	42%	148,111
2014	10	2.8	3,050	1,624	53%	89,045
2015	9	3.2	3,219	1,462	45%	88,833
2016	17	3.5	6,409	2,761	43%	182,308
2017	13	2.9	6,148	2,111	34%	312,530
2018	16	3.7	7,605	2,598	34%	216,246
2019	22	4.4	20,214	3,573	18%	347,843
2020	8	2.1	1,136	1,299	114%	27,854
2021	14	2.5	3,598	2,273	63%	84,683
2022	11	2.6	703	1,786	254%	71,938
Total	**175**	**3.3**	**72,310**	**28,418**	**39%**	**1,845,461**

Table 4-3: Verified Savings by Program Evaluation Period, WALIEE

Program Evaluation Period	Evaluation Period Homes	Average Number of Installed Measures	Expected Therms Saved	Verified Therms Saved	Realization Rate	Total Incentives and Agency Costs ($)
PY2010-PY2013	55	3.3	20,228	8,931	44%	424,181
PY2014-PY2017	49	3.1	18,826	7,958	42%	672,716
PY2018-PY2022	71	3.3	33,256	11,529	35%	748,564
Total	**175**	**3.3**	**72,310**	**28,418**	**39%**	**1,845,461**

4.1 Database Review and Document-based Verification

Before conducting the impact analysis, the Evaluators conducted a database review for the WALIEE Program. The Evaluators selected a subset of rebate applications to cross-verify tracking data inputs, summarized in Section 2.2.4.

The Evaluators reviewed each measure's number of units, efficiency, square footage, capacity and insulation values where available. During the review, the Evaluators found there were some projects with incomplete, missing, duplicate, or other documentation issues, as summarized in Table 4-4.

Table 4-4: Project Documentation Summary, WALIEE

Project Documentation Status	Number of Participants	% of Participants
Complete	8	9%
Incomplete	77	83%
Missing	7	8%
Duplicate	0	0%
Other	1	1%
Total	**93**	**100%**

The Evaluators found that 77 out of 93 customers had project documentation, but this documentation lacked the necessary information to successfully complete the database review. Many of these customers did not provide an actual invoice for the work that was performed. The customers that did provide invoices were missing critical specification information needed to complete the database review such as square footage values, R-values, and make/model information. Therefore, the Evaluators could not complete the database review for these customers.

The Evaluators also found 7 customers did not have any project documentation and the Evaluators were not able to perform database review for these customers. Lastly, there was one customer with documentation that did not match the name and address in the raw tracking data.

The Evaluators found that the WALIEE program had some of the same data quality issues as the OILEE program. Only 8 of the 93 customers had complete project documentation from which to perform database review. Many specifications were missing from the project documentation such as insulation square footage values, window/door quantities, and model information for furnaces and water heaters. Measures such as furnace tune-ups and direct vent space heaters did not provide any specification information. The Evaluators were not able to perform database review for these measures. Furthermore, there were additional measures in the documentation that were not accounted for in the raw tracking data for many customers. The required information necessary to complete verification activities and proper expected savings calculations are measure installed square footage values for insulation measures, measure quantities for window/door measures, and make/model information for Water Heaters/Furnaces to calculate precise savings.

4.2 Verification Survey

The Evaluators randomly selected a subset of participant customers to survey for simple verification of installed measures. The Evaluators included questions such as:

- Was the program equipment detailed in program records received?
- Are the received program measures installed and working?

The responses to this verification survey were used to calculate ISRs for the measures offered in the WALIEE Program. All survey respondents for each measure described equipment as currently functioning, leading to a 100% ISR.

4.3 Billing Analysis

The results of the billing analysis for the WALIEE Program are provided in this section. The methodology for the billing analysis is provided in Section 2.2.7.

Table 4-5 displays customer counts for customers considered for measure-level billing analysis. The Evaluators require at least 75 isolated projects in order to be sufficient for billing analysis estimates, depending on expected magnitude of measure savings. None of the three single measures installed had sufficient participation to move forward with a measure-level billing analysis.

Table 4-5: Measures Considered for Billing Analysis, WALIEE Program Evaluation Period PY2018-PY2022

Measure	Measure Considered for Billing Analysis	Number of Customers w/ Isolated-Measure Installations	Sufficient Participation for Billing Analysis
90% High Efficiency Furn (WA)	✓	1	
Furnace Tune-up (WA)	✓	13	
HE Water Heater (EF=.62) (WA)	✓	1	

The Evaluators were provided with a considerable pool of control customers to draw upon. Before matching treatment and control customers, both the treatment group and pool of control customers were restricted to customers with at least nine months of pre-period and post-period calendarized billing data. Additionally, customers were required to have billing data from all four seasons of the pre-period year. Once these restrictions were satisfied, the Evaluators used nearest neighbor matching with a 1-to-1 matching ratio. Matching with replacement was utilized, which allowed a control customer to be matched with more than one treatment customer. The final number of customers in the treatment and control group are listed in Table 4-6.

The Evaluators performed three tests to determine the success of PSM:

1. *t*-test on pre-period usage by month
2. Joint chi-square test to determine if any covariates are imbalanced
3. Standardized difference test for each covariate employed in matching

All tests confirmed that PSM performed well for each measure and the Evaluators conducted a linear regression using the matched participant and nonparticipant monthly billing data.

Table 4-7 provides verified annual Therms savings per customer. Model 2 (PPR) was selected as the final model for as it provided the highest adjusted R-squared among the regression models. Regression Model 1 (D-n-D) provided similar estimates of whole-home savings, but with a lower model fit (adjusted R-squared). The Evaluators estimated savings of 162.39 Therms annually per customer, a 25.2 percent savings compared to the control customers.

Table 4-6: Customer Counts After Data Restrictions, WALIEE

Group	Starting Number of Treatment Customers	Customers with Calendarized Billing Data	Customers with Pre-Period and Post-Period Billing Data	Customers with Sufficient Seasonal Pre-period Data	Customers After PSM Matching
Treatment	173	172	49	49	49
Control	14,151	14,151	2,642	2,642	47

Table 4-7: Billing Analysis Results, WALIEE

Treatment Customers	Average Number of Installed Measures	Annual Savings per Customer	90% Confidence Interval	Average Annual Therms Usage for Control Customers	Percent Savings of Annual Therms Usage	Adjusted R-Squared	Model
49	3.3	162.39	(130.81, 193.97)	645.62	25.2%	0.807	PPR

4.4 Program-Level Results

Table 4-8 and Table 4-9 shows expected and verified savings by program year and program evaluation period for the WALIEE program.

Table 4-8: Verified Impact Savings by Program Year, WALIEE

Program Year	Number of Participant Homes	Average Number of Installed Measures	Expected Therms Saved	Verified Therms Saved	Realization Rate	Total Incentives and Agency Costs ($)
2010	16	3.4	6,393	2,598	41%	122,685
2011	11	2.9	3,634	1,786	49%	99,938
2012	8	3.5	2,517	1,299	52%	53,447
2013	20	3.5	7,684	3,248	42%	148,111
2014	10	2.8	3,050	1,624	53%	89,045
2015	9	3.2	3,219	1,462	45%	88,833
2016	17	3.5	6,409	2,761	43%	182,308
2017	13	2.9	6,148	2,111	34%	312,530
2018	16	3.7	7,605	2,598	34%	216,246
2019	22	4.4	20,214	3,573	18%	347,843
2020	8	2.1	1,136	1,299	114%	27,854
2021	14	2.5	3,598	2,273	63%	84,683
2022	11	2.6	703	1,786	254%	71,938
Total	**175**	**3.3**	**72,310**	**28,418**	**39%**	**1,845,461**

Table 4-9: Verified Savings by Program Evaluation Period, WALIEE

Program Evaluation Period	Evaluation Period Homes	Average Number of Installed Measures	Expected Therms Saved	Verified Therms Saved	Realization Rate	Total Incentives and Agency Costs ($)
PY2010-PY2013	55	3.3	20,228	8,931	44%	424,181
PY2014-PY2017	49	3.1	18,826	7,958	42%	672,716
PY2018-PY2022	71	3.3	33,256	11,529	35%	748,564
Total	**175**	**3.3**	**72,310**	**28,418**	**39%**	**1,845,461**

Verified savings from 2010 to 2022 for the program are 26,632 Therms, 37% of Expected Savings. Drivers of non-100% realization which are specific to the WALIEE program are:

- Verified Therms savings as a percentage of annual usage were 25%; however, expected Therms savings as a percentage of annual usage were 68%. Therefore, the expected Therms

savings per customer are too high for the program, likely due to lack of project-level energy savings estimates in the tracking data. The Evaluators typically see whole-home retrofit savings for Low-Income programs fall between 10% and 20% of annual usage. The Evaluators observed that the expected savings in the tracking data for each customer may have represented savings for multiple projects.

5 LOW-INCOME PROGRAM PROCESS RESULTS

5.1 Staff Interview

The Evaluators interviewed three NW Natural staff involved in the implementation of the Low-Income programs. Interviewees included the Energy Efficiency portfolio manager, the Low-Income Energy Efficiency program manager, and the Environmental Program Assistant. Staff explained that NW Natural's Low-Income program began in Oregon in 2006 and Washington in 2009. As of the 2024 program year, nine Oregon based CAP agencies, one Washington based CAP agency, and three community-based organizations partner with NW Natural to provide energy efficiency equipment upgrades to NW Natural customers.

5.1.1 PROGRAM DESIGN

The Low-Income program provides energy efficient weatherization and heating equipment to qualified customers, as well as health and safety upgrades. Prior to spring 2024 NW Natural capped the health-safety allowances to $2,000 per home, but after spring 2024 NW Natural did away with this cap to provide customers with more services and assistance. The program is funded by public service funds, as well as federal, state, and county specific funding. Staff explained that NW Natural continued to collect public service funds during the COVID-19 pandemic but were not able to update many homes and therefore the program currently has a healthy reserve of funds they are currently working through.

The participating CAP Agencies and community-based organizations complete the housing audits, contract with trade allies to install the upgrades, and submit reimbursement applications on behalf of their clients. Program participants receive all measures free of charge.

5.1.2 MARKETING

Promotion of the program is a joint effort between NW Natural, the CAP Agencies, and the community-organizations. Marketing strategies include bill inserts, DIY weatherization kits with program insert, website page, and booths at community events. NW Natural staff explained that depending on the county, the program has varying levels of waitlists so although they are actively promoting the program to all customers, they are cognizant of potential delays in service delivery.

5.1.3 PROGRAM PARTICIPANTS

Customers qualify for NW Natural funding if their annual household income is at or below 80% of the area median income (AMI). Prior to the spring of 2024, eligibility was based on annual household income being at or below 200% the federal poverty line, but NW Natural expanded its criteria based off feedback from CAP Agencies and other community representatives.

Most program participants live in single-family homes that they own. Although renters are eligible for the program, the landlord needs to agree to participate and promise to not raise rent nor evict tenants for a certain period-of-time. Additionally, although the program is open to multi-family apartment buildings, due to the low proliferation of multi-family apartment buildings with gas heating, few large buildings have participated in the program.

5.1.4 PROGRAM CHALLENGES

Staff cited a lack of engaged contractors and staff turnover as the primary barriers to increased program engagement. They explained that some contractors do not consider the projects lucrative due to the payment structure and proposal-based nature of the program. Staff noted a shortage of certified auditors available to assess homes. Additionally, staff explained that the CAP Agencies rely on a variety of funding sources and often prioritize customers based on need and funding availability.

Staff also explained that program engagement varies by county, indicating some counties have more capacity and staff to implement the program than other counties. For example, staff noted that Multnomah and Washington County can observe up to 80 projects per year, while Linn and Benton counties may observe less than 20 projects.

5.1.5 PROGRAM SUCCESSES

Despite these challenges, program staff feel optimistic about the Low-Income program moving forward. Recent partnerships and pilot program with local community-based organizations like LatinoBuilt, Oregon Energy Fund, and African American Alliance for Homeownership have enabled NW Natural to expand its program to traditional hard to reach communities as well as expand its services. Additionally, program staff indicated the change in program eligibility requirements opened the program up to more customers and allowed for more assistance.

Moving forward, NW Natural staff want to continue improving the program to better serve the needs of their CAP Agency and community-based organization partners and their customers.

5.2 CAP Agency Interview Results

The evaluation team conducted interviews with CAP Agency and community-based organization (CBO) associated with the NW Natural Low-Income program to learn more about how NW Natural works with these partners to deliver residential retrofit services to customers throughout Oregon and SW Washington. In general, these interviews focused on how NW Natural collaborates with these various entities, how these collaborations serve priority populations, and the various partnerships' strengths, weaknesses, and opportunities for improvement.

NW Natural staff provided the Evaluators contact information for representatives from the eleven participating CAP Agencies in Oregon (n=10) and SW Washington (n=1); as well as representatives from three community-based organizations. The Evaluators reached out to each CAP Agency and CBO up to three times via phone and email and invited them to participate in a thirty-minute interview. Seven CAP Agencies and three CBOs responded to interview requests. Table 5-1 outlines which CAP Agencies and CBOs responded to interview requests; Clark County Weatherization (WA), Mid-Willamette Valley Community Action Agency (OR), and Yamhill Community Action Partnership (OR) did not participate in an interview.

Table 5-1: Interviewed CAP Agencies and CBOs

Organization	Counties served	Type
Clackamas County Weatherization	Clackamas (OR)	CAP Agency
Community Action Organization - Hillsboro	Washington (OR)	CAP Agency
Community Action Team - Astoria (St. Helens)	Clatsop, Columbia (OR)	CAP Agency
Community Services Consortium - Corvallis	Benton, Lincoln, Linn (OR)	CAP Agency
Homes for Good Housing Agency	Lane (OR)	CAP Agency
Multnomah County Community Services Division	Multnomah (OR)	CAP Agency
SW OR Com Action Committee - OR Coast Com Action	Coos (OR)	CAP Agency
Oregon Energy Fund	Multnomah, Washington (OR)	CBO
African American Alliance for Homeownership (AAAH)	Multnomah (OR)	CBO
Latino Built	Multnomah, Clackamas, Washington, Marion, Polk (OR)	CBO

Representatives interviewed tended to be the agencies director or weatherization program manager, and tenures ranged from 2.5 years to 38 years. CAP Agency representatives explained that their agencies have been partnered with NW Natural since the onset of the Low-Income program; the three CBO representatives indicated that their partnerships began about two to three years ago and that these partnerships were part of pilot program aimed at expanding services past CAP Agencies.

5.2.1 FUNDING SOURCES & SERVICES PROVIDED

Eight of the CAP agencies and CBOs receive funding from other sources, like Energy Trust of Oregon and LIHEAP, to help fund the weatherization and heating equipment upgrades for their community members. All these agencies explained they braid funding sources to maximize the benefits available to their clients; each funding source has specific rules and regulations, so representatives make sure the funds are being used appropriately. For example, although NW Natural has more lenient income eligibility requirements – 200% area median income rather than 80% federal poverty line – only customers with gas fueled heat sources are eligible for NW Natural funding. In addition to the more lenient income qualifications, respondents indicated that NW Natural's health and safety measure coverage is broader and more comprehensive. They went on to explain that some funding sources are strict about making sure all measures meet a certain level of cost-effectiveness, however NW Natural is less strict, open to negotiations, and tries to do what needs to be done to improve the health, safety, and energy consumption of customers.

All the representatives indicated that NW Natural does not deny any cost-effective or health and safety related improvement and that the improvements they will deny are ones that are completely aesthetic in nature. Multiple representatives (n=4) cited windows as the most requested, but rejected measure, explaining that although customers desire new windows, the energy calculations often demonstrate

that new windows will not drastically reduce or improve energy usage and therefore they are not the best option for the home. Instead, updated insulation and furnaces tend to be the most effective measures at reducing energy usage.

All the representatives described a similar program design. Once a client enrolls in the program, they receive a home energy assessment from a qualified auditor. The auditor then provides a list of recommendations to both the client and the CAP agency or CBO, and the CAP agency or CBO contracts the work out to contractors. All the representatives noted that although clients can reject some measure recommendations, typically, the clients want all the measures provided; additionally certain measures, like bathroom fans are legally required to be a part of the program and therefore clients cannot reject this measure.

> *"We do our utmost to provide everything possible. We have the funding to do so and as long as we have the justification, we want to be as holistic as we can on every household. We, I believe, have become very adept at braiding dollars and finding the allowances within those dollars."* –CAP Agency representative

The CAP agencies and CBOs approach to external contractors vary. While one of CBOs explained that their auditors often double as contractors, the other two CBOs indicated they have a network of contractors they call on to make the home improvements recommended by the auditors. Meanwhile, the eight CAP agency representatives explained that all the auditors are in-house employees, but that equipment installations are contracted to contractors. Contractors must participate in regular RFP bids and are then assigned work based on their prices provided; the frequency of the RFP bids range from every project to every few years.

5.2.2 ENGAGING CUSTOMERS

All interviewees indicated the weatherization services are exclusive to residential customers. Although all the agencies and CBOs offer the services to multi-family apartment buildings, in general, participating customers are single-family home and/or mobile homeowners and/or tenants. Clients typically learn about the program through other social services providers, NW Natural bill inserts/communications, and community events. CAP agency representatives indicated that most of their clients are also enrolled in bill assistance programs. Interviewees explained that they do not heavily market the program because there is already substantial interest, and they want to reduce wait times as much as possible.

> "*We don't need to do marketing because we have our energy assistance list, and we don't want to keep adding people to the list. We do get some referrals from clients, housing authority, and other community orgs.*" –CAP agency Representative

Waitlists for the program vary by CAP agency and CBO. One of the CBOs explained that they avoid waitlists by making their program invite-only; the other two CBOS and all eight CAP agencies indicated they have a wait list. Wait list times range from a few months to over a year (n=6). Moreover, NW Natural and the other funding sources require substantial paperwork that can slow down the job completion timeline. These representatives understood and appreciated the need for reviews and paperwork but noted it can slow the process down.

5.2.3 WORKFORCE DEVELOPMENT

Some agency representatives explained that workforce issues are their largest barrier to increased engagement (n=3). These representatives indicated that funds are available to help more customers, but they struggle to find qualified contractors: "*the bottleneck is lack of contractors or existing contractors being busy.*" One CAP agency representative noted that "*what we are seeing is a whole trade issue. There's a shortage across the trades*." Representatives from across the CAP agencies and CBOs remarked that their existing auditors and contractors have been involved in weatherization business for many years and that they have a *"good formula nailed down*." These representatives are more concerned about the future longevity of the program due to the lack of new contractors and auditors. One CAP agency representative mentioned an internship program offered by Oregon Training Institute as a possible solution to this issue but noted the state needs more contractors.

5.2.4 SATISFACTION

Overall, all the CAP agency and CBO representatives were pleased with their relationship with NW Natural. Everyone underscored the NW Natural team's communicativeness, commitment to serving customers, and generally helpful nature.

"*We have the right partners and people*." –CBO representative
"*They always try to stretch program dollars and help more clients*." –CAP agency representative
"*I think NW Natural gas is a leader and our programs have gotten better because of their leadership*." –CAP agency representative

Moreover, multiple CAP agency representative (n=5) mentioned that NW Natural listened to their feedback and made actual programmatic changes based on that feedback, including adjusting income eligibility requirements and expanding the health and safety measure coverage. One CAP agency representative also highlighted NW Natural's allowances towards using funding for administrative costs, which greatly helps with program delivery.

"NW Natural is really great to work with; they listen to our needs and questions. They'll make changes based on our feedback – ex: they increased H&S amounts; it used to be really small and they increased; they're willing to cover more work than they had in the past." –CAP agency representative
"*They continually address things they hadn't previously addressed. Always getting better. I don't know how it will get any better*." –CAP agency representative
"Been at the table and been able to communicate with them about what's working and what's not working. It's been a great success story. NW Natural has listened to other gas programs and taken notes and made changes accordingly, they're always open to change." –CAP agency representative

Some CAP agency representatives identified challenges with the program (n=4). Challenges included the long waitlists (n=2), cost effectiveness requirements (n=3), and confusing application forms (n=2). Although these representatives acknowledged some of these challenges are out of NW Natural's

control, they suggested a more streamlined application process with clear instructions on what types of measures will and will not qualify before they take the time to assess someone's home.

CBO representatives were asked to reflect on how NW Natural can better engage similar organizations in this program. Two representatives emphasized that they need to build new, and leverage existing, relationships; these representatives explained that NW Natural could strengthen their program by expanding their presence in the communities they serve through attendance at and sponsorship of community events. One of the CBO representatives noted that having a formal contract and master services agreement has also been very helpful in ensuring the program remains funded.

5.3 Contractor Interview Results

The evaluation team conducted interviews with contractors and auditors associated with the participating CAP agencies and community-based organizations that deliver residential retrofit services to customers throughout Oregon and SW Washington. In general, these interviews focused on contractors' and auditors' involvement in the NW Natural program, market conditions and customer outreach, and their satisfaction with the program.

NW Natural staff, CAP agencies, and community-based organization staff provided evaluators contact information for 33 contractors and auditors who completed projects for the NW Natural program. Evaluators reached out to each contact up to three times via phone and email and invited them to participate in a thirty-minute interview. Eight contractors and one auditor responded to interview requests. Table 5-2provides additional background information about the respondents.

Table 5-2: Interviewed CAP Agencies and CBOs

Respondent	Organization	Type	Specialty
Respondent 1	Multnomah County Community Services Division Clackamas County Weatherization Community Action Organization - Hillsboro	Contractor	Weatherization
Respondent 2	Homes for Good Housing Agency	Auditor	Audits
Respondent 3	LatinoBuilt (Portland/Salem metros)	Contractor	HVAC
Respondent 4	LatinoBuilt (Portland/Salem metros)	Contractor	Weatherization
Respondent 5	LatinoBuilt (Portland/Salem metros)	Contractor	HVAC
Respondent 6	Multnomah County Community Services Division Community Action Team – Astoria Community Action Organization – Hillsboro Yamhill Community Action Partnership Mid-Willamette Valley Community Action Agency	Contractor	Weatherization
Respondent 7	Clackamas County Weatherization	Contractor	Weatherization
Respondent 8	Clackamas County Weatherization	Contractor	Weatherization
Respondent 9	LatinoBuilt (Portland/Salem metros)	Contractor	Weatherization

Most respondents primarily focused on weatherization measures (n=6) and respondents typically completed projects in the Portland and Salem metro areas (n=9). While the one auditor interviewed was directly employed by the CAP Agency, the contractors interviewed worked on a contract basis. Seven respondents indicated they primarily work on single family homes and manufactured homes; the remaining contractor respondent indicated they primarily focus on multi-family buildings but have expanded to single family and manufactured homes when working with CAP agencies and community-based organizations for the NW Natural program.

5.3.1 MARKET CONDITIONS & CUSTOMER OUTREACH

All respondents indicated the agencies they work with tend to have a steady flow of applicants and sizeable waitlists. They noted that the agencies do a good job promoting the program in their communities and providing services to community members in need. Two respondents noted that it is likely that some community members are being left behind due to language barriers and other accessibility issues, however overall, the CAP agencies and community-based organizations are going above and beyond to help their clients.

While the four respondents who work with LatinoBuilt generate their own project leads and are provided with project leads by LatinoBuilt, the CAP Agency focused respondents (n=6) noted that the agencies assign them all their NW Natural based work. One respondent went on to explain: *"we want to help expand the program, but we also don't want to flood the system. Don't want to overpromise."* Respondents indicated that each agency has an RFP process and bond limit, and that they are assigned leads based on their proposed bids and bond status. This process ensures work is both as cost effective as possible and spread out across participating contractors.

5.3.2 PROGRAM PARTICIPATION & PROCESS

The eight responding contractors explained that they are not involved in any of the application and rebate paperwork, but rather they are provided with a work order by the CAP Agency or community-based organization with a list of measures to install. The auditor respondent noted that these work orders are based off the recommendations provided in audits and the subsequent cost-effectiveness calculations and models.

The eight contractor respondents indicated that they are not involved in the process of determining what measures are and are not included in the work orders. However, based on the projects they have completed, they speculated that the program is comprehensive and provides the necessary assistance to improve customers' homes and reduce their utility bills.

In general, customers do not reject any of the proposed measures, as all measures are provided for free, and customers are often appreciative of the help. The measures customers are most commonly hesitant about are those that alter the general aesthetic and appearance of the home, such as door covers and vents. Customers are allowed to reject any measures – except the requisite air fan – however this rarely occurs. When customers do express concerns about certain measures or equipment the contractor explains why the measure is needed and/or refers the customer to the CAP agency for more information. Multiple respondents (n=3) indicated that customers request measures that are not part of the work order, most commonly windows; when these requests arise, contractors refer customers to CAP agencies, as they do not have the ability to add new measures without authorization.

A few respondents recalled attending training related to weatherization and HVAC upgrades and improvements, but they were not sure if these trainings were NW Natural specific (n=3). Three of the other respondents noted that they do not need any additional training opportunities as they and their staff *"have been in business for a while and know what [they're] doing."*

5.3.3 PROGRAM SATISFACTION

Respondents were satisfied with their relationship with the CAP agencies and community-based organizations and the NW Natural program:

"The whole process is streamlined, we get detailed workorders with specific directions for abnormalities. [We are] provided the entire audit so we know what was found. We have everything we need to do the job. They're setting us up for success." –Contractor
"*NW Natural is a really great company and I think the fact that they're even willing to help us out as well as helping out their customer base. It's been great working with them."* – Contractor
"What they do is very good. Getting homes weatherized can be pretty expensive for somebody with, you know, Low-Income or fixed income or something like that, right. What they do, you know, is good. The funding that they get. I know that sometimes you know they have to get creative, sometimes on things, and they do a good job of doing that to keep the, you know, the project going to help the homeowner, you know, get what they need." – Contractor

All the respondents ranked the process of receiving project leads, the range of qualifying measures, and the program overall as a "4" or "5" on a scale of 1-5, with "5" being "excellent." Respondents also noted they talk to their contacts at the CAP agencies and community-based organizations at least once a month and that staff are very responsive and communicated. One respondent suggested the CAP agencies and community-based organizations digitize as much of the process as possible rather than relying on paperwork orders and notes; none of the other respondents had ideas or suggestions for improvement. This lack of negative feedback and suggestions for improvement underscore the success and appreciation of the program amongst participating contractors and the customers they serve.

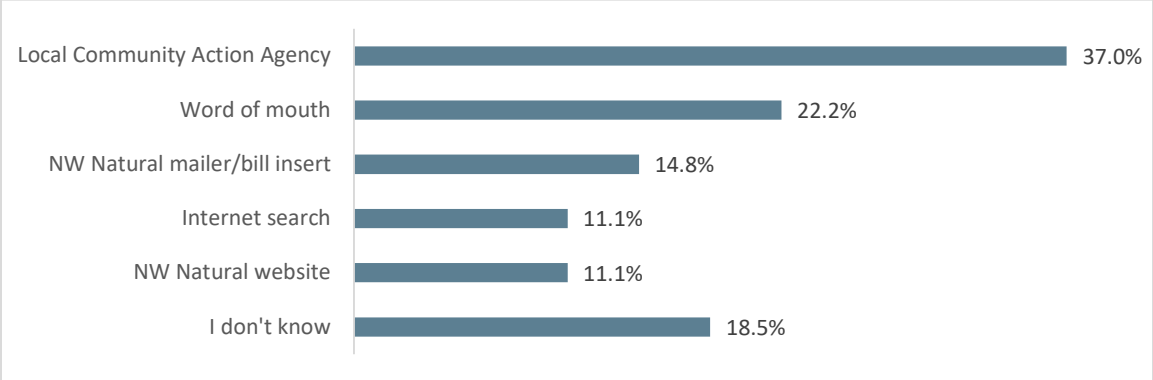
5.4 Participant Survey Results

The Evaluators conducted a survey of Northwest Natural's Low-Income Program participants in program year 2023 to gather feedback about customers' engagement with and experience of the program. The most recent program year was utilized for participant surveys to ensure participants would be able to recall their experiences with the program. Participants were contacted via phone and/or email three times and asked to complete a survey. In total, evaluators had contact information for 168 unique program participants and 35 responded to survey efforts. Three respondents did not remember receiving weatherization nor heating related measures from NW and five respondents stopped responding to questions mid survey and were excluded from analysis. Twenty-seven respondents were included in the analysis.

5.4.1 PROGRAM AWARENESS & MOTIVATION TO PARTICIPATE

Respondents learned about the program through a variety of avenues, most commonly through their local Community Action Agency (37.0%, n=10) or word of mouth (22.0%, n=6) (Figure 5-1).

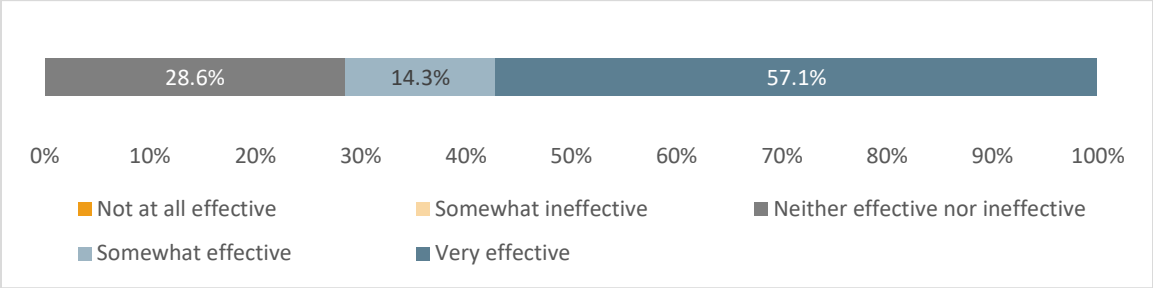
Figure 5-1: Program Awareness (n=498)



Just over half of the respondents remember receiving informational brochures or materials about the energy-efficiency program when they met with CAP Agency and/or local non-profit organization representatives (53.9%, n=14). Respondents who remembered receiving brochures noted the materials highlighted weatherization measures (n=8), furnaces (n=6), and water heaters (n=5) and most respondents found the materials effective in communicating the benefits of the program (Figure 5-2). Additionally, respondents noted that the CAP agency representatives highlighted the cost saving potential of receiving the upgrades (n=8), the free nature of the program (n=3), and the potential to

improve the comfort of their home (n=3). Respondents did not provide any feedback on how to improve the information provided. Only one respondent had concerns about the program before enrolling; they were skeptical of the offerings because they were free.

Figure 5-2: Informational Material's Effectiveness (n=14)



Respondents were motivated to participate to get their old equipment upgraded (n=12), save energy and money (n=4), and improve the comfort of their home (n=2). Respondents ranked increasing their home's energy efficiency as the most important factor they consider when considering home improvements, followed by improving health and safety, improving home comfort, and increasing home value (Table 5-3).

Table 5-3: Factors to Consider in Making Home Improvements (n=21)

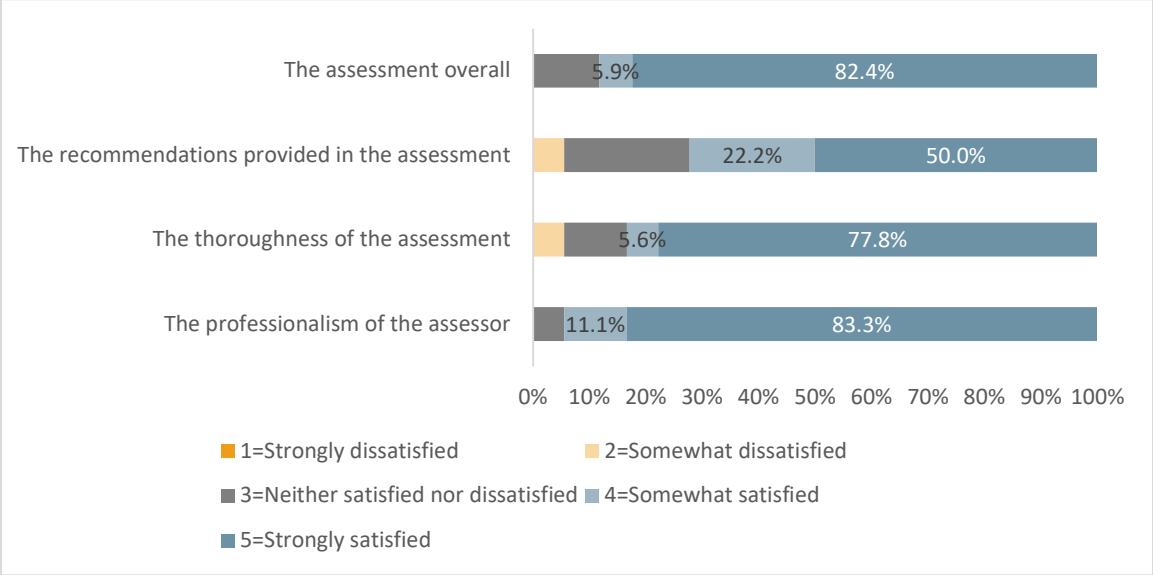
	1st	2nd	3rd	4th
Increasing home's energy efficiency	42.9%	42.9%	9.5%	4.8%
Improve your health and safety in your home	38.1%	19.1%	33.3%	9.5%
Improve your comfort in your home	14.3%	38.1%	47.6%	0.0%
Increase home value	4.8%	0.0%	9.5%	85.7%

5.4.2 ASSESSMENT AND CONTRACTOR EXPERIENCE

Two-thirds of respondents remember receiving an energy assessment of their home (66.7%, n=18); of these respondents, two-thirds remember receiving recommendations from their energy auditor (66.7%, n=12). Two respondents noted they did not act on some of the recommendations provided, including installing vents on the base of each door (n=1), as well as replacing attic, floor, and wall insulation (n=1), and windows (n=1). These respondents explained they did not like the aesthetics of the door vents (n=1) and that their roof needed to be repaired before they could install the new insulation and windows (n=1).

Respondents who remember receiving an assessment (n=18) indicated they were satisfied with the assessment overall, the recommendation provided, the thoroughness of the assessment, and the professionalism of the assessor (Figure 5-3).

Figure 5-3: Assessment Satisfaction (n=18)



Respondents found their contractor through a variety of sources including the internet, a personal contact, and referral from community agency (Figure 5-4). In general, respondents agreed that the work was scheduled and completed in a reasonable amount of time and the contractor was professional and courteous (Figure 5-5).

Figure 5-4: Contractor Source (n=27)

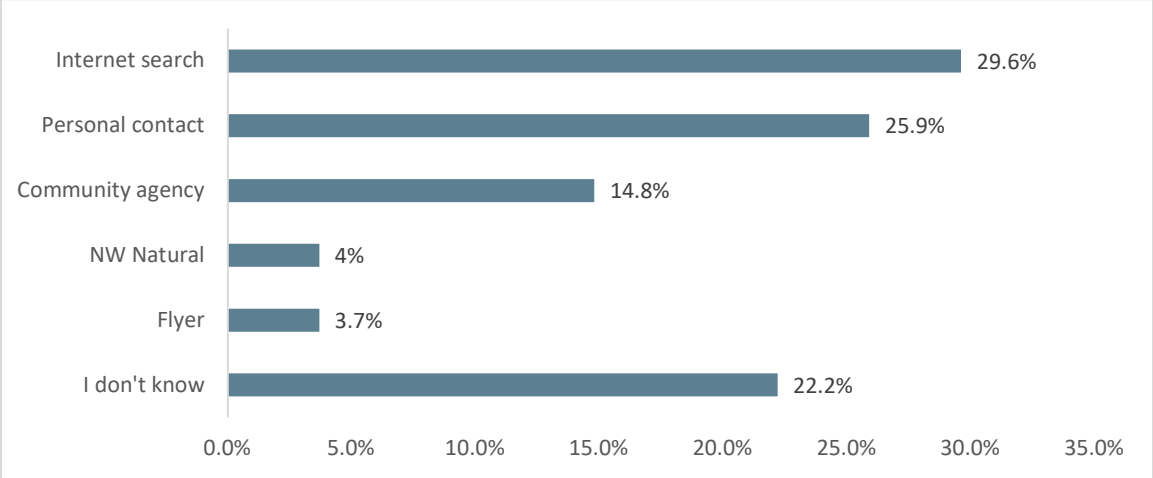
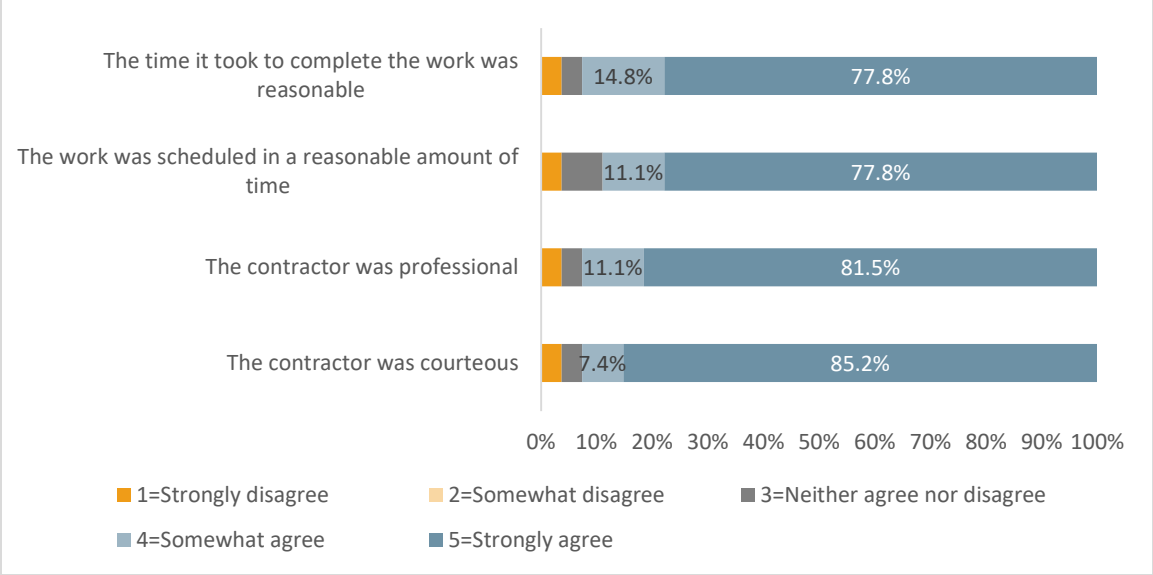


Figure 5-5: Contractor Satisfaction (n=27)

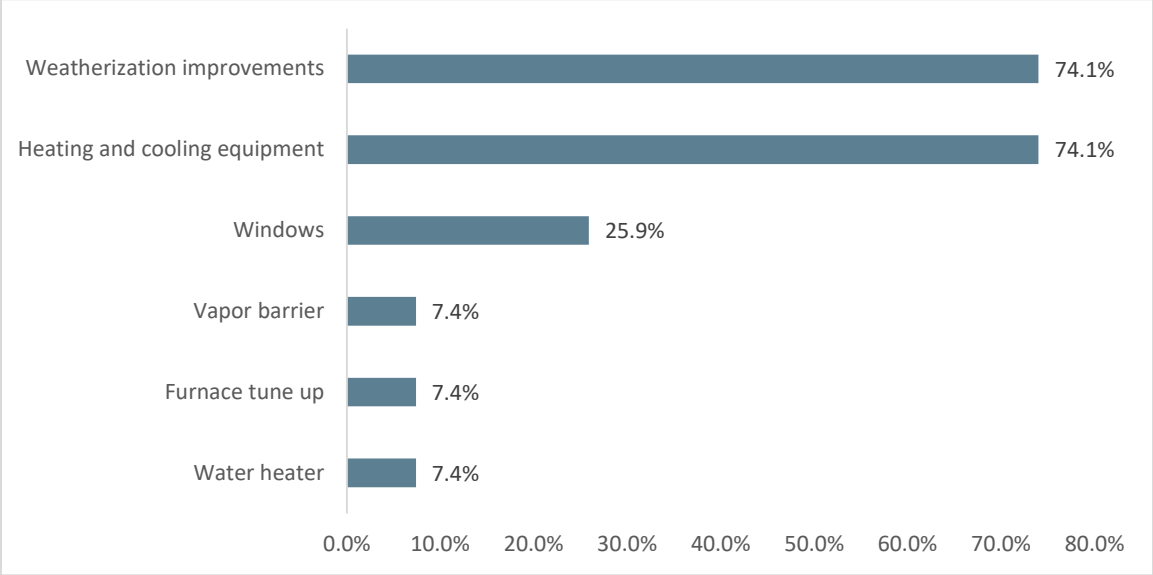


Three respondents noted their contractor suggested additional upgrades, including new windows (n=2) and a new refrigerator and water heater (n=1).

5.4.3 EQUIPMENT RECEIVED

Respondents received a variety of different equipment upgrades from the program, most commonly weatherization improvements and heating and cooling equipment upgrades (Figure 5-6). All the respondents reported that the equipment they received from the program was still installed and working.

Figure 5-6: Measures Received (n=27)



More than half of the respondents explained that there were additional measures they wanted, but did not receive (59.3%, n=16); the most common desired but not provided measures were windows and air conditioners (Table 5-4).

Table 5-4: Desired Measures (n=16)

Measure	n
Windows	6
Air conditioner	4
Additional insulation	3
Roof	2
Front door	1
Solar panels	1
Kitchen and bathroom vents	1
Electrical panel	1

5.4.4 PROGRAM SATISFACTION

Respondents were generally satisfied with NW Natural as their natural gas service provider and their experience with the program overall (Figure 5-7). About half of respondents did not have strong opinions regarding the application process, which may indicate they were not involved in this process and the CAP Agency completed the application on their behalf. About two-thirds of respondents indicated that participation in the program increased their satisfaction with NW Natural (63.0%, n=27); the remaining respondents noted that participation in the program did not increase nor decrease their satisfaction with the utility (Figure 5-8). Moreover, almost all respondents indicated they would recommend the program to others (88.9%, n=25) (Figure 5-9). More than three-quarters of respondents believe NW Natural is a very or extremely trustworthy source of information regarding energy savings in the home (77.8%, n=21).

Only two respondents provided negative reports about their experience with the program, indicating that they wished their fireplace could have been replaced (n=1) and that the contractor did not seal their windows and door properly (n=1).

Figure 5-7: Program Satisfaction (n=26)

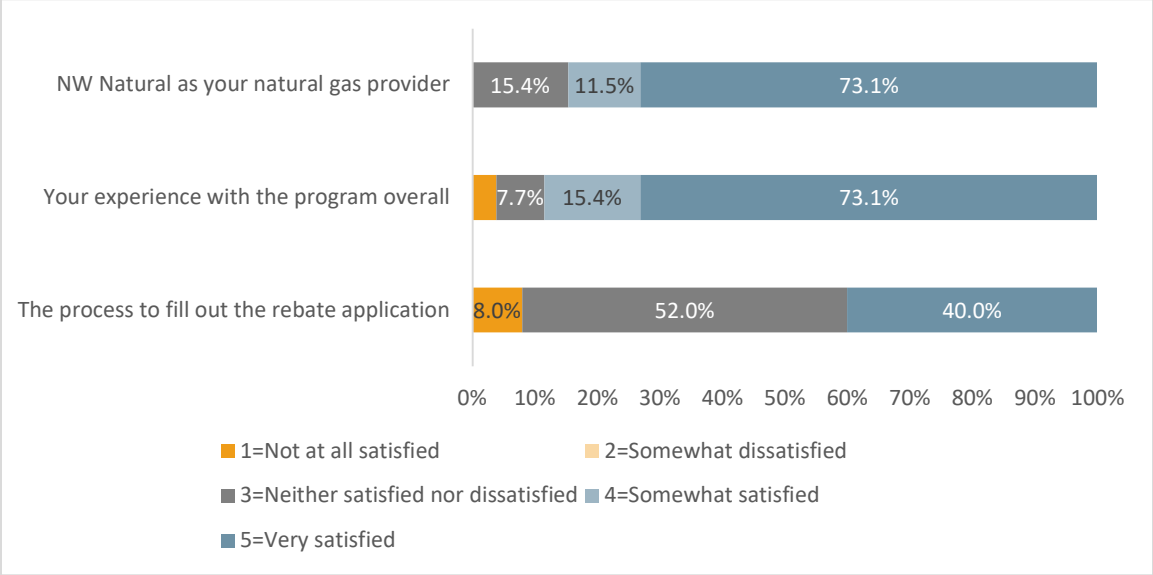


Figure 5-8: Impact of Program on Satisfaction with NW Natural (n=27)

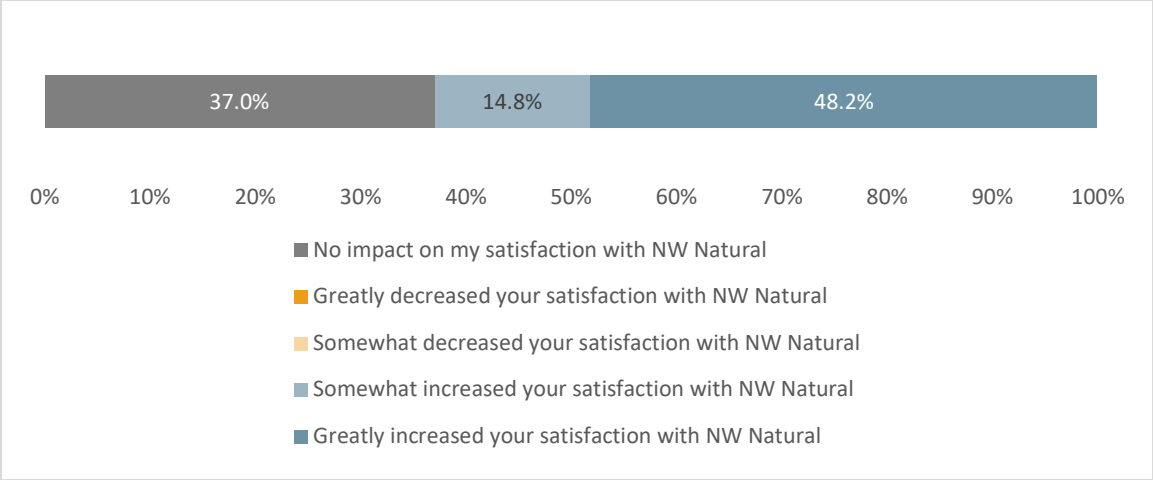
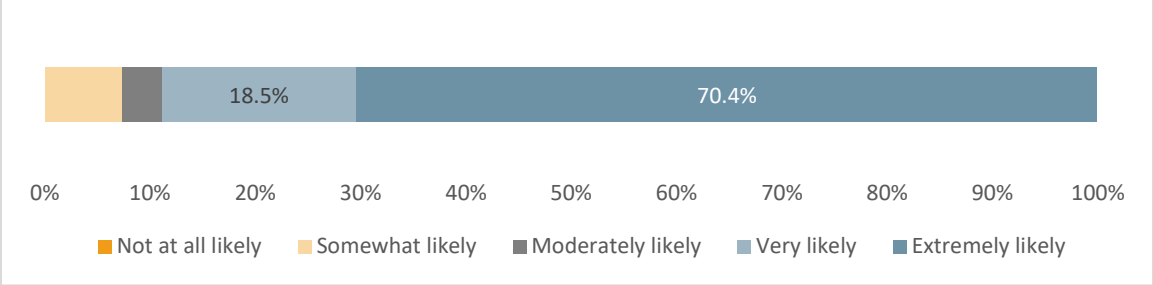


Figure 5-9: Likelihood to Recommend Program (n=27)



5.4.5 DEMOGRAPHICS

Table 5-5 describes the demographics of survey respondents. All respondents confirmed their annual income was at or below 80% the area median income of their county.

Table 5-5: Demographics (n=27)

Answer	%	Count
Homeownership		
Own	81.5%	22
Rent	11.1%	3
Own and rent to someone else	0.0%	0
Prefer not to answer	7.4%	2
Home Type		
Single-family house detached	85.2%	23
Mobile or manufactured home	11.1%	3
Apartment with 2 to 4 units	0.0%	0
Apartment with 5 or more units	0.0%	0
Prefer not to answer	3.7%	1
Building Age		
Before 1950	31.8%	7
1950 to 1959	9.1%	2
1960 to 1969	9.1%	2
1970 to 1979	22.7%	5
1980 to 1989	9.1%	2
1990 to 1999	18.2%	4
2000 to 2009	0.0%	0
2010 or later	0.0%	0
Don’t know	0.0%	0
Prefer not to answer	0.0%	0
Household Size		
1 person	40.7%	11
2 people	22.2%	6
3 people	7.4%	2
4 people	11.1%	3
5 people	3.7%	1
6 people	3.7%	1
7 people	0.0%	0
8 or more people	3.7%	1
Prefer not to answer	7.4%	2
Education		
Did not graduate high school	0.0%	0
High school graduate	22.2%	6
Associates degree, vocation/ technical school, or some college	18.5%	5
Four-year college degree	25.9%	7
Graduate or professional degree	22.2%	6
Prefer not to answer	11.1%	3
Race/Ethnicity		
American Indian or Alaska Native	7.4%	2

East Asian	3.7%	1
South Asian	0.0%	0
Black or African American	0.0%	0
Hispanic, Latino, or Spanish origin	3.7%	1
Native Hawaiian or Pacific Islander	0.0%	0
Middle Eastern or North African	0.0%	0
White or Caucasian	74.1%	20
Another race, ethnicity, or origin not listed	0.0%	0
Prefer not to answer	11.1%	3

5.5 Non-Participant Survey Results

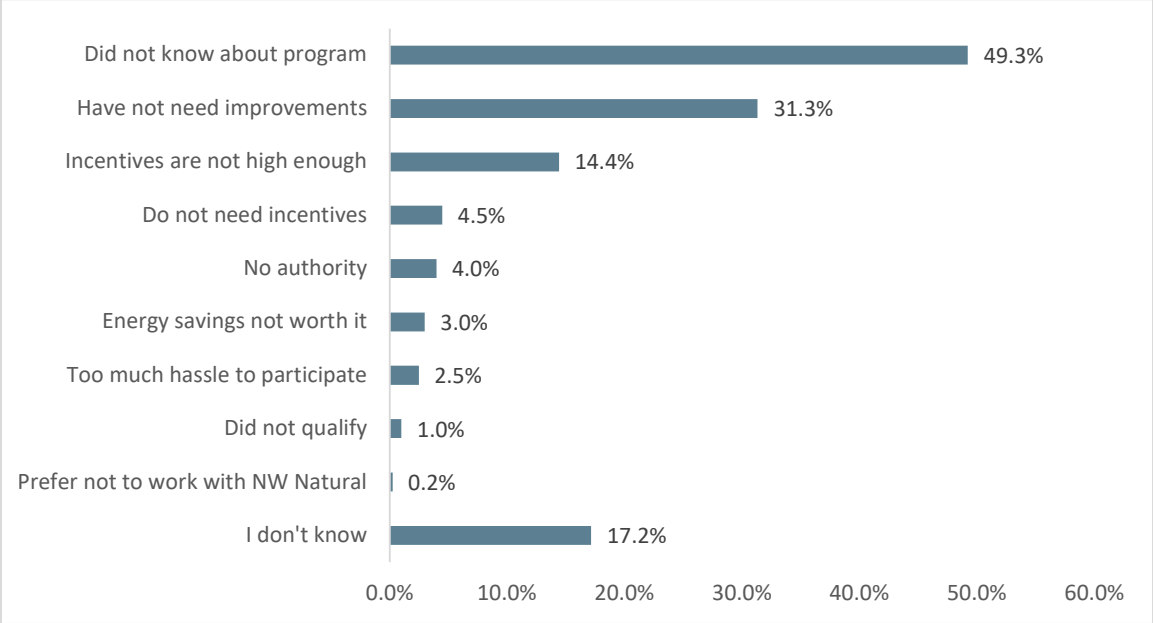
The Evaluators conducted a survey of Northwest Natural customers who qualified for the Low-Income Program but did not participate, to gather feedback about customers' awareness of NW Natural's offerings, opinions towards energy efficiency, and energy use behaviors. Participants were contacted via email two times and asked to complete a survey. In total, the Evaluators had valid emails for 5,495 unique customers; 520 responded to survey efforts. 118 respondents were excluded from analyses because they reported having no authority over the improvements made to their home (n=106) or they had received assistance from NW Natural to make improvements to their home (n=12). In total, 402 responses were included in the analyses.

5.5.1 ENGAGEMENT WITH NW NATURAL

Most respondents were homeowners and therefore had full authority to make changes and improvements to their home (81.1%, n=326); the remaining respondents were renters with some-to-full authority to make and/or request improvements (18.9%, n=76). Almost three-quarters of respondents indicated they had not replaced or upgraded any gas equipment in the past three years (70.4%, n=283). Among the 119 respondents who had replaced equipment, heating equipment, water heaters, and thermostats were the most popular equipment purchased. More than half of the respondents participated in NW Natural's bill assistance program (62.6%, n=251).

Respondents explained that they have not engaged in NW Natural's weatherization and furnace replacement program for a variety of reasons, including not knowing about the program (49.3%, n=198) and not needing improvements (31.3%, n=126) (Figure 5-1). Moreover, when asked directly, 80.4% (n=323) reported not knowing NW Natural offers weatherization and furnace replacement in partnership with local community agencies.

Figure 5-10: Reasons for Not Participating (n=402)



Among respondents who were previously aware of NW Natural's weatherization and furnace replacement assistance (n=79), most respondents had learned about the offerings through NW Natural mailers, website, or email (Figure 5-11). Respondents were most familiar with NW Natural's bill assistance and heating and cooling equipment incentive programs (Figure 5-12).

Figure 5-11: Program Awareness Source (n=79)

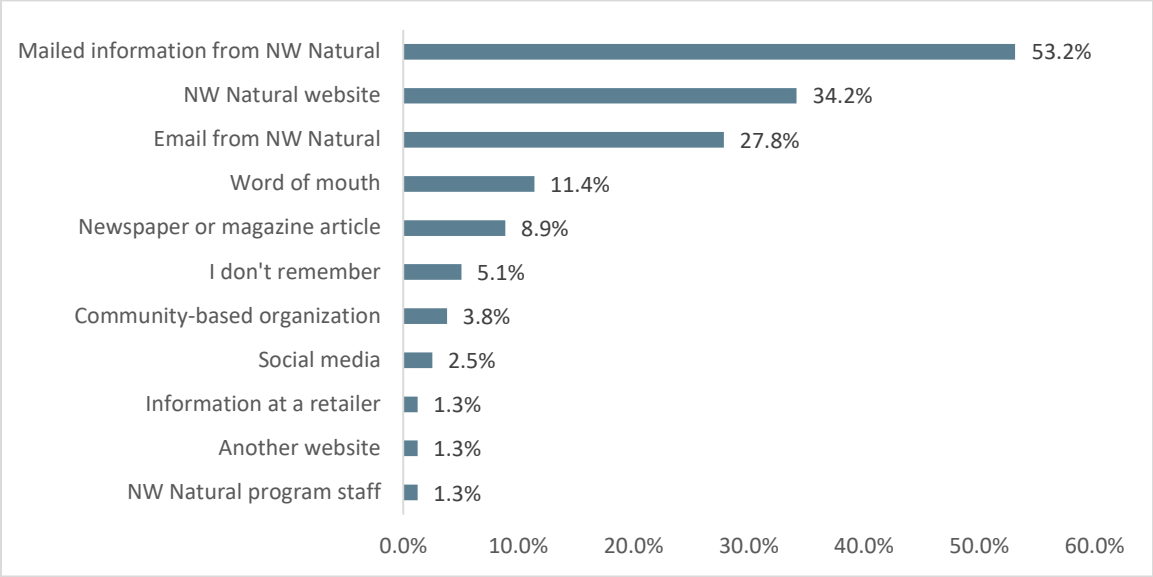
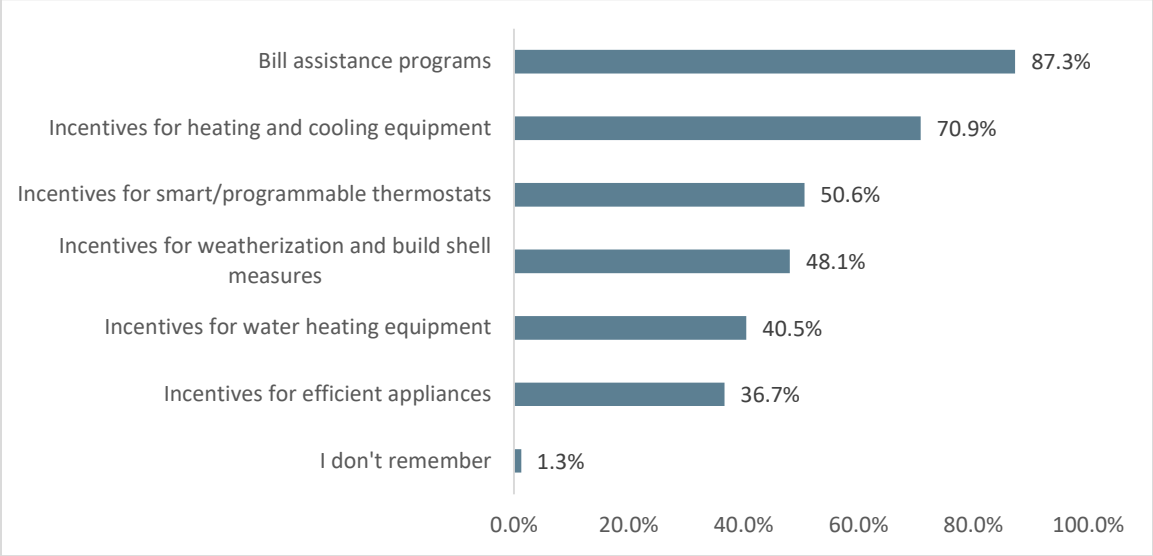


Figure 5-12: Program Awareness Levels (n=79)



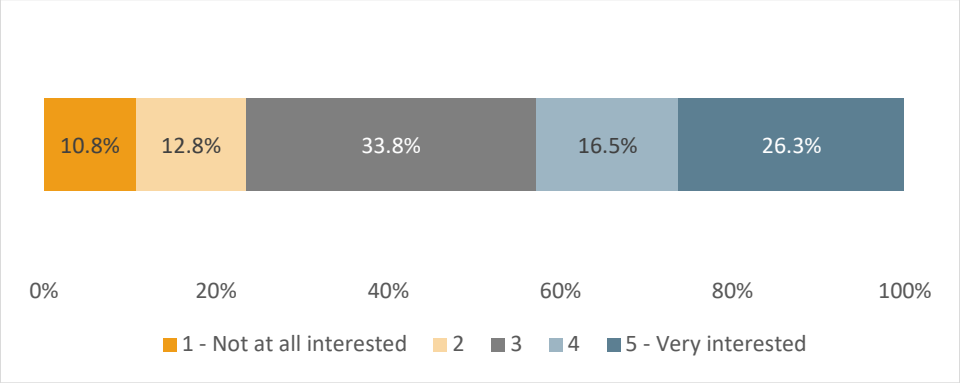
More than half of all non-participant respondents expressed interest in making energy efficient improvements to their home (61.7%, n=246). These respondents were most interested in weatherization and heating and cooling equipment updates (Table 5-6). Overall, 42.8% (n=171) indicated they were somewhat or very interested in participating in NW Natural's energy efficiency programs. ^

Respondents explained that the cost of equipment upgrades were the main factor preventing them from engaging in this type of program (51.0%, n=204); other reasons for not engaging included not needing new equipment, not having authority to make decisions, and needing more information about the program.

Table 5-6: Services Respondents are Interested In (n=246)

	%	n
Home weatherization	74.0%	182
Heating/cooling equipment	63.4%	156
Water heating equipment	44.3%	109
Smart/programmable thermostats	38.6%	95
Efficient appliances	36.6%	90
Windows	2.0%	5
Not sure	1.6%	4

Figure 5-13: Interest in NW Natural's Programs (n=400)



Respondents suggested NW Natural increases awareness of the programs through enhanced marketing, increased attendance at community events, and easier to understand application materials (n=55). Additionally, 50 respondents suggested NW Natural offer higher incentives and rebates. Together, these sets of comments suggest awareness of NW Natural's assistance for Low-Income is limited and many eligible customers do not realize they may qualify for free weatherization and heating equipment updates.

5.5.2 CURRENT ENERGY USAGE

About two-thirds of respondents believed their heating and/or cooling equipment are the largest energy consumer in their home (Figure 5-14). Most respondents fueled their homes with natural gas (82.0%, n=327). The age of respondents' heating system varied; one-third of respondents reported their heating system was less than 10 years old (32.6%, n=124), while half of respondents indicated their heating system was 10-20 years old or more than 20 years old (Figure 5-15). More than half of respondents had serviced their heating system in the last three years (59.3%, n=226) (Figure 5-16). Just over half of respondents have a programmable thermostat (53.9%, n=215); the remaining respondents either have a manual thermostat (17.7%, n=71), smart thermostat (21.8%, n=87), or are not sure (6.5%, n=26).

Figure 5-14: Largest Energy Consumers (n=399)

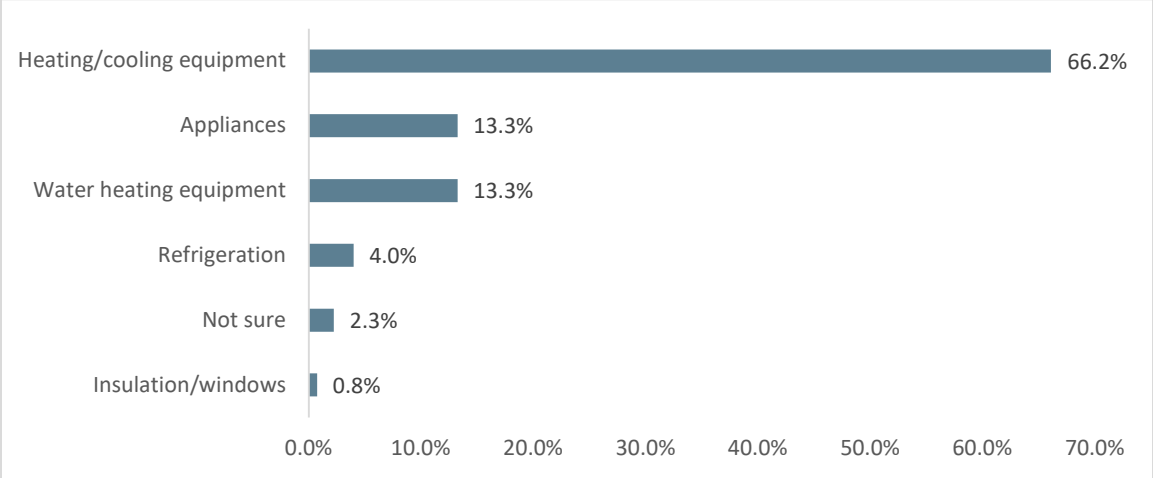


Figure 5-15: Age of Heating System (n=381)

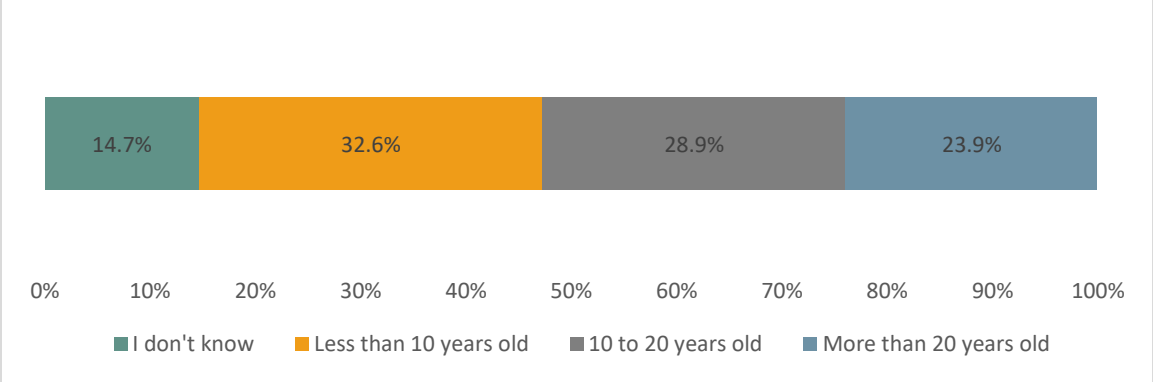
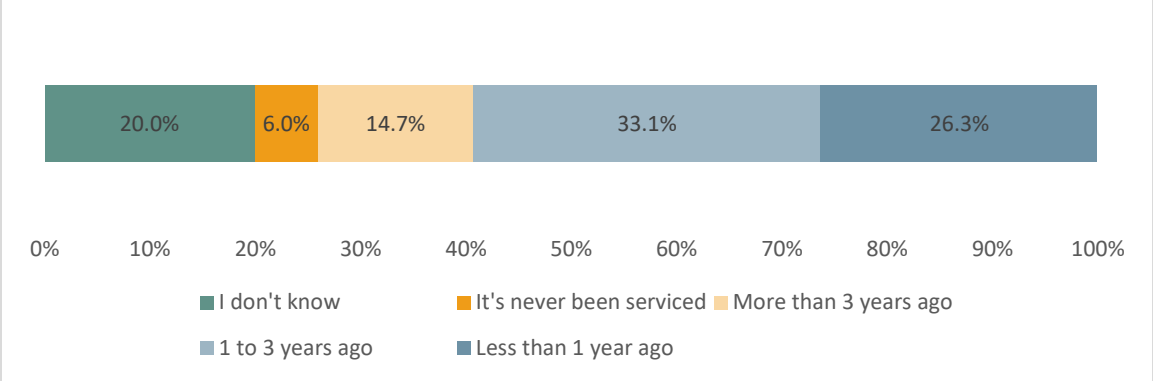


Figure 5-16: Time of Most Recent Heating System Service (n=381)



5.5.3 DEMOGRAPHICS

Table 5-5 describes the demographics of survey respondents. 285 respondents provided the data necessary to verify their eligibility for the NW Natural Low-Income program (annual household income is at or below 80% the area median income of their county); among these respondents 94.0% (n=268) qualified for the programs.

Table 5-7: Demographics (n varies)

Answer	%	Count
Homeownership (n=400)		
Own	79.8%	319
Rent	16.5%	66
Own and rent to someone else	0.3%	1
Prefer not to answer	3.5%	14
Home Type (n=397)		
Single-family house detached	83.4%	331
Single-family house attached to one or more other houses	11.8%	47
Mobile or manufactured home	2.3%	9
Apartment with 2 to 4 units	0.5%	2
Apartment with 5 or more units	0.8%	3
Prefer not to answer	1.3%	5
Building Age (n=317)		
Before 1950	16.4%	52
1950 to 1959	9.2%	29
1960 to 1969	7.3%	23
1970 to 1979	9.2%	29
1980 to 1989	5.7%	18
1990 to 1999	17.0%	54
2000 to 2009	19.6%	62
2010 to 2019	7.6%	24
2020 to Present	3.2%	10
I don't know	4.1%	13
Prefer not to answer	1.0%	3
Household Size (n=392)		
1 person	25.1%	99
2 people	31.7%	125
3 people	16.0%	63
4 people	7.3%	29
5 people	8.6%	34
6 people	5.1%	20
7 people	0.5%	2
8 or more people	0.5%	2
Prefer not to answer	5.3%	21
Education (n=387)		
Did not graduate high school	2.3%	9
High school graduate	18.4%	71
Associates degree, vocation/ technical school, or some college	32.0%	124
Four-year college degree	26.9%	104
Graduate or professional degree	13.7%	53
Prefer not to answer	6.7%	26
Race/Ethnicity (n=400)		

White or Caucasian	73.3%	293
Prefer not to answer	11.3%	45
Hispanic, Latino, or Spanish origin	8.0%	32
Black or African American	5.5%	22
East Asian (e.g. Chinese, Filipino, Asian Indian, Vietnamese, Korean, Japanese)	5.0%	20
American Indian or Alaska Native	2.8%	11
Native Hawaiian or Pacific Islander	0.5%	2
South Asian (e.g. Asian Indian, Pakistani, Bangladeshi)	0.3%	1
Middle Eastern or North African	0.3%	1
Jewish	0.3%	1
Mixed American	0.3%	1
Syrian	0.3%	1
Polish	0.3%	1

5.6 Process Conclusions and Recommendations

The following section details the Evaluators' conclusions and recommendations for the Low-Income programs.

1) **Conclusion 1: NW Natural's Low-Income program utilizes lenient qualification criteria and provides comprehensive measure coverage.** Stakeholders from across the interview groups – program staff, CAP Agency and CBO staff, and trade allies – remarked on NW Natural's comprehensive measure coverage and willingness to stretch the boundaries of the services they can provide. Not only did NW Natural modify the qualification criteria from 200% FPL to 80% AMI in response to requests by the CAP Agency, but they also expanded health and safety qualifying measures, allowing for more holistic coverage and home updates for customers. CAP agency and CBO staff noted that NW Natural's program has some of the most lenient and flexible qualification criteria – as compared to other similar programs – and participating trade allies indicated that the measures covered are thorough.

2) **Conclusion 2: Most participants and eligible non-participants participate in the CAP Agencies and CBO energy related bill assistance programs. Waitlist times for the program vary across agencies.** One CBO representative explained that they avoid waitlists by making their program invite-only, while other CBO representatives and CAP agency staff indicated their wait list times range from a few months to over a year.

3) **Conclusion 3: Non-participants respondents explained that the cost of equipment upgrades was the main factor preventing them from engaging in this type of program**, suggesting awareness of NW Natural's assistance for Low-Income is limited and many eligible customers do not realize they may qualify for free weatherization and heating equipment updates.

    Recommendation 1: Although wait lists for some of the weatherization and HVAC programs can be lengthy, CAP agency and CBO staff should continue to enroll existing

clients into this program to ensure comprehensive energy assistance, as more than half of all non-participant respondents expressed interest in making energy efficient improvements to their home.

4) **Conclusion 4: Workforce development issues limit program expansion**. Some CAP Agency representatives explained that workforce issues are their largest barrier to increased engagement. These representatives indicated that funds are available to help more customers, but they struggle to find qualified contractors. Representatives from across the CAP agencies and CBOs remarked that their existing auditors and contractors have been involved in the weatherization business for many years, but that they are concerned about the future longevity of the program due to the lack of new contractors and auditors. One CAP agency representative mentioned an internship program offered by Oregon Training Institute as a possible solution to this issue but noted the state needs more contractors.

   Recommendation 2: NW Natural should consider partnering with the Oregon Training Institute and other similar organizations to help offer more workforce development and training opportunities for future contractors and trade allies.

5) **Conclusion 5: CBO representatives underscored the importance of leveraging existing relationships in communities when promoting the program.**

   Recommendation 3: NW Natural can continue to strengthen their program by expanding their presence in the communities they serve through attendance at and sponsorship of community events. One of the CBO representatives also noted that having a formal contract and master services agreement has also been very helpful in ensuring the program remains funded.

6) **Conclusion 6: Satisfaction across stakeholder groups – CAP agency and CBO staff, contractors, and participants – was high.** Interview respondents highlighted NW Natural's communicativeness and willingness to answer questions, while most survey respondents indicated they would recommend the program to others and that they believe NW Natural is a very or extremely trustworthy source of information regarding energy savings in the home.

6 APPENDIX A: COST-EFFECTIVENESS TESTING

6.1 Summary

The Evaluators estimated the cost-effectiveness for the overall energy efficiency of programs, based on costs and savings estimates provided by NW Natural and their third-party implementers. This appendix provides the cost-effectiveness results, as well as a brief overview of the approach taken by the Evaluators. The tables below present the cost-effectiveness results for the most recent evaluation periods (Py2014-PY2017 and PY2018-PY2022).

Table 6-1: Cost-Effectiveness Results, PY2014-PY2017

Program	TRC	UCT	RIM	PCT	SCT
OLIEE	2.08	0.25	0.20	N/A	2.34
WALIEE	1.37	0.23	0.19	N/A	1.57
Total	**1.99**	**0.25**	**0.20**	**N/A**	**2.25**

Table 6-2: Cost-Effectiveness Results, PY2018-PY2022

Program	TRC	UCT	RIM	PCT	SCT
OLIEE	2.31	0.23	0.19	N/A	2.60
WALIEE	2.08	0.33	0.25	N/A	2.38
Total	**2.29**	**0.24**	**0.19**	**N/A**	**2.58**

The Evaluators benchmarked RIM tests for other recent Low-Income Weatherization programs and found NW Natural's RIM test results to be comparable with the average RIM test for other utilities (see Table 6-3). A low RIM test is expected for Low-Income programs because measures in these programs are usually provided free of charge to customers (e.g., incremental costs are zero), which increases the costs of the utility.

Table 6-3: RIM Test Benchmarking

Utility	Fuel Type	Program	Program Year	RIM
Utility 1	Electric	Income Eligible Single-Family	2022	0.29
Utility 1	Electric	Income Eligible Single-Family	2023	0.37
Utility 2	Electric	Income-Qualified Weatherization	2023	0.45
Utility 3	Electric	Income-Qualified Weatherization	2023	0.16
Utility 4	Gas	Residential Low-Income	2023	0.26
Utility 4	Electric	Residential Low-Income	2023	0.00
Utility 4	Gas	Residential Low-Income	2022	0.05
Utility 4	Electric	Residential Low-Income	2022	0.30
Average				**0.24**

6.2 Methods

The California Standard Practice Model was used as a guideline for the calculations, along with guidance from the 2020-2022 and 2023 Natural Gas Demand-Side Management (DSM) plans and the AR TRM V9.2. The cost-effectiveness analysis methods that were used in this analysis are among the set of standard methods used in this industry and include the Total Resource Cost Test (TRC), Utility Cost Test (UCT)[7], Ratepayer Impact Measure Test (RIM), Participant Cost Test (PCT) and Societal Cost Test (SCT). All tests weigh monetized benefits against costs. These monetized amounts are presented as Net Present Value (NPV) evaluated over the lifespan of the measure. The benefits and costs differ for each test based on the perspective of the test. The definitions below are taken from the California Standard Practice Manual.

The TRC measures the net costs of a demand-side management program as a resource option based on the total costs of the program, including both the participants' and the utility's costs.

The UCT measures the net costs of a demand-side management program as a resource option based on the costs incurred by the program administrator (including incentive costs) and excluding any net costs incurred by the participant. The benefits are similar to the TRC benefits. Costs are defined more narrowly.

The PCT is the measure of the quantifiable benefits and costs to the customer due to participation in a program. Since many customers do not base their decision to participate in a program entirely on quantifiable variables, this test cannot be a complete measure of the benefits and costs of a program to a customer.

[7] The UCT is also referred to as the Program Administrator Cost Test (PACT).

The RIM test measures what happens to customer bills or rates due to changes in utility revenues and operating costs caused by the program. Rates will go down if the change in revenues from the program is greater than the change in utility costs. Conversely, rates or bills would go up if revenues collected after program implementation is less than the total costs incurred by the utility in implementing the program. This test indicates the direction and magnitude of the expected change in customer bills or rate levels.

The SCT test measures the net costs of a demand-side management program as a resource option based on the total costs of the program, including both the participants' and the utility's costs in the same way that the TRC measures these, but utilizes a societal discount rate, which is lower than the discount rate used for the TRC. The lower discount rate effectively assigns a higher net present value to program benefits that occur in the future.

A common misperception is that there is a single best perspective for evaluation of cost-effectiveness. Each test is useful and accurate, but the results of each test are intended to answer a different set of questions. The questions to be addressed by each cost test are shown in the table below.[8]

Table 6-4: Questions Addressed by the Various Cost Tests

Cost Test	Questions Addressed
Participant Cost Test (PCT)	▪ Is it worth it to the customer to install energy efficiency?
	▪ Is it likely that the customer wants to participate in a utility program that promotes energy efficiency?
Ratepayer Impact Measure (RIM)	▪ What is the impact of the energy efficiency project on the utility's operating margin?
	▪ Would the project require an increase in rates to reach the same operating margin?
Utility Cost Test (UCT)	▪ Do total utility costs increase or decrease?
	▪ What is the change in total customer bills required to keep the utility whole?
Total Resource Cost Test (TRC)	▪ What is the regional benefit of the energy efficiency project (including the net costs and benefits to the utility and its customers)?
	▪ Are all of the benefits greater than all of the costs (regardless of who pays the costs and who receives the benefits)?
	▪ Is more or less money required by the region to pay for energy needs?

Overall, the results of all five cost-effectiveness tests provide a more comprehensive picture than the use of any one test alone. The TRC and SCT cost tests address whether energy efficiency is cost-effective overall. The PCT, UCT, and RIM address whether the selection of measures and design of the program are balanced from the perspective of the participants, utilities, and non-participants. The scope of the benefit and cost components included in each test are summarized in the table below.[9]

[8] https://www.epa.gov/energy/understanding-cost-effectiveness-energy-efficiency-programs

[9] *Ibid*.

Table 6-5: Benefits and Costs Included in each Cost-Effectiveness Test

Test	Benefits	Costs
PCT (Benefits and costs from the perspective of the customer installing the measure)	▪ Incentive payments	▪ Incremental equipment costs
	▪ Bill Savings	▪ Incremental installation costs
	▪ Applicable tax credits or incentives	
UCT (Perspective of utility, government agency, or third party implementing the program	▪ Energy-related costs avoided by the utility	▪ Program overhead costs
	▪ Capacity-related costs avoided by the utility, including supply and distribution	▪ Utility/program administrator incentive costs
TRC (Benefits and costs from the perspective of all utility customers in the utility service territory)	▪ Energy-related costs avoided by the utility	▪ Program overhead costs
	▪ Capacity-related costs avoided by the utility, including supply and distribution	▪ Program installation costs
	▪ Additional resource savings	▪ Incremental measure costs
	▪ Monetized non-energy benefits as outlined by the TRM.	
RIM (Impact of efficiency measure on non-participating ratepayers overall)	▪ Energy-related costs avoided by the utility	▪ Program overhead costs
	▪ Capacity-related costs avoided by the utility, including supply and distribution	▪ Lost revenue due to reduced energy bills
		▪ Utility/program administrator installation costs

6.2.1 ECONOMIC INPUTS

The Evaluators used the avoided costs, discount rates, and other economic inputs provided by NW Natural for the cost benefit analysis.

Additionally, the table below outlines the discount rates, escalation rate and avoided costs used in the cost-effectiveness analysis.

Table 6-6: Economic Inputs for Cost-Effectiveness Analysis

Discount Rates	
Utility (TRC)	3.87%
Utility (UCT)	3.87%
Utility (RIM)	3.87%
Societal (SCT)	3.00%
Participant (PCT)	10.00%
Line Losses	
Line Losses	0.00%
Escalation rate	2.45%
Avoided Costs	
Avoided Energy ($/Therm)	$0.961

6.3 Arrearage and Disconnections Results

The table below displays the observed average differences in arrearages, disconnects, and disconnection notices between the matched treatment and control groups of each cohort. Data on arrearages is complete only for the latest evaluation period of customers in Oregon. On average, control customers accrued $97.98 more in annualized arrearages during 2023 than during 2017, while treatment customers on average accrued $115.00 less, resulting in a difference-in-difference savings of $212.97[10]. Assuming a participant discount rate of 10%, the NEB adder per participant is $21.30 for the arrearage reduction.

Additionally, the average number of disconnects and disconnection notices per customer decreased more in the treatment group than in the control group in the post-period year for every cohort with complete data except for Oregon customers during the PY2014-PY2017 evaluation period, where disconnects decreased more for control customers than treatment customers. However, the results for disconnects and disconnection notices were not statistically significant for any cohort.

Table 6-7: Arrearage and Disconnections Results

Statistic	Cohort	Difference in Annual Averages (Post - Pre)		Savings	Statistical Significance (alpha < .05)
		Control	Treatment		
Arrearages	EP3 (OR)	$97.98	$(115.00)	$ 212.97	Yes
Disconnects	EP2 (OR)	-0.026	-0.010	-0.016	No
Disconnects	EP3 (OR)	0.006	-0.015	0.021	No
Disconnection Notices	EP1 (OR)	0.268	-0.773	1.041	No
Disconnection Notices	EP2 (OR)	-0.429	-0.670	0.241	No
Disconnection Notices	EP3 (OR)	1.012	-0.693	1.705	No
Disconnection Notices	WA	0.468	0.143	0.325	No

[10] Annualized arrearage estimates were based on 90-day arrearage totals expected to increase at the same rate over the course of one year.

6.4 Program-Level Results

Sections below show results, benefits, costs and net benefits for the most recent evaluation periods (PY2014-PY2017and PY2018-PY2022).

6.4.1 COST-EFFECTIVENESS RESULTS FOR EVALUATED PROGRAM YEARS

The tables below outline the results for each test for both Low-Income programs.

Table 6-8: Cost-Effectiveness Results by Program, PY2014-PY2017

Program	TRC	UCT	RIM	PCT	SCT
OLIEE	2.08	0.25	0.20	N/A	2.34
WALIEE	1.37	0.23	0.19	N/A	1.57
Total*	**1.99**	**0.25**	**0.20**	**N/A**	**2.25**

*Sums may differ due to rounding.

Table 6-9: Cost-Effectiveness Benefits by Program, PY2014-PY2017

Program	TRC Benefits	UCT Benefits	RIM Benefits	PCT Benefits	SCT Benefits
OLIEE	$2,165,512	$2,146,214	$2,146,214	$9,123,859	$2,436,282
WALIEE	$187,075	$186,031	$186,031	$803,001	$214,087
Total*	**$2,352,587**	**$2,332,245**	**$2,332,245**	**$9,926,860**	**$2,650,370**

*Sums may differ due to rounding.

Table 6-10: Cost-Effectiveness Costs by Program, PY2014-PY2017

Program	TRC Costs	UCT Costs	RIM Costs	PCT Costs	SCT Costs
OLIEE	$1,043,227	$8,582,884	$10,729,099	$0	$1,043,227
WALIEE	$136,537	$809,253	$995,284	$0	$136,537
Total*	**$1,179,764**	**$9,392,137**	**$11,724,382**	**$0**	**$1,179,764**

*Sums may differ due to rounding.

Table 6-11: Cost-Effectiveness Net Benefits by Program, PY2014-PY2017

Program	TRC Net Benefits	UCT Net Benefits	RIM Net Benefits	PCT Net Benefits	SCT Net Benefits
OLIEE	$1,122,285	-$6,436,670	-$8,582,884	$9,123,859	$2,436,282
WALIEE	$50,538	-$623,222	-$809,253	$803,001	$214,087
Total*	**$1,172,823**	**-$7,059,892**	**-$9,392,137**	**$9,926,860**	**$2,650,370**

*Sums may differ due to rounding.

Table 6-12: Cost-Effectiveness Results by Program, PY2018-PY2022

Program	TRC	UCT	RIM	PCT	SCT
OLIEE	2.31	0.23	0.19	N/A	2.60
WALIEE	2.08	0.33	0.25	N/A	2.38
Total*	**2.29**	**0.24**	**0.19**	**N/A**	**2.58**

*Sums may differ due to rounding.

Table 6-13: Cost-Effectiveness Benefits by Program, PY2018-PY2022

Program	TRC Benefits	UCT Benefits	RIM Benefits	PCT Benefits	SCT Benefits
OLIEE	$3,360,868	$3,335,947	$3,335,947	$15,562,557	$3,781,270
WALIEE	$300,636	$299,123	$299,123	$961,630	$343,856
Total*	**$3,661,504**	**$3,635,070**	**$3,635,070**	**$16,524,188**	**$4,125,126**

*Sums may differ due to rounding.

Table 6-14: Cost-Effectiveness Costs by Program, PY2018-PY2022

Program	TRC Costs	UCT Costs	RIM Costs	PCT Costs	SCT Costs
OLIEE	$1,455,276	$14,509,972	$17,845,919	$0	$1,455,276
WALIEE	$144,593	$893,157	$1,192,280	$0	$144,593
Total*	**$1,599,869**	**$15,403,128**	**$19,038,199**	**$0**	**$1,599,869**

*Sums may differ due to rounding.

Table 6-15: Cost-Effectiveness Net Benefits by Program, PY2018-PY2022

Program	TRC Net Benefits	UCT Net Benefits	RIM Net Benefits	PCT Net Benefits	SCT Net Benefits
OLIEE	$1,905,592	-$11,174,024	-$14,509,972	$15,562,557	$3,781,270
WALIEE	$156,042	-$594,033	-$893,157	$961,630	$343,856
Total*	**$2,061,634**	**-$11,768,058**	**-$15,403,128**	**$16,524,188**	**$4,125,126**

*Sums may differ due to rounding.

7 APPENDIX B: UNIT ENERGY SAVINGS

Table 7-1 provides UES (or deemed) Therms savings for measures found in project documentation or program tracking data.

The Evaluators provide deemed measure savings to assist NW Natural with savings estimates, which may be useful in future program years. If the program measures change substantially, the whole-home billing analysis results from the evaluated periods in this report may not provide accurate estimates of whole-home savings in future program years.

The Evaluators used various sources to calculate deemed savings estimates such as the RTF, TRMs, and previous studies. The Evaluators identified separate efficiency levels for each measure where applicable and assigned savings using the sources mentioned in Table 7-1. The Evaluators then took an average of the Unit Energy Savings across different measure efficiency levels for the projects that had complete data. This resulted in average household level savings per measure which the Evaluators then used to assign to the sample based on document verification findings. The average savings per household using the deemed savings method resulted in 79.42 Therms. However, the Evaluators found 96 projects that did not provide enough specification information to calculate savings. Excluding these projects causes the average savings per household to increase to 119.34 Therms.

Table 7-1: Deemed Measure Savings, TRM-based

Measure	Efficiency	Savings % of Sampled Projects	Measure Unit	Measure Unit Average	Unit Energy Savings (Therms)	TRM Source
Attic/Ceiling Insulation	R0 to R38	12.45%	SQFT	799	164.1	RTF: ResSFWx_v6_2
	R0 to R49	5.24%	SQFT	843	176.0	RTF: ResSFWx_v6_2
	R11 to R38	2.62%	SQFT	943	65.2	RTF: ResSFWx_v6_2
	R11 to R49	3.28%	SQFT	800	58.0	RTF: ResSFWx_v6_2
	R19 to R38	1.31%	SQFT	825	24.3	RTF: ResSFWx_v6_2
	R19 to R49	0.66%	SQFT	676	22.6	RTF: ResSFWx_v6_2
	R30 to R49	0.98%	SQFT	775	12.6	RTF: ResSFWx_v6_2
Direct Vent Space	Unknown	Unknown	Unknown	Unknown	81.7	Avisa TRM
Duct	R0 to R11	9.44%	SQFT	206	35.8	RTF: ResSFWx_v6_2
Duct Sealing	Unknown	13.94%	CFM50 reduction	67	44.1	Illinois TRM Algorithm 5.3.4
Faucet Aerators	1.5 GPM	0.00%	Efficiency Value	Unknown	1.5	AR TRM V9

Floor Insulation	R0 to R19	1.61%	SQFT	726	32.2	RTF: ResSFWx_v6_2
	R0 to R25	6.85%	SQFT	1,115	53.9	RTF: ResSFWx_v6_2
	R0 to R30	7.85%	SQFT	1,018	51.7	RTF: ResSFWx_v6_2
Furnace Tune Up	Unknown	0.74%	Unknown	Unknown	14.0	Illinois TRM
HE Water Heater	Not ES, No Gas line Upgrade	0.14%	Efficiency Value	0.91	32.6	RTF: ResGasWH_v3_2
	Not ES, with Gas Line Upgrade	0.57%	Efficiency Value	0.91	32.6	RTF: ResGasWH_v3_2
HE Windows	Single Pane to Class 30	2.08%	Quantity of Windows	146	51.3	RTF: ResSFWx_v6_2
	Single Pane to Class 22	2.77%	Quantity of Windows	4	1.6	RTF: ResSFWx_v6_2
High Efficiency Furnace	CEE Tier 2	7.81%	Efficiency Value	0.95	42.9	RTF: ResESGasFurnaces_v2_1
	CEE Tier 3	6.28%	Efficiency Value	0.97	54.9	RTF: ResESGasFurnaces_v2_1
Hot Water Pipe	Unknown	0.21%	Foot of Insulation	Unknown	2.0	Illinois TRM Table 5.4.1
Infiltration	CFM50 reduction	5.38%	SQFT	1,217	13.9	RTF: ResSFWx_v6_2
Thermal Door	Unknown	0.19%	Unknown	Unknown	22.0	Illinois TRM
Wall	R0 to R11	7.59%	SQFT	694	28.8	RTF: ResSFWx_v6_2

Table 7-2 provides deemed measure savings and effective useful life (EUL) based on average measure efficiency values observed for sampled projects that were part of the document-based verification.

Table 7-2: Deemed Measure Savings (Average Efficiency), TRM-based

Measure	Measure Unit	Measure Unit Average	Unit Energy Savings (Therms)	EUL	EUL Source
Attic/Ceiling Insulation	SQFT	816	74.7	45	RTF
Direct Vent Space Heater	Unknown	Unknown	81.66	20	AR TRM V9
Duct Insulation	SQFT	206	35.8	45	RTF
Duct Sealing	CFM50 reduction	67	44.1	20	RTF
Faucet Aerators	Efficiency Value	Unknown	1.5	10	AR TRM V9
Floor Insulation	SQFT	1,036	45.9	45	RTF
Furnace Tune-Up	Unknown	Unknown	14.0	5	NY TRM V11
HE Water Heater	Efficiency Value	0.91	32.6	15	RTF
HE Windows	Quantity of Windows	150	52.7	25	RTF
High Efficiency Furnace	Efficiency Value	0.96	43.4	20	RTF
Hot Water Pipe Insulation	Foot of Insulation	Unknown	2.0	20	PGW TRM 2023
Infiltration	SQFT	1,217	13.9	15	RTF
Thermal Doors	Unknown	Unknown	22.0	40	RTF
Wall Insulation	SQFT	694	28.8	45	RTF

Table 7-3 provides deemed measure savings resulting from the billing analyses. The regression savings were extrapolated to TMY X data using the latest available years of data (2018-2023). Extrapolating to TMY X ensures that savings are weather normalized to average expected weather in the region[11].

Table 7-3: Deemed Measure Savings, Billing Analysis

Measure	Measure Unit	Unit Energy Savings (Therms)	Source
Whole-home Cohort (PY2018-PY2022)	Home	104.0	2024 Billing Analysis
High Efficiency Furnace (PY2018-PY2022)	Unit	116.3	2024 Billing Analysis

[11] The Evaluators weighted TMY X weather (HDD) by the number of participants belonging to each of the weather stations utilized in the billing analysis.

8 APPENDIX C: DATA COLLECTION RECOMMENDATIONS

To determine more accurate savings for individual measures in future program years, the Evaluators recommend collecting information detailed in Table 8-1.

In general, the following data collection fields are useful fields to collect for every measure: measure quantity, baseline operating conditions and efficiency values, efficient measure operating conditions and efficiency values, measure descriptions, make and model number for baseline equipment, make and model number for efficient measure equipment, relevant square footage (e.g., whole home, conditioned/unconditioned space, amount installed), heating type, and cooling type.

Table 8-1: Recommended Data Collection Information

Measure	Recommended Data Collection
Ceiling Insulation	Square footage of installed insulation, baseline efficiency and installed efficiency (R-values)
Direct Vent Space Heater	Quantity, make and model number
Duct Insulation	Conditioned square footage of home, baseline efficiency and installed efficiency (R-values), heating and cooling type
Duct Sealing	Measure specification information (e.g., pre/post duct leakage rate), gas furnace efficiency (AFUE)
Faucet Aerators	Quantity, baseline efficiency, installed efficiency
Floor Insulation	Square footage of installed insulation, baseline efficiency, installed efficiency (R-values)
Furnace Tune-Up	Quantity, make and model number, furnace input capacity pre tune-up (Btuh), efficiency of furnace before and after tune-up
HE Water Heater	Quantity, make and model number
HE Windows	Quantity, baseline and efficient window type (e.g., single vs. double pane) baseline and efficient U-values, square footage of area associated with window install
High Efficiency Furnace	Quantity, make and model number
Hot Water Pipe Insulation	Linear footage of installed insulation, thickness of pipe insulation, inside circumference of the pipe, baseline efficiency and installed efficiency (R-values)
Infiltration	Measure specification information (e.g., CFM50 reduction), square footage of affected areas, heating and cooling type
Thermal Doors	Quantity, baseline and efficient door type & installed efficiency (R-Values), square footage of area associated with thermal door install
Wall Insulation	Square footage of installed insulation, baseline efficiency, installed efficiency (R-values)

9 APPENDIX D: SURVEY COLLECTION INSTRUMENTS

9.1 Participant Survey

Table 9-1: Overview of Data Collection Activity

DESCRIPTOR	THIS INSTRUMENT
Instrument Type	Survey
Estimated Time to Complete	10 Mins
Population Description	participants

Table 9-2: Research Objectives

RESEARCH QUESTION FROM PROPOSAL
Is customer service of high quality, timely, and effective?
Are marketing plans implemented per design and effective?
Are program materials effective and complete?
Are rebates/incentives appropriate for meeting program goals?
What are the market barriers that impede program reach?
Is the program reaching the intended hard to reach customers?
Are there remaining customers that qualify for the program have issues or barriers with participating in these programs?

9.1.1 RECRUITMENT SCRIPTS

9.1.1.1 Email Recruitment (Initial & Reminder 1 & 2)

SUBJECT LINE: NW Natural wants your feedback!

Dear **${e://Field/CONTACT_NAME}**,

NW Natural wants to better understand customers' experience with its energy-efficiency programs, potential barriers to participate in these programs, and general awareness of energy-efficiency offerings. NW Natural is evaluating all of this through ADM Associates (ADM), a national research firm specializing in energy research and program evaluation, which is also the sender of this email.

NW Natural is asking for your help to improve its programs by completing the survey linked below. The survey should take about 10 to 15 minutes to complete, and you will receive a **$10 electronic gift card** as a thank you for your time. Your responses will be completely confidential.

Click the link below to access the survey:
[Survey link]
Or copy and paste the URL below into your internet browser:
[Survey link]

We value your time and feedback. If you have questions or require assistance using the link, please reach out to us at surveyinfo@admenergy.com. If you have questions about how the data will be used, please contact CONTACT AT NW Natural.

Best,

ADM Associates / Contractor to Northwest Natural

Note: ADM conducts research to support research and evaluation in the energy sector. Survey data is not shared with third parties for marketing purposes. Our full privacy statement is available here: admenergy.com/privacy. If you would prefer to opt out of future emailing, follow the link provided: ${l://OptOutLink?d=Click here to unsubscribe}

9.1.2 SURVEY INSTRUMENT

Welcome! Thank you for taking this survey to tell us about your participation in NW Natural's energy-efficiency programs. Your feedback is very important to us and will help us improve programs for our customers. This survey should take 10 to 15 minutes. Your responses are confidential and will be used for research purposes only. If you have questions about how we treat collected data, please see ADM's privacy police at *https://www.admenergy.com/privacy*.

Once you have entered a response for each question, use the arrow at the bottom right of the screen to get to the next question.

9.1.2.1 Awareness

1. Our records indicate that you received energy-efficient equipment improvements through NW Natural at **[ADDRESS]**, in collaboration with your local community agency, in 2023. Is that correct? Upgrades may have included a new gas furnace, new insulation, and/or other energy-related improvements.
    1. Yes
    2. No, I received upgrades BUT my address is incorrect (Please provide correct address) **[OPEN-ENDED]**
    3. No, I did not receive any upgrades **[TERMINATE]**

2. How did you first learn about the NW Natural energy-efficiency program? Select all that apply **[MULTI-SELECT]**
    1. NW Natural mailer or bill insert
    2. NW Natural website
    3. NW Natural email
    4. Local Community Action Agency
    5. Latino Built
    6. African American Alliance for Homeownership (AAAH)
    7. Oregon Energy Fund
    8. Newspaper or magazine
    9. Radio
    10. Television

11. Internet search
12. Social media (e.g. Facebook, Instagram, Twitter/X, Tik Tok, etc.)
13. Contractor
14. Word of mouth (friend, family, colleague, neighbor, etc.)
15. Other – please explain **[OPEN-ENDED]**
16. I don't know

3. Did you receive any informational brochures or materials about the energy-efficiency program from NW Natural or your local community agency?
    1. Yes
    2. No

[DISPLAY IF Q3=1]

4. What type of equipment and/or services did the brochure cover? **[OPEN ENDED]**

[DISPLAY IF Q3=1]

5. How effective were those materials in getting you to think about purchasing more efficient equipment and/or upgrading your existing equipment? **[SCALE = 1 (NOT AT ALL) TO 5 (EXTREMELY)]**

[DISPLAY IF Q5=4, 5]

6. What did you find effective about those materials?

7. How could the materials have been improved to be more effective?

9.1.2.2 CAP Agency

In this section, we'd like to learn more about your experience working with the community agency that installed your energy-efficiency improvements.

8. How did you find the community action agency that installed your energy-efficiency improvements?
    1. Through a personal contact (friend, family, colleague, neighbor, etc.)
    2. Internet search
    3. Through another community agency (please describe) **[OPEN ENDED]**
    4. Other (please describe) **[OPEN ENDED]**

9. How did the agency describe the program to you and motivate you to apply? **[OPEN ENDED]**

10. Before applying for the program, did you have any concerns about the program or the energy-efficiency improvements?
    1. Yes
    2. No

[DISPLAY if Q10=1]

11. What were these concerns? **[OPEN ENDED]**

[DISPLAY if Q10=1]

12. How did the agency address your concerns? **[OPEN ENDED]**

9.1.2.3 Participation

13. Why did you decide to participate in the program? **[OPEN ENDED]**

14. When thinking about making energy-efficiency improvements or purchases, what factors, if any, do you consider when making your decision? **[OPEN ENDED]**

15. Please rank the following reasons you might consider when making improvements to your home, in order of importance to you:
    1. Increase your home's energy efficiency
    2. Improve your comfort in your home
    3. Improve your health and safety in your home
    4. Increase home value

9.1.2.4 Assessment

16. As part of your participation in the program, you received an energy assessment of your home. Do you remember receiving this assessment?
    1. Yes
    2. No
    3. I don't remember

[DISPLAY IF Q16=1]

17. After the assessment, did the assessor provide you with a list of findings and recommendations for home improvements?
    1. Yes
    2. No
    3. I don't remember

[DISPLAY IF Q16=1]

18. Were there any recommendations from your assessment that you **DID NOT** act on?
    1. Yes. Please explain **[OPEN ENDED]**
    2. No
    3. I don't remember

[DISPLAY IF Q19=1]

19. Why did you choose not to act on those recommendations? **[OPEN ENDED]**

[DISPLAY IF Q16=1]

20. How satisfied are you with each of the following? **SCALE: 1=STRONGLY DISSATISFIED, 2=SOMEWHAT DISSATISFIED, 3=NEITHER SATISFIED NOR DISSATISFIED, 4=SOMEWHAT SATISFIED, 5=STRONGLY SATISFIED]**
    1. The professionalism of the assessor

2. The thoroughness of the assessment
3. The recommendations provided in the assessment
4. The assessment overall

[DISPLAY IF Q20<3]
21. You indicated some dissatisfaction, please explain. **[OPEN-ENDED]**

9.1.2.5 Contractor

In this section, we will ask you about your experience with the contractor who made the energy-efficiency improvements to your home.

22. How did you find the contractor who installed the energy-efficiency improvements?
    1. NW Natural representative referred me to the contractor
    2. Community agency representative referred me to the contractor
    3. The contractor was someone I've worked with before
    4. Through a personal contact (friend, family, colleague, neighbor, etc.)
    5. Internet search
    6. Other – please describe **[OPEN-ENDED]**
    7. I don't know

23. Please rate your agreement with the following statements regarding your experience with your contractor **[SCALE: 1=STRONGLY DISAGREE, 2=SOMEWHAT DISAGREE, 3=NEITHER AGREE NOR DISAGREE, 4=SOMEWHAT AGREE, 5=STRONGLY AGREE]**
    1. The contractor was courteous
    2. The contractor was professional
    3. The work was scheduled in a reasonable amount of time
    3. The time it took to complete the work was reasonable

[DISPLAY IF Q23<3]
24. You indicated some disagreement. Why do you disagree? **[OPEN-ENDED]**

9.1.2.6 Equipment

Next, we would like to confirm the type of equipment you received from the energy-efficiency program.

25. NW Natural records say that you received the following equipment and/or improvements. Is this correct? **[OPTIONS: Yes, No, Don't know]**
    1. Heating and cooling equipment (e.g. furnace, fireplace, HVAC system)
    2. Thermostat(s)
    3. Weatherization improvements (insulation, duct sealing, etc.)
    4. Other – please specify **[OPEN-ENDED]**

26. Are these improvements still installed and working?
    1. Yes
    2. No

[DISPLAY IF Q26=2]

27. What happened to the improvements that are no longer installed and/or working? **[OPEN ENDED]**

28. Were there additional energy-efficiency improvements you wanted, but did not receive? Please describe.
    1. No
    2. Yes **[OPEN ENDED]**

9.1.2.7 Satisfaction

In this section, we will ask about your overall satisfaction with the program.

29. Please rate your level of satisfaction with the following **[SCALE: 1=NOT AT ALL SATISIFED, 2=SOMEWHAT DISSATISFIED, 3=NEITHER SATISFIED NOR DISSATISFIED, 4=SOMEWHAT SATISFIED, 5=VERY SATISFIED]**
    1. The amount of the rebate you received
    2. The time it took to receive your rebate
    3. Your experience with the program overall
    5. NW Natural as your natural gas provider

[DISPLAY IF Q29<3]

30. You expressed some dissatisfaction. Why are you dissatisfied? **[OPEN-ENDED]**

31. Would you say that your participation in the energy-efficiency program has…
    1. Greatly decreased your satisfaction with NW Natural
    2. Somewhat decreased your satisfaction NW Natural
    4. Somewhat increased your satisfaction with NW Natural
    5. Greatly increased your satisfaction with NW Natural

32. How likely are you to recommend the energy-efficiency program to others?
    1. Not at all likely
    2. Somewhat likely
    3. Moderately likely
    4. Very likely
    5. Extremely likely

33. How trustworthy is NW Natural as a source of information about saving energy in your home?
    1. Not at all trustworthy
    2. Somewhat trustworthy
    3. Moderately trustworthy
    4. Very trustworthy
    5. Extremely trustworthy

34. Is there any other feedback you would like to provide to NW Natural and/or the community agency you worked with?
    1. No
    2. Yes **[OPEN ENDED]**

9.1.2.8 Demographics and Residence Characteristics

This last set of questions are about your home.

35. Do you rent or own your home?
    1. Own
    2. Rent
    3. Own, and rent out to someone else
    4. Prefer not to answer

36. Which of the following best describes your home?
    1. Single-family home
    2. Manufactured or mobile home
    3. Duplex or townhome
    4. Apartment or condominium
    5. Other – please specify **[OPEN-ENDED]**
    4. Prefer not to answer

37. Approximately when was your home built?
    1. Before 1960
    2. 1960 to 1979
    3. 1980 to 1989
    4. 1990 to 1999
    5. 2000 to 2009
    6. 2010 or later
    7. I don't know
    8. Prefer not to answer

38. About how many square feet is your home? If you are unsure, an estimate is okay.
    1. Less than 1,000 square feet
    2. 1,000 to 1,999 square feet
    3. 2,000 to 2,999 square feet
    4. 3,000 to 3,999 square feet
    5. 4,000 square feet or more
    6. I don't know
    7. Prefer not to answer

39. What is your age?
    1. 18 to 24
    2. 25 to 34

3. 35 to 44
4. 45 to 54
5. 55 to 64
6. 65 to 74
7. 75+
8. Prefer not to answer

40. Which of the following best describes you? Please select all that apply **[MULTI-SELECT]**
    1. American Indian or Alaska Native
    2. East Asian (e.g. Chinese, Filipino, Asian Indian, Vietnamese, Korean, Japanese)
    3. South Asian (e.g. Asian Indian, Pakistani, Bangladeshi)
    4. Black or African American
    5. Hispanic, Latino or Spanish origin
    6. Native Hawaiian or Pacific Islander
    7. Middle Eastern or North African
    8. White or Caucasian
    9. A race, ethnicity or origin not listed above– please specify **[OPEN-ENDED]**
    10. Prefer not to answer

41. What is the highest level of education you have completed?
    1. High school graduate or GED
    2. Associates degree, vocational/technical school, or college
    3. Four-year college degree
    4. Graduate or professional degree
    98. I don't know
    99. Prefer not to answer

42. What county do you live in?
    1. Benton, OR
    2. Clackamas, OR
    3. Clatsop, OR
    4. Columbia, OR
    5. Coos, OR
    6. Hood River, OR
    7. Lane, OR
    8. Lincoln, OR
    9. Linn, OR
    10. Marion-Polk, OR
    11. Multnomah, OR
    12. Washington, OR
    13. Yamhill, OR
    14. Clark, WA

43. Including yourself, how many people live in your home year-round?

1. 1 person
2. 2 people
3. 3 people
4. 4 people
5. 5 people
6. 6 people
7. 7 people
8. 8 or more people
9. Prefer not to answer

44. Including all money earned from wages, salaries, tips, commissions, workers' compensation, unemployment insurance, child support, or other sources, did your household make more than the following amount of money in 2023? **[MATRIX OPTIONS: The same amount or less, More, I don't know]**
    1. **IF Benton, OR** -- $108,000
    2. **IF Clackamas, OR** -- $118,000
    3. **IF Clatsop, OR** -- $92,300
    4. **IF Columbia, OR** -- $118,000
    5. **IF Coos, OR** -- $80,900
    6. **IF Hood River, OR** -- $97,900
    7. **IF Lane, OR** – $89,100
    8. **IF Lincoln, OR** -- $80,900
    9. **IF Linn, OR** -- $84,900
    10. **IF Marion-Polk, OR** -- $91,300
    11. **IF Multnomah, OR** -- $118,000
    12. **IF Washington, OR** -- $118,000
    13. **IF Yamhill, OR** -- $118,00
    14. **IF Clark, WA** -- $94,400

9.1.2.9 Thank You!

Thank you for taking time today to complete this survey. As stated in the email, we are providing a **$10 electronic gift card** as a thank you for your responses. You should receive this gift card in the next 3 to 5 business days; the email will be from Tango Rewards. The email address we have on file for you is **[EMAIL]**. Please confirm this information.

1. Yes, please send my electronic gift card to the above email address
2. No, please send my electronic gift card to the following email address **[OPEN-ENDED]**

9.2 Non-Participant Survey

Table 9-3 Overview of Data Collection Activity

DESCRIPTOR	THIS INSTRUMENT

Instrument Type	Survey
Estimated Time to Complete	10 Mins
Population Description	Nonparticipants

Table 9-4 Research Objectives

RESEARCH QUESTION FROM PROPOSAL
Is customer service of high quality, timely, and effective?
Are marketing plans implemented per design and effective?
Are program materials effective and complete?
Are rebates/incentives appropriate for meeting program goals?
What are the market barriers that impede program reach?
Is the program reaching the intended hard to reach customers?
Are there remaining customers that qualify for the program have issues or barriers with participating in these programs?

9.2.1 RECRUITMENT SCRIPTS

9.2.1.1 Email Recruitment (Initial & Reminder 1 & 2)

SUBJECT LINE: NW Natural wants your feedback!

Dear **${e://Field/CONTACT_NAME}**,

NW Natural hired ADM Associates, an independent research and evaluation firm, to gather feedback about its services and programs from residential customers like you. We would like to hear from 200 people by **[DATE TBD]**. Can you be one of those who help us reach that goal by answering a few quick questions about your experience with NW Natural? The survey should take about **10 minutes**. After you complete the survey, we will send you a **$10 e-gift card** that can be used at a variety of retailers as our way of saying thanks.

Your responses will be kept anonymous and completely confidential.

Click the link below to access the survey:
[Survey link]
Or copy and paste the URL below into your internet browser:
[Survey link]

We value your time and feedback. If you have questions or require assistance using the link, please reach out to us at surveyinfo@admenergy.com. If you have questions about how the data will be used, please contact CONTACT AT NW NATURAL.

Kind Regards,

ADM Associates / Contractor to NW Natural

Note: ADM conducts research to support research and evaluation in the energy sector. Survey data is not shared with third parties for marketing purposes. Our full privacy statement is available here: admenergy.com/privacy. If you would prefer to opt out of future emailing, follow the link provided: ${l://OptOutLink?d=Click here to unsubscribe}

9.2.2 SURVEY INSTRUMENT

9.2.2.1 Introduction

Thank you for agreeing to provide your feedback about your experience with NW Natural's services and programs. To start, we have a few questions about your awareness of NW Natural's programs and services. Your feedback is very important to us and will help us improve programs for customers like you. This survey should take 10-15 minutes.

Your responses are confidential and will be used for research purposes only. If you have questions about how we treat collected data, please see ADM's privacy policy at admenergy.com/privacy.

9.2.2.2 Screening

Q2. According to our records, NW Natural provides natural gas to your residence at [ADDRESS]. Is that correct?

1. Yes
2. Yes, but address is incorrect **[OPEN-ENDED: CORRECT ADDRESS]**
3. No **[TERMINATE]**

Q3. We understand that it is not always possible to make improvements to your home. Which of the following best describes your authority to make decisions?

1. No authority – as a renter, I am not allowed to make improvements **[TERMINATE]**
2. Some authority – as a renter, I am allowed to make some improvements
3. Full authority – I am the owner
4. Full authority – as part of my rental agreement, I am required to maintain/repair the home

Q4. To the best of your knowledge, have you replaced or upgraded equipment that requires gas, in the last three years? This could have been heating/cooling equipment, weatherization improvements (eg. insulation, duct sealing, etc.), or water heating equipment.

1. Yes
2. No
3. I don't know

[DISPLAY IF Q3=1]

Q5. What types of equipment or improvements did you replace in the last three years? Select all that apply **[MULTI-SELECT]**

1. Heating and cooling equipment (e.g. furnace, fireplace, HVAC system)
2. Efficient appliances (e.g. washer, dryer, range)
3. Thermostat(s)

4. Weatherization improvements (e.g. insulation, duct sealing, etc.)
5. Water heating equipment
7. Other – please specify [OPEN-ENDED]

[DISPLAY IF Q3=1]

Q6. Did you receive an incentive from NW Natural for any of that equipment?
1. Yes **[SKIP TO END, TERMINATE]**
2. No
3. Don't know

Q7. Have you participated in a NW Natural-sponsored bill assistance program?
1. Yes
2. No

Q8. Why haven't you participated in any of NW Natural's programs? Select all that apply **[MULTI-SELECT]**
1. I have not needed to replace any of my gas equipment or make weatherization improvements
2. I did not know enough about the programs and incentives
3. Energy savings from the equipment replacements or improvements was not worth the trouble
4. Too much time or trouble to receive the incentives
5. Prefer not to work with NW Natural
6. Incentives are not high enough to offset the cost of high-efficiency equipment, compared to standard-efficiency equipment
7. I am financially able to make the improvements without the incentives
8. I don't have the authority to participate in any NW Natural programs
9. Other – please specify **[OPEN-ENDED]**
10. I don't know

9.2.2.3 Program Awareness

[ASK ALL]

Q9. Before today, had you heard that NW Natural offers a weatherization (e.g. insulation, duct sealing, air sealing, etc.) and furnace-replacement program in collaboration with local community agencies?
1. Yes
2. No

[ASK IF Q9 =1, Yes]

Q10. How did you learn about NW Natural's weatherization and furnace-replacement offerings? **[OPEN-ENDED]**
1. Mailed information from NW Natural

2. Email from NW Natural
3. NW Natural program staff
4. NW Natural website
5. Community agency representative
6. Community-based organization representative
7. Newspaper or magazine article or advertisement
8. Contractor
9. Word of mouth from a personal contact (e.g., family member, friend, neighbor, colleague, etc.)
10. Radio advertisement
11. Another website
12. Social media (e.g. Facebook, Instagram, Twitter, Tik Tok, etc.)
13. Information at a retailer
14. Other, please specify: _____

[DISPLAY IF Q9=1]

Q11. What programs or services were you already aware of? Select all that apply **[MULTI-SELET]**

1. Bill assistance programs
2. Incentives for heating and cooling equipment (e.g. furnaces, fireplaces, HVAC systems)
3. Incentives for building shell improvements and weatherization (e.g. pipe wrap insulation, attic insulation)
4. Incentives for water heating equipment
5. Incentives for smart/programmable thermostats
6. Incentives for efficient appliances (e.g. washer, dryer, range)
7. Other – please specify **[OPEN-ENDED]**
8. I don't remember

Q12. Are you interested in making energy-efficiency improvements and participating in a NW Natural energy-efficiency program?

1. Yes
2. No

[DISPLAY IF Q12=1]

Q13. What energy-efficiency improvements or programs are you interested in? Select all that apply **[MULTI-SELECT]**

1. Heating/cooling equipment
2. Water heating equipment
3. Smart/programmable thermostats
4. Efficient appliances (e.g. washer, dryer, range)
5. Home weatherization (e.g. pipe wrap insulation, attic insulation, insulated door)
6. Other – please specify **[OPEN-ENDED]**

[DISPLAY IF Q12=1]

Q14. How soon do you plan to replace the equipment?

1. In the next year
2. In the next 1-2 years
3. In the next 2-4 years
4. More than 4 years from now
5. I don't know

9.2.2.4 Participation Barriers

Q15. On a scale of 1 through 5, where 1 means "not at all interested" and 5 means "very interested", how interested are you in participating in NW Natural's energy-efficiency programs?

1. 1 – Not at all interested
2. 2
3. 3
4. 4
5. 5 – Very interested

Q16. What might prevent you from participating in a NW Natural's program? **[OPEND ENDED]**

Q17. Are there any changes NW Natural can make to its programs to encourage you to participate? **[OPEN ENDED]**

9.2.2.5 End Uses

Q18. What do you think is the largest energy user in your home?

1. Heating/cooling equipment
2. Water heating equipment
3. Appliances (clothes washer/dryer, range, etc.)
4. Refrigeration
5. Other – please specify **[OPEN-ENDED]**

Q19. What type of heating system do you currently have in your home?

1. Gas furnace
2. Gas fireplace
3. Heat Pump
4. Mini split
5. Electric resistance (e.g. baseboard)
6. I don't heat the home

7. I don't know

Q20. What is the main fuel used to heat your home?

1. Electricity
2. Natural Gas
3. Propane
4. Other, please specify: _____
5. I don't heat my home
6. I don't know
7. Prefer not to answer

[SKIP IF 0=5 OR 98]

Q21. Approximately how old is the heating system?

1. Less than 10 years old
2. 10 to 20 years old
3. More than 20 years old
4. I don't know

Q22. When was the last time your heating system was serviced?

1. Less than 1 year ago
2. 1 to 3 years ago
3. More than 3 years ago
4. It's never been serviced
5. I don't know

Q23. What type of thermostat do you use?

1. Manual
2. Programmable
3. Smart thermostat
4. I don't know

9.2.2.6 Demographics

This last set of questions will help NW Natural develop more effective programs that may best serve the needs of the community. Your answers will remain anonymous, so no information will be linked with you or your household. You may choose "Prefer not to answer."

Q24. Do you own or rent the home at **${e://Field/ADDRESS}**?

1. Own
2. Rent
3. Own and rent to someone else
4. Prefer not to answer

[DISPLAY IF Q24 = 1 OR 3]

Q25. When was your home built?

1. Before 1950
2. 1950 to 1959
3. 1960 to 1969
4. 1970 to 1979
5. 1980 to 1989
6. 1990 to 1999
7. 2000 to 2009
8. 2010 to 2019
9. 2020 to Present
10. I don't know
11. Prefer not to answer

Q26. Which best describes your home?

1. Single-family house detached
2. Single-family house attached to one or more other houses (e.g., duplex, condominium, townhouse, etc.)
3. Mobile or manufactured home
4. Apartment with 2 to 4 units
5. Apartment with 5 or more units
6. Other, please specify: _____
7. Prefer not to answer

Q27. What county do you live in?

1. Benton, OR
2. Clackamas, OR
3. Clatsop, OR
4. Columbia, OR
5. Coos, OR
6. Hood River, OR
7. Lane, OR
8. Lincoln, OR
9. Linn, OR
10. Marion-Polk, OR
11. Multnomah, OR
12. Washington, OR
13. Yamhill, OR
14. Clark, WA

Q28. Including yourself, how many people live in your home year-round?

1. 1 person
2. 2 people
3. 3 people
4. 4 people
5. 5 people
6. 6 people
7. 7 people
8. 8 or more people
9. Prefer not to answer

Q29. Including all money earned from wages, salaries, tips, commissions, workers' compensation, unemployment insurance, child support, or other sources, did your household make more than the following amount of money in 2023? **[MATRIX OPTIONS: The same amount or less, More, I don't know]**

1. **IF Benton, OR** -- $108,000
2. **IF Clackamas, OR** -- $118,000
3. **IF Clatsop, OR** -- $92,300
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6. **IF Hood River, OR** -- $97,900
7. **IF Lane, OR** – $89,100
8. **IF Lincoln, OR** -- $80,900
9. **IF Linn, OR** -- $84,900
10. **IF Marion-Polk, OR** -- $91,300
11. **IF Multnomah, OR** -- $118,000
12. **IF Washington, OR** -- $118,000
13. **IF Yamhill, OR** -- $118,00
14. **IF Clark, WA** -- $94,400

Q30. What is the highest level of education you have completed?

1. Did not graduate high school
2. High school graduate
3. Associates degree, vocation/ technical school, or some college
4. Four-year college degree
5. Graduate or professional degree
6. Prefer not to answer

9.2.2.7 Customer Information and Thank You Page

Q31. This is the end of the survey. As a thank you for your time answering our questions, NW Natural would like to provide you with a $10 MasterCard gift card.

The email address we have for you is **${e://Field/RecipientEmail}**. Please let us know if you would like us to send your electronic gift card to this address or a different address.

1. Please send my electronic gift card to the **above** email address
2. Please send my electronic gift card to the **following** email address:

_____