



Evaluation of BPA's Performance Tested Comfort System (PTCS) Program

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EXECUTIVE SUMMARY

PROGRAM BACKGROUND

The Bonneville Power Administration (BPA), a federal agency based in the Pacific Northwest, markets wholesale electrical power in the region. BPA has taken responsibility for the public power share of the Northwest Power and Conservation Council (NWPPCC) targets. To support that responsibility, BPA promotes energy efficiency by administering conservation funding and third-party programs designed to save energy and help its utility customers reach the energy efficiency targets set forth by the NWPPCC. One such third-party program, geared to the residential sector, is an HVAC offering based on the Performance Tested Comfort System (PTCS) protocols.

Performance Tested Comfort Systems is a training, certification, and quality control protocol for the installation and optimization of ducted heat pumps and duct systems. In the late 1990s, the Northwest Energy Efficiency Alliance (NEEA) developed PTCS as a residential energy-efficient HVAC specification program. NEEA also created an independent nonprofit called *Climate Crafters* to develop the market for PTCS, but after several years of struggling to meet business plan goals, NEEA ceased funding the *Climate Crafters* venture in 2005. However, BPA believed in the regional value of PTCS and took on its administration; BPA began offering PTCS as a residential HVAC certification program option to its utility customers in 2006.

Since BPA took over administration of PTCS in 2006, program participation has grown steadily, with over 10,000 PTCS jobs completed in 2010. PTCS certification training has been successful in reaching a wide audience of HVAC contractors (over 2,000), with more than 750 contractors currently participating.

RESEARCH APPROACH

BPA contracted with Research Into Action, Inc. to conduct an evaluation to support BPA's ongoing programmatic review of PTCS, and to inform future decisions around the design and implementation of the program. In particular, BPA sought information to help them:

- ➔ Increase PTCS measure activity
- ➔ Increase stakeholder satisfaction with the PTCS program
- ➔ Increase program functionality for contractors
- ➔ Understand and mitigate program barriers
- ➔ Reduce program costs



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→ Improve the program's evaluability

For this evaluation, we contacted PTCS program and HVAC market actors to understand and assist BPA in mitigating any program barriers that PTCS may be experiencing. We surveyed three key audiences, including: in-depth interviews with program stakeholders (n=8)¹; in-depth interviews and email surveys with participating utility program managers (n=42); and in-depth interviews and email surveys with participating trade allies (n=119). Through these surveys and interviews, we collected information aimed at supporting BPA's ongoing programmatic review, and, in particular, to identify ways to improve satisfaction with PTCS and increase PTCS measure activity.

KEY FINDINGS AND RECOMMENDATIONS

For this evaluation, we talked to several PTCS program and HVAC market actors to understand and assist BPA in mitigating any program barriers that PTCS may be experiencing. Through interviews and surveys with key audiences – program stakeholders, participating utility program managers, and participating trade allies – we collected information aimed at supporting BPA's ongoing programmatic review and, in particular, to identify ways to improve satisfaction with PTCS and increase PTCS measure activity.

Our study found that program participants widely believe that the PTCS approach to heat pump installations and duct sealing is more effective at saving energy over non-performance-based approaches. However, program participants – both utility program managers and trade allies – gave relatively low satisfaction ratings to several program aspects and offered thoughts and suggestions about ways in which PTCS could be improved.

After careful review of all the research, we have identified four key program elements that underlie many of the implementation challenges.

- **Conclusion: The technical complexity of PTCS requires easily accessible, knowledgeable, and reliable technical support.** BPA formed PTCS to be run by a third-party implementer, whose job was originally designed primarily as database administration and on-site QA/QC. When contractors have run into technical questions, they historically have turned to their utility for answers. However, not all utilities have the staff resources to meet this need and consistency in technical support across utility territories could improve trade ally understanding of how to meet the specifications in the field.

¹ For the purposes of this evaluation, stakeholders are defined as deeply knowledgeable people working with the PTCS program and specifications, including BPA program staff, implementation staff, PTCS trainers, engineering consultants and local university staff.



- **Recommendation: Create a technical support mechanism that will enable contractors throughout the region to have access to reliable technical support.**
Regardless of location or utility service territory, PTCS trade allies should have equal access to consistent, knowledgeable HVAC experts who can help them make decisions in uncertain situations on the job.

- ➔ **Conclusion: Many program participants (both utility managers and trade allies) believe that the PTCS program is unnecessarily complex.** Program actors routinely expressed a desire to simplify many aspects of the program, including focusing program specifications on what's most important to obtain energy savings in this climate zone, simplifying reporting requirements, and making the PTR measure list more user-friendly. In addition, some program participants perceive that program specifications are frequently changing, which leads to confusion. Finally, trade allies have noted that some of the program's reference documents containing specifications and other helpful materials are either located on BPA's PTCS website or the RTF website, but not on both. This makes it further complicated to keep track of information.

- **Recommendation: Identify program areas where complexity can be reduced.**
Examine program attributes with the help of a new program logic model to determine which elements are most critical, in distinction from those that are "nice to have."

- **Recommendation: Ensure consistency between the links, resources, and support documents that are available on BPA's PTCS website and those on the RTF website.**

- **Recommendation: Create a PTCS logic model to explicitly outline how program activities map to desired outcomes.** A PTCS logic model would also help clarify program goals (for example, *to establish proficiency with duct-testing equipment* versus *to achieve optimal duct sealing technique in the market*).

- ➔ **Conclusion: Although two utilities in the Northwest offer a prescriptive duct sealing program, there is no research to estimate the relative impacts of prescriptive vs. performance duct sealing approaches.** The only duct sealing measure recognized by the Regional Technical Forum, the PTCS duct sealing protocol, requires test-in/test-out duct leakage measurements that are relatively labor intensive and time consuming. The PTCS duct sealing protocol requires a multi-day training course, as well as the use of complex leakage testing equipment requiring substantial training time in its application. An alternative approach is prescriptive duct sealing, which some utilities and stakeholders in the region favor. Impact evaluation numbers for prescriptive duct sealing installations will be available in 2011; a PTCS impact assessment would allow the actual field savings to be compared.

- **Recommendation: Review the results of the upcoming impact evaluation for a prescriptive duct sealing program at one Northwest utility and consider conducting an impact evaluation of the PTCS duct sealing protocol to compare**



results with the prescriptive program. In addition, assess the cost implications of both implementation approaches.

- ➔ **Conclusion:** While trade allies value the credibility PTCS testing and quality control provides to their customers, many have expressed dissatisfaction with the program's QA/QC protocol. Trade allies expressed several frustrations with the QA/QC process, including: that it's too lax; concern that inspectors are not always knowledgeable; the perception that QA is "spotty" and inconsistent; and a sense that coordination with utility inspections could be improved.
- **Recommendation:** Review the quality assurance/quality control processes for PTCS, including inspector training and qualifications, consistency across inspections, and coordination between the implementation contractors and local utilities.



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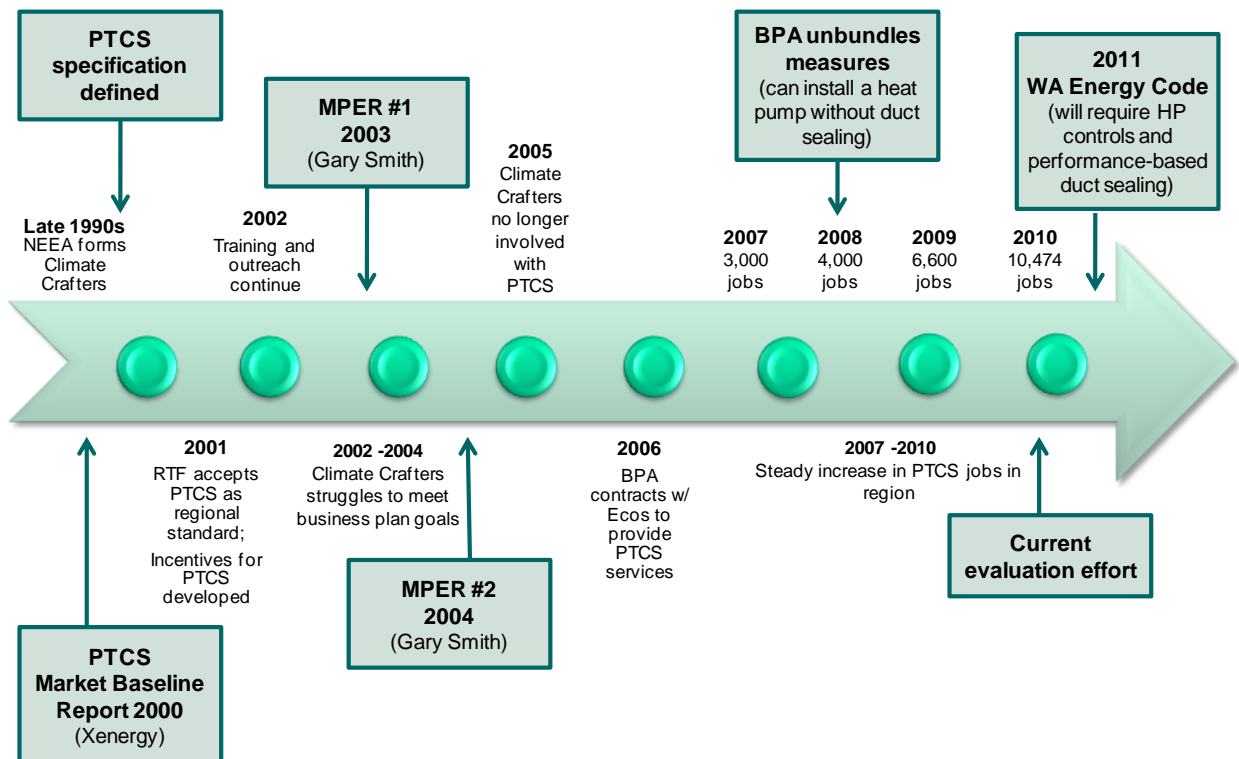
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INTRODUCTION

The Bonneville Power Administration (BPA), a federal agency based in the Pacific Northwest, markets wholesale electric power in the region. As part of its responsibilities, BPA promotes energy efficiency by administering incentive programs designed to save energy and help its utility customers reach the energy efficiency targets set forth by the Northwest Power and Conservation Council (NWPCC). One such residential program is Performance Tested Comfort Systems (PTCS). BPA contracted with Research Into Action, Inc. to evaluate PTCS.

Performance Tested Comfort Systems is a training, certification, and quality control program for the installation and optimization of ducted heating and cooling systems, based on a collection of technical specifications and provider standards that reside with the Regional Technical Forum (RTF). Figure 1.1 presents the evolution of PTCS since its inception.

Figure 1.1: PTCS Timeline



In the late 1990s, the Northwest Energy Efficiency Alliance (NEEA) developed PTCS as a residential energy-efficient HVAC specification program. NEEA also created an independent nonprofit called *Climate Crafters* to develop the market for PTCS, but after several years of



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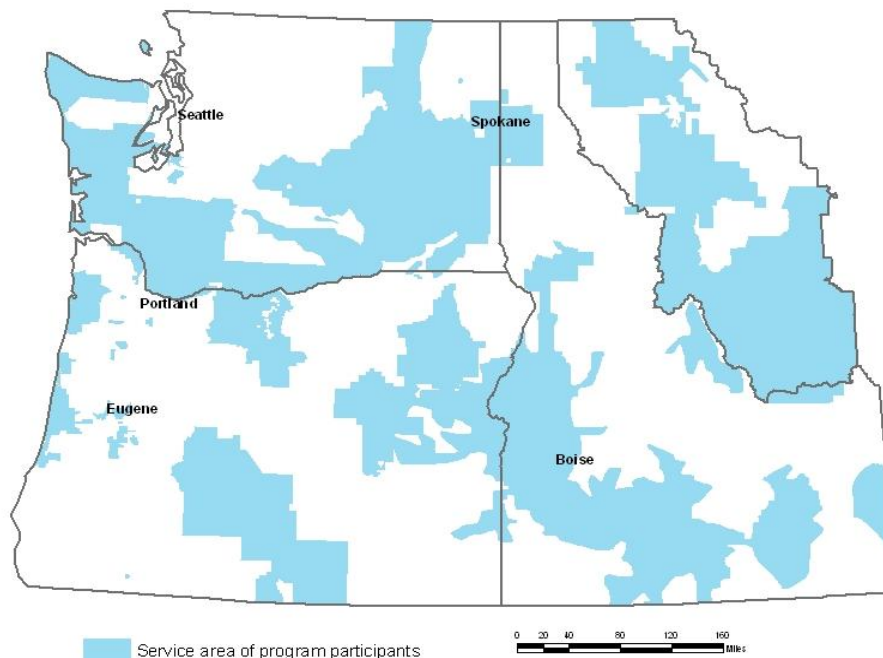
struggling to meet business plan goals, NEEA ceased funding the *Climate Crafters* venture in 2005. However, BPA believed in the potential value of PTCS to the region and took on administration of the program. BPA began offering PTCS as a residential HVAC program option to its utility customers in 2006. From 2006 through 2010, PTCS has trained over 2,000 contractors across the region.

Prior to offering PTCS, BPA offered a large incentive for stand-alone heat pumps without installation or duct sealing requirements. However, the RTF determined that it is not enough to simply *install* an efficient heat pump – there are several steps that must occur to achieve the full energy savings of the technology. For these reasons, BPA took over PTCS in 2006 and refined the program to include:

- ➔ **Training and certification of HVAC contractors**
- ➔ **A heat pump installation protocol** – including unit sizing, commissioning (Cx), and controls requirements (including a provision to lock out backup heat above 35°F)
- ➔ **A performance-based duct sealing protocol** – requiring one of two paths (see *PTCS Duct Sealing in Chapter 4*)
- ➔ **Minimum efficiency ratings on heat pump units**

Figure 1.2 shows the current BPA areas serviced by PTCS.

Figure 1.2: PTCS Service Territories

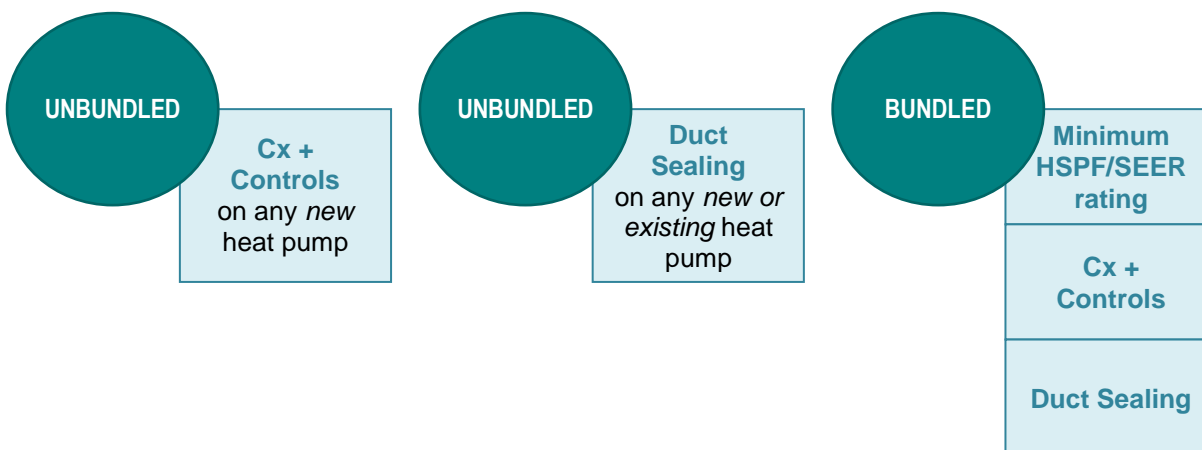


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From 2006 to 2008, only the bundled measure of an efficient heat pump (8.5+ HSPF² and 14+ SEER³) *plus* PTCS Commissioning & Controls *plus* PTCS Duct Sealing (where duct sealing was applicable) qualified for the BPA incentive. However, in 2008, PTCS participation lagged behind program goals, and BPA unbundled these measures to enable greater flexibility in program design for its customers and to provide additional business opportunities for HVAC trade allies. Figure 1.3 shows the current bundled and unbundled measure options for PTCS.

Figure 1.3: PTCS Installation Options as of 2008



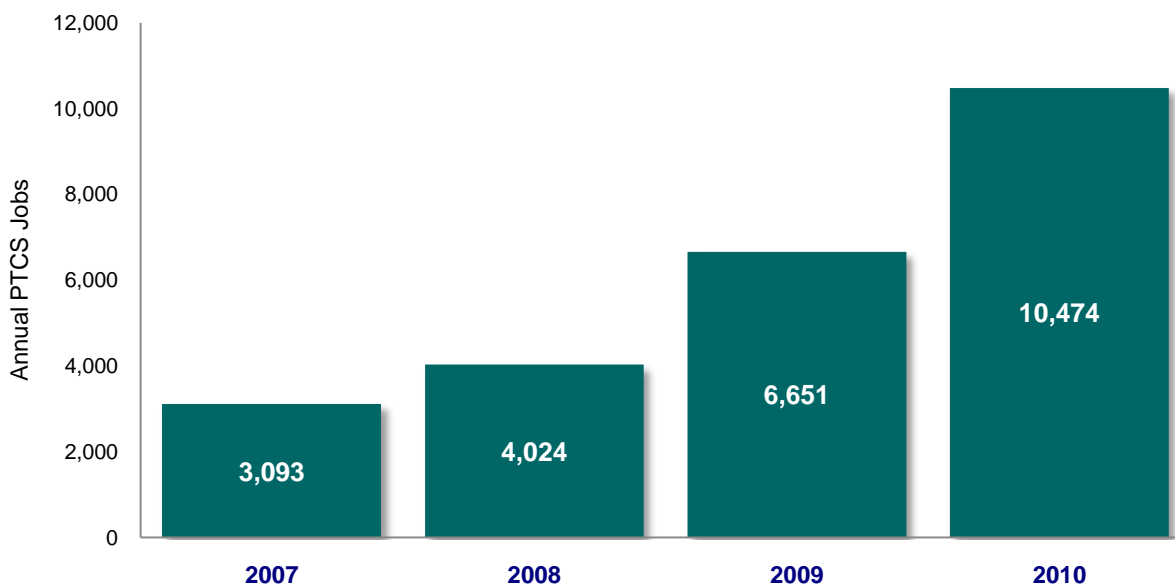
Under BPA's administration, participation in PTCS has grown steadily each year. The unbundling of measures in 2008, together with higher efficiency goals associated with the 6th Power Plan, appears to have contributed to significant increases in participation between years 2008, 2009, and 2010.

Figure 1.4 shows the number of PTCS jobs completed per year since BPA began managing the program.

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- ² *Heating Seasonal Performance Factor* – the heat output over the heating season divided by the total energy input in watt-hours during the same period. The higher a unit's HSPF rating, the more energy efficient it is.
- ³ *Seasonal Energy Efficiency Ratio* – the cooling output in Btu during a typical cooling season divided by the total electric energy input in watt-hours during the same period.



Figure 1.4: PTCS Jobs by Year



STUDY GOALS AND APPROACH

We undertook this evaluation to support BPA’s ongoing programmatic review of PTCS, and to inform future decisions around the design and implementation of the program. In particular, BPA sought information to help them:

- ➔ Increase PTCS measure activity
- ➔ Increase stakeholder satisfaction with the PTCS program
- ➔ Increase program functionality for contractors
- ➔ Understand and mitigate program barriers
- ➔ Reduce program costs
- ➔ Improve the program’s evaluability

Interviews and surveys with key program participants and market actors were at the heart of our approach to this research. In addition to these core audiences, we also interviewed: two Northwest utilities offering prescriptive duct sealing programs; non-participating trade allies; and several national “peer utilities” to learn about other methods for implementing energy efficiency programs for ducted heating and cooling systems. To strengthen our understanding of the program, we augmented our primary research with a review of PTCS program documents and training materials, as well as regional and national HVAC program literature.



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Chapter 2 of this report outlines the research methodology used for this evaluation, Chapter 3 reviews cost-effectiveness assumptions, Chapter 4 provides key research findings, Chapter 5 reviews program training materials, and Chapter 6 offers conclusions and recommendations.



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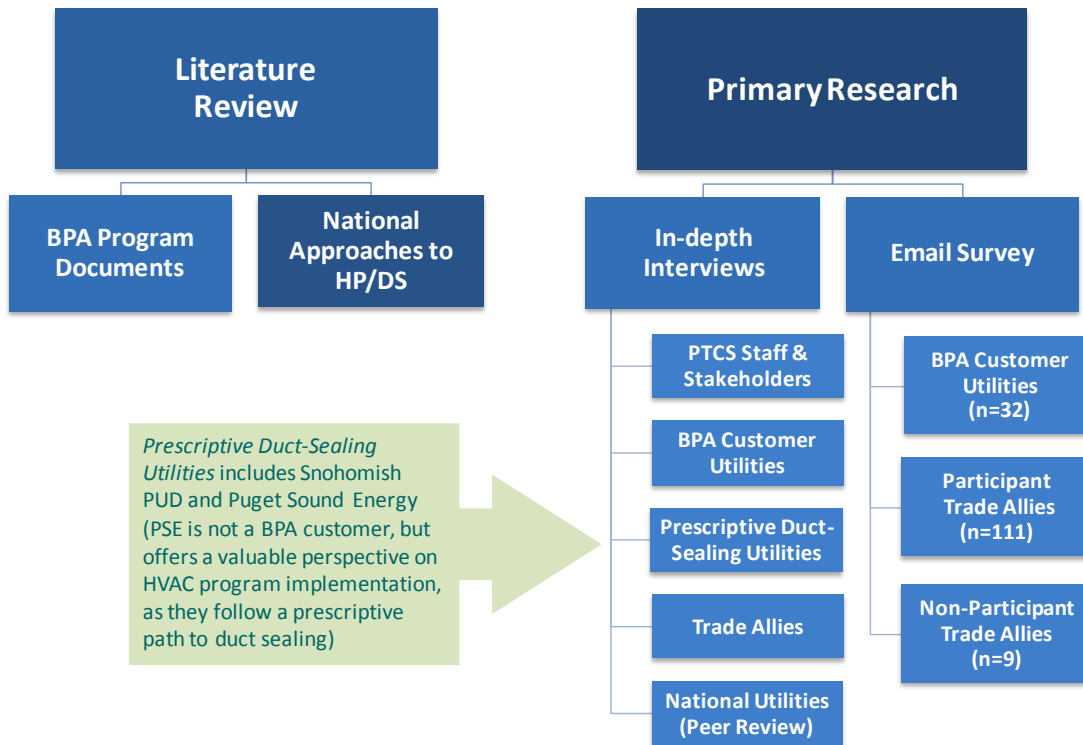
RESEARCH METHODOLOGY

This chapter describes our data collection activities for the evaluation, including literature review, in-depth interviews, and email surveys. For our primary research, we describe the number and type of surveys and interviews conducted, and the audiences with whom they occurred. Survey dispositions are also included in this section.

RESEARCH ACTIVITIES

Figure 2.1 illustrates our research activities for this evaluation.

Figure 2.1: Research Method



As with any research, we faced a tension in data collection between learning a great deal about a small set of individuals and learning less detailed information about a larger, more representative sample. We addressed this tension by combining both approaches for two key audiences: PTCS participating utilities and trade allies. For these contacts, we aimed to conduct in-depth interviews with 10 contacts and complete email surveys with at least 20 contacts. In fact, we



were able to complete all 10 in-depth interviews with both audiences, 32 email surveys with utilities, and 111 email surveys with trade allies. We also conducted in-depth interviews with program stakeholders (n=8),⁴ national peer utilities (n=3), and prescriptive duct-sealing utilities (n=2).

It is important to note that the goal of this research was to gather perspectives from these audiences on the PTCS protocol, which contains some highly technical elements. However, the research and findings of this evaluation are not intended as a technical assessment of the protocol itself.

Figure 2.1 presents the audiences we talked to and the research objectives associated with each.

Table 2.1: Primary Data Collection: Modes and Objectives

Audience	Mode	Research Objective – To Learn More About...
PTCS Stakeholders	In-depth interviews	<ul style="list-style-type: none"> • Program background • How goals were established • Program design, implementation and functionality • PTCS challenges • Recommendations for improvement
Utility HVAC Program Managers (Participants)	In-depth interviews and email survey	<ul style="list-style-type: none"> • Program functionality • Satisfaction with program specs and administration requirements • Implementation barriers • Experiences with trade allies • Recommendations for improvement
Trade Allies (Participants)	In-depth interviews and email survey	<ul style="list-style-type: none"> • General program experience from the trade ally perspective • Training effectiveness • Implementation processes • Benefits & drawbacks of PTCS participation • QA/QC protocol • Concerns and issues

Table 2.2 displays data collection populations and methods.

⁴ For the purposes of this evaluation, stakeholders are defined as deeply knowledgeable people working with the PTCS program and specifications, including BPA program staff, implementation staff, PTCS trainers, engineering consultants, and local university staff.



Table 2.2: Data Collection Summary

Information Source	Estimated Population Size	Sample Size	Completes By Activity	Length of Interviews
Stakeholders	NA	8	In-depth interviews (n=8)	1 to 2 hours
Peer Utilities	NA	3	In-depth interviews (n=3)	45 minutes to 1 hour
Participating Utilities	64	18	In-depth interviews (n=10)	30 to 40 minutes
		32	Online survey (n=32)	NA
Prescriptive Duct-Sealing Utilities*	NA	2	In-depth interviews (n=2)	20 to 30 minutes
Participating Trade Allies	1,226	18	In-depth interviews (n=8)	20 to 40 minutes
		1,160	Online survey (n=111)	NA

* We interviewed two Northwest utilities that implement non-PTCS HVAC programs. We called these *Prescriptive Duct-Sealing Utilities*. Note that only one of the two utilities is a BPA customer and therefore has the option to participate in PTCS. The other utility, an IOU, implements an HVAC program utilizing strategies very different from PTCS, so we sought their input to learn more about alternative methods.

In addition to primary data collection, we conducted an analysis of secondary data, including PTCS specifications, training materials, and program documentation. To better understand program participation and measure definitions, we reviewed program data in BPA's Planning, Tracking and Reporting System (PTR), and in the PTCS Database maintained by the implementation contractor.

INTERVIEWS AND SURVEYS

Stakeholder Interviews

We interviewed a group of stakeholders, which consisted of deeply knowledgeable people working with the PTCS program and specifications, including BPA program staff, implementation staff, PTCS trainers, engineering consultants, and local university staff. Working with the BPA program manager, we selected a sample of eight and conducted the interviews between July 26 and August 18, 2010. The interview guides contained primarily open-ended questions designed to help us learn more about the goals of PTCS, why the program was designed the way it was, details of its services and specifications, program implementation activities, barriers to success, and suggestions for improvements. We posed similar questions to all stakeholders, with additional tailored questions for each type of respondent.

Peer Utility Interviews

Our interviews (n=4) with peer utilities around the country collected information about other utilities' program requirements, procedures, strategies, and opinions as to what constitutes best



practices in HVAC energy efficiency. We conducted these interviews as a series of open-ended questions between and October 4 and November 8, 2010.

Participating Utility Interviews and Surveys

Utility interviews explored program structure, goals, and limitations. Respondents commented on the role of BPA in their programs and what challenges they have experienced with PTCS. We conducted the utility in-depth interviews (n=10) in September of 2010. Following the in-depth interviews, the survey team developed a shorter email survey to learn from a wider audience of utility participants. The email survey (n=32) ran from September 10 to September 20, 2010. Table 2.3 shows the utility email survey details.

Table 2.3: Utility Survey Details

Disposition	Number of Surveys
Original List Number	72
Email Bounces	2
Sampling Frame	70
Number of Responses Received	35
Number of Responses Eliminated for Eligibility or Quality	3
Number of Completes	32
Overall Response Rate	46%

In addition to interviews with participating utilities, the survey team conducted in-depth interviews with two Prescriptive Duct-Sealing Utilities. These interviews explored the reasons these two utilities choose to offer alternative programs for duct sealing and heat pumps.

Trade Ally Interviews and Surveys

We collected data from trade allies via in-depth interviews (n=8) and online surveys (n=111). In-depth interviews collected detailed information that informed the topics and questions for the email surveys. As with the utility interviews and surveys, this method achieved both depth of information from a smaller sample and broader information from a larger sample of individuals.

BPA provided us with an *Excel* file from the implementation contractor containing contacts for program trade allies, which we understood to contain PTCS participants. With input from BPA, we made the decision to send the email to the full population of contacts with email addresses in order to maximize feedback. However, we later learned that the list contained non-trade ally contacts, such as utility and program implementation personnel, which led to several completed surveys being removed from the analysis. In total, the number of completed surveys far exceeded the evaluation goal of 20, with 158 responses. Of the 158 total responses, 111 passed quality and eligibility screening. Upon review of contact and data quality, we eliminated 47 responses due to



contact ineligibility, missing data, or respondents' failure to identify their relationship to PTCS. Three-quarters of the respondents to the email survey were participating PTCS contractors who had completed jobs (participants) while the remaining quarter were certified, but had not completed any PTCS jobs (nonparticipants). A screening question in the beginning of the survey directed those who had completed jobs to a set of participant survey questions, while those indicating they had not completed any jobs were directed to a set of nonparticipant questions.

Trade ally interviews collected feedback about training, quality control, program processes and interactions, and the benefits and drawbacks of participating in PTCS. Trade allies also offered suggestions for improvement. We conducted our in-depth interviews with trade allies in August and September 2010, and collected email survey data between September 20 and October 1, 2010.

Table 2.4 shows the trade-ally email survey details.

Table 2.4: Trade Ally Survey Details

Email Survey Disposition	Count
Original List Number	1,226
Email Bounces	61
Sampling Frame	1,165

Note that the supplied list of trade ally contacts included potential respondents who did not meet the study definition of trade ally; therefore, the true sampling frame may be smaller than 1,165. The difficulty of determining the number of certified contractors in the contact list makes it hard to determine if the sample has biases in the final results, or where the biases may lie. Table 2.5 shows the trade-ally email response rate for the survey.

Table 2.5: Trade Ally Email Survey Response Rate

Response Status	Participant	Non-Participant	Total
Number of Responses Received	158	19	177
Number of Responses Eliminated for Quality or Eligibility	47	5	52
Number of Responses Used for Analysis	111	14	125
Overall Response Rate	—	—	11%





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COST EFFECTIVENESS

The Regional Technical Forum evaluates all PTCS measures for cost effectiveness before those measures are deemed. This evaluation did not review the savings impacts or costs for measure-level savings; rather, it uses the RTF assumptions on costs and savings for each additional measure.

Table 3.1 shows that since 2007, BPA has spent 12.3 million dollars on incentives and 3.5 million dollars on program and utility administrative overhead, with an average first year cost of 42¢ per kWh. The program is cost-effective using either the 5th Plan or the 6th Plan avoided costs. The TRC for the 5th Plan Period, as shown in Table 3.2 is 1.49 and the TRC for the 6th Plan Period is 2.81, as shown in Table 3.3.

Table 3.1: PTCS Program Savings by Year

PTCS 2006 - 2010	2007	2008	2009	2010
Energy Savings (kWh)	4,066,651	5,453,023	6,198,029	15,232,866
Energy Savings (aMW)	0.46	0.62	0.71	1.74
BPA and Utility Program Administration Costs	\$380,156	\$550,307	\$973,353	\$1,564,054
Incentive Costs	\$1,309,361	\$2,263,935	\$2,674,670	\$6,030,535
Incentive \$/kWh	\$0.32	\$0.42	\$0.43	\$0.40
Total Costs \$/kWh	\$0.42	\$0.52	\$0.59	\$0.50

Table 3.2: Cost Effectiveness Program Summary – 5th Power Plan Period

PTCS 2007-2009 (5th Plan Period)	Benefits (NPV)	Costs (NPV)	Net Benefits	B/C Ratio	Electric (\$/kWh)
Total Resource Cost Test (TRC)	\$10,872,354	\$7,312,964	\$3,559,390	1.49	\$0.044
Utility (UCT)	\$9,111,618	\$7,312,964	\$1,798,655	1.25	\$0.044
Participant (PCT)	\$16,423,708	\$5,610,947	\$10,812,761	2.93	\$0.034
Ratepayer Impact (RIM)	\$9,111,618	\$18,125,724	-\$9,014,106	0.50	\$0.109



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Table 3.3: Cost Effectiveness Program Summary, 6th Power Plan Period

PTCS 2007-2009 (5th Plan Period)	Benefits (NPV)	Costs (NPV)	Net Benefits	B/C Ratio	Electric (\$/kWh)
Total Resource Cost Test (TRC)	\$21,358,029	\$7,594,590	\$13,763,440	2.81	\$0.042
Utility (UCT)	\$10,447,322	\$7,594,590	\$2,852,733	1.38	\$0.042
Participant (PCT)	\$17,651,763	\$6,030,535	\$11,621,228	2.93	\$0.033
Ratepayer Impact (RIM)	\$10,447,322	\$19,215,817	-\$8,768,495	0.54	\$0.106



4

KEY RESEARCH FINDINGS

THE STAKEHOLDER PERSPECTIVE

We interviewed eight BPA stakeholders involved in various ways with PTCS. These stakeholders are deeply knowledgeable people working with the PTCS program and specifications, including BPA program staff, implementation staff, PTCS trainers, engineering consultants, and local university staff.

As one of the first activities of the evaluation, the stakeholder interviews set the stage for our subsequent research with program participants and nonparticipants by providing insights into some of the key issues associated with the program. We asked the stakeholders to educate us on the history and background of PTCS, including how BPA established the program goals and program design, as well as what prompted the program to change at certain points. We also asked stakeholders to give us their opinions on real-world program functionality, including implementation challenges they have observed and what, if anything, they would recommend to mitigate these challenges.

Even with their varied perspectives, each of the stakeholders described the goals of PTCS in similar terms: to increase the quality of heat pump installations and duct sealing in the Northwest to save energy. They also agreed that achieving this increase in quality requires an involved set of market and program activities that make PTCS complex. During the interviews, the stakeholders expressed several thoughts on the current state of PTCS. They also provided useful ideas and suggestions on future program direction. Below is a summary of the most salient of these thoughts, ideas, and suggestions.

Stakeholder Thoughts on PTCS Barriers

Technical Support

In terms of program difficulties, several stakeholders touched on a common theme: Technical support for contractors is critical to the success of the program, but a significant number of utilities do not have the staff size or resources necessary to provide the level of in-house technical expertise required for an optimally-performing PTCS program.

This raises the question of who should provide technical support to contractors in the field encountering questions on the job. This notion is complicated further by the fact that most utilities wish to “own” their contractor relationships and would rather not refer their contractors to outside sources for technical support.



PTCS Complexity

Another barrier that stakeholders expressed was the perception that PTCS is overly complex and laborious. This notion seems to relate to three key aspects of PTCS:

1. The amount of paperwork required – both for utilities to submit a completed job for approval and for trade allies to fill out when certifying jobs;
2. Confusion around program specifications; and
3. The program lacks a centralized, consistent source of technical support.

The technical complexities of PTCS create a need for technical support and cause difficulties where this technical support is not available from the local utility programs staff. It should be noted that some utilities only have one or less than one staff person devoted to energy efficiency, creating time and technical expertise constraints.

Another barrier related to program complexity is in the management of the PTCS database, called the *Site Registry*, which the implementation contractor maintains. A few of the stakeholders expressed concern over the overall effectiveness of the database, using terms such as “complicated process,” “not user-friendly,” and “laborious for utilities.”

PTCS Duct Sealing

Generally, stakeholders identified the advantages of performance-based duct sealing as the ability to measure the effectiveness of the job and to collect field data in real time. Contacts often described – or indicated that other program actors have described – this built-in measurement as a way of ensuring the quality of the job.

The main method to meet the protocol is to “test out” the ducts below a certain flow rate measured in cubic feet/ minute that is generalized as 10% of the floor area. The second option to meet the protocol is to reduce the leakage 50% from the pre-reading. Some homes meet both of these requirements. This 50% requirement was adopted as a “safety valve” for those homes where parts of the ducts were inaccessible or other barriers prevented a total seal of the ducts. These homes would never be able to exercise the first method to meet the protocol, yet could still benefit from a reduction in duct leakage. Because there is no mechanism to verify the pre-sealing leakage readings, stakeholders expressed concern that the reduction in leakage is based on the honor system. Since the pre-reading cannot be verified by an external quality assurance/quality control (QA/QC) check, the only verification is by the contractor performing the job. This can create a conflict, as tightening a difficult duct system costs the contractor time and money that does not increase the incentive paid by the utility.

A recurring theme from stakeholders revolved around the question of what should constitute the program’s focus: duct *sealing* or duct *leakage testing*? By all accounts, the testing requirements (and thereby the training curriculum associated with the performance-based process) are quite rigorous and time consuming. Therefore, there is a sense that more time is spent on leakage



testing than on actual duct sealing, which leads some stakeholders to question whether the program disproportionately focuses on the testing protocol.

In summary, while many program actors expressed feeling reassured of job quality by the PTCS performance testing, some questioned the notion that the testing procedures improve and/or confirm program savings.

In our research with stakeholders, and later with utility and trade ally contacts, we learned that people in the HVAC and energy efficiency communities are conflicted over whether PTCS is the best approach to duct sealing. Some believe in the PTCS performance-based approach, others believe that a prescriptive duct sealing protocol would be easier and more effective, and still others aren't sure which approach would be best. Subsequent sections of this report further elaborate on some of the reasons behind these divergent viewpoints.⁵

PTCS Heat Pumps

When discussing the PTCS heat pump protocols, two stakeholders suggested that the program could perhaps lessen its focus on unit efficiency ratings (referred to in industry parlance as “box specs”). They cited two reasons for this opinion: the HSPF/SEER rating is less important for energy performance than the installation protocol; and higher HSPF ratings increase product cost and thereby first-cost barriers for consumers, whereas any heat pump is significantly more efficient than many existing electric heat sources.

Another area of the PTCS heat pump protocol that came up in stakeholder interviews was the issue of proper heat pump sizing. While there are concerns for both undersizing and oversizing, due to the nature of heat pump heat (some refer to it as “cold heat”) occupant comfort is important to consider, both from the perspective of potential overuse of backup heat sources, as well as overall customer satisfaction with the technology. A 2005 study by Ecotope found that undersizing was a significant issue, explaining, “Heat pump systems tend to be sized to about 70% of the required heating load according to the field research and interviews. Contractor interviews indicate that this is due primarily to first-cost considerations. Larger systems (more “tons”) mean most or all of heating season requirements can be met by the refrigerant cycle rather than by auxiliary heat, but it is cheaper at the initial point of installation to install a smaller compressor and a larger resistance element combination. There is ongoing debate in the region on the best way to size a heat pump.”⁶

⁵ See the sections below on *The Utility Perspective – Prescriptive Approach to Duct Sealing: A Key Issue* and *Nonparticipant Utility Perspective*.

⁶ Ecotope, “Analysis of Heat Pump Installation Practices and Performance” Prepared for the *Heat Pump Working Group*, December 2005, ES-3.



Stakeholder Ideas and Suggestions

Stakeholder ideas and suggestions for how PTCS might be improved included the following:

- ➔ Conduct an impact evaluation to more clearly understand the benefits and energy savings associated with PTCS.
- ➔ Simplify the information collected onsite, especially on the heat-pump side (one contact suggested using Blackberry/iPhone technology).
- ➔ Encourage every utility to have someone on staff technically conversant in PTCS.
- ➔ Focus the program requirements on those elements that contribute most toward energy savings for the region.

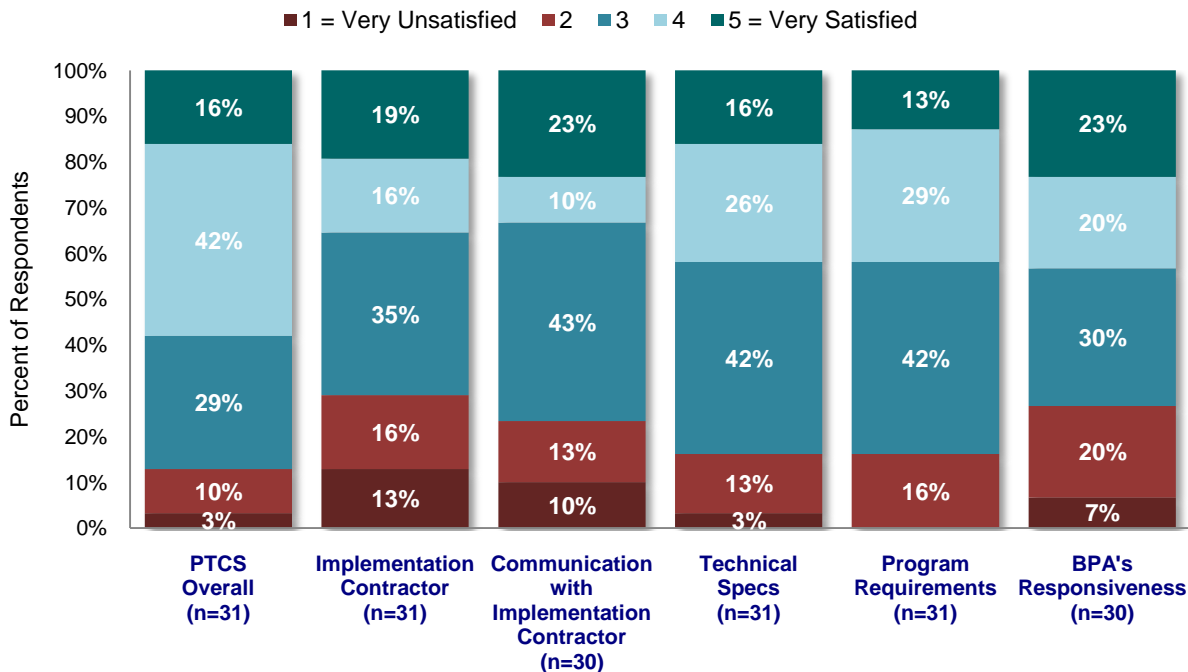
THE UTILITY PERSPECTIVE

Satisfaction with PTCS

We asked utility contacts to rate their satisfaction with six different aspects of PTCS: overall (summary assessment); implementation contractor activities; communication with the implementation contractor; technical specifications; program requirements; and BPA's responsiveness. We used a five-point rating scale, with "1" being *Very Unsatisfied* and "5" being *Very Satisfied*. The category of *Overall Satisfaction* received the highest rating, with 58% indicating they were satisfied (a rating of "4" or "5," see Figure 4.1).



Figure 4.1: Utility Satisfaction with Aspects of PTCS



Respondents did not rate the other categories as favorably. *Technical Specs* and *Program Requirements* each received around 42% satisfaction (a “4” or “5”). The categories related to communications and interactions with the implementing agencies – both the implementation contractor and BPA – showed the lowest levels of satisfaction. Respondents elaborated on their low ratings of the implementation contractor with comments such as, “no follow up with contractors when information is missing,” “slow communication,” “lack of communication,” and “inaccessible.” We were unable to locate any specific comments to explain the relatively low ratings for BPA. We infer that dissatisfaction with the implementation contractor “rubbed off” onto BPA, following the logic that BPA bears ultimate responsibility for program implementation.

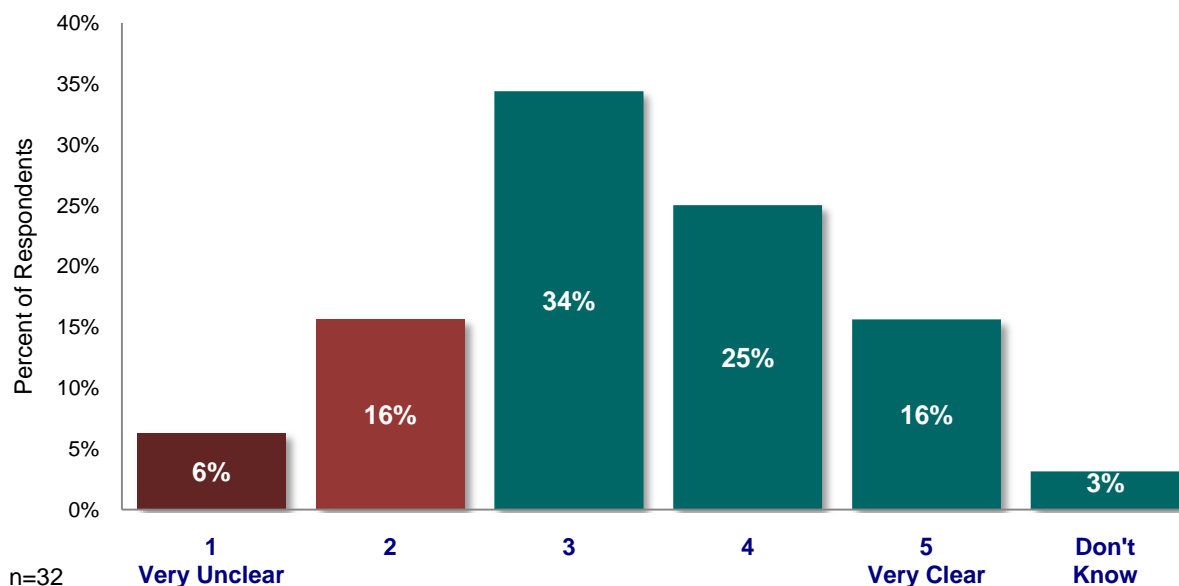
Clarity of PTCS Specifications

We asked utilities participating in our email survey, “How clear are the PTCS specifications for utilities?” Respondents rated the clarity of PTCS program specifications on a five-point scale, with “1” being *Very Unclear*, and “5” being *Very Clear*.

Approximately 40% of survey respondents indicated that they think the PTCS specifications are clear (a rating of “4” or “5”; see Figure 4.2).



Figure 4.2: Utilities – How Clear are PTCS Specifications?



Respondents indicating lack of clarity elaborated with comments such as the following:

- “I believe most of the confusion lies with the duct portion of the specs rather than the commissioning.”
- “[The technical specs] keep changing.”
- “Contractors are having difficulty knowing how to comply with certain types of existing homes.”

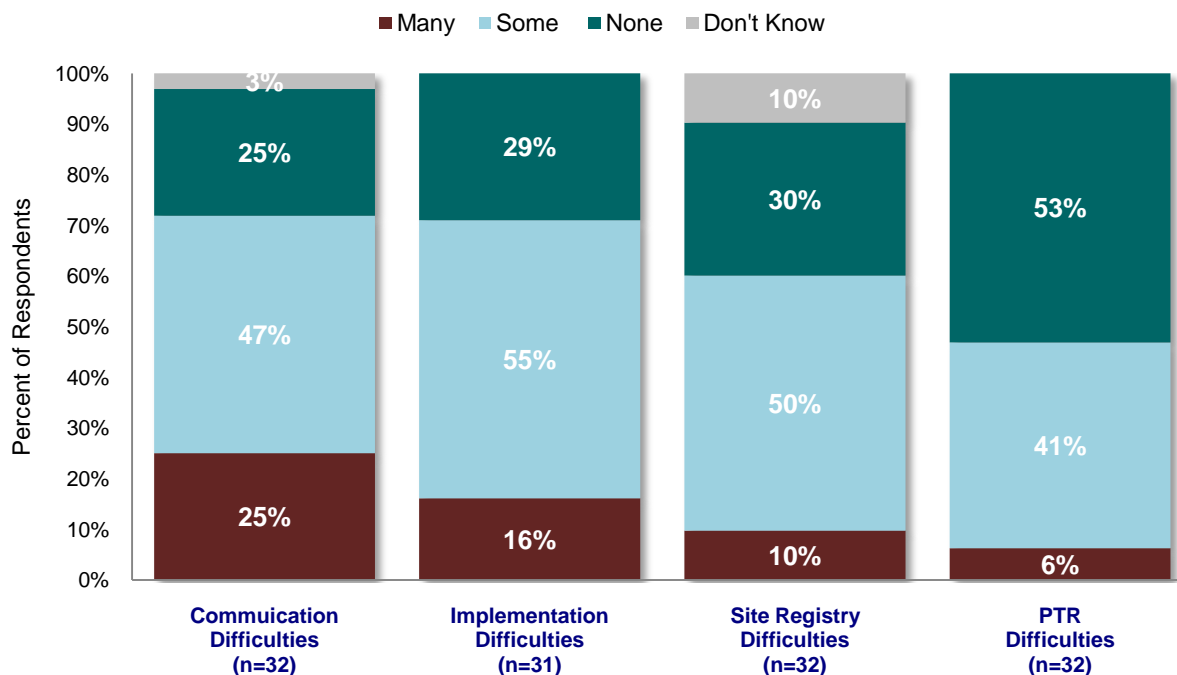
One in-depth interviewee expressed dismay at how unclear the specs are, saying, “I think they are the worst specifications out there right now. They are very unclear.” One contact said, “They could be better.”

Utility-Reported Difficulties

We asked utility participants to rate PTCS difficulty in the following categories: *Communication*, *Implementation*, *Site Registry* (implementation contractor’s database), and the *PTR* (BPA’s measure database). Figure 4.3 shows how the utilities responded.



Figure 4.3: Utility-Reported Difficulties with PTCS



Utilities reported the greatest difficulty in the areas of *Communication* and *Implementation*, with 72% reporting communication issues with the implementation contractor. Problems included: incorrect or slow data entry; no follow-up when data are missing or incomplete; slow or lack of communication; and general inaccessibility. Nearly 70% of contacts reported general implementation difficulties. Respondents reporting difficulties elaborated with comments such as, “slow and inconsistent quality assurance,” “RTF and BPA changing specs,” “paperwork delays,” “time spent for administration and monitoring contractors,” and “the program is confusing to customers and contractors.” Although it appears that utility managers experience some confusion with both the implementation contractor’s Site Registry, as well as BPA’s PTR database, they reported slightly more trouble with the Site Registry, expressed by comments such as “jobs didn’t show up,” “mistakes with data,” and “slow process.” With regard to the PTR database, utilities commonly complained about its complexity and difficulty with matching installed measures to the measure list. One utility manager suggested creating a drop-down list of measures.

Utility Perception of Amount of Work

While utility perceptions of the amount of work varied, utilities consistently expressed a desire for greater simplification. Figure 4.4 illustrates the utility viewpoint on the amount of *total* work associated with PTCS, while Figure 4.5 shows how utilities view the amount of *administrative* work required.



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Utility responses illustrated in Figure 4.4 and Figure 4.5 suggest utilities find the administrative work disproportionately taxing. When asked to elaborate on their perceptions of the administrative work, utility managers offered comments such as the following.

- *“The PTCS measures are working out really well for our customers. The paperwork end, however, is laborious.”*
- *“Why do we need to collect heating load calculations and balance point worksheets, when no one but us reviews the documentation?”*
- *“Going over the requirements and collecting the proper paperwork with consumers, the HVAC technicians and companies, and [the implementation contractor] are daily issues that take up a large part of our office and field time.”*

Figure 4.4: Total Work is Reasonable for the Benefit

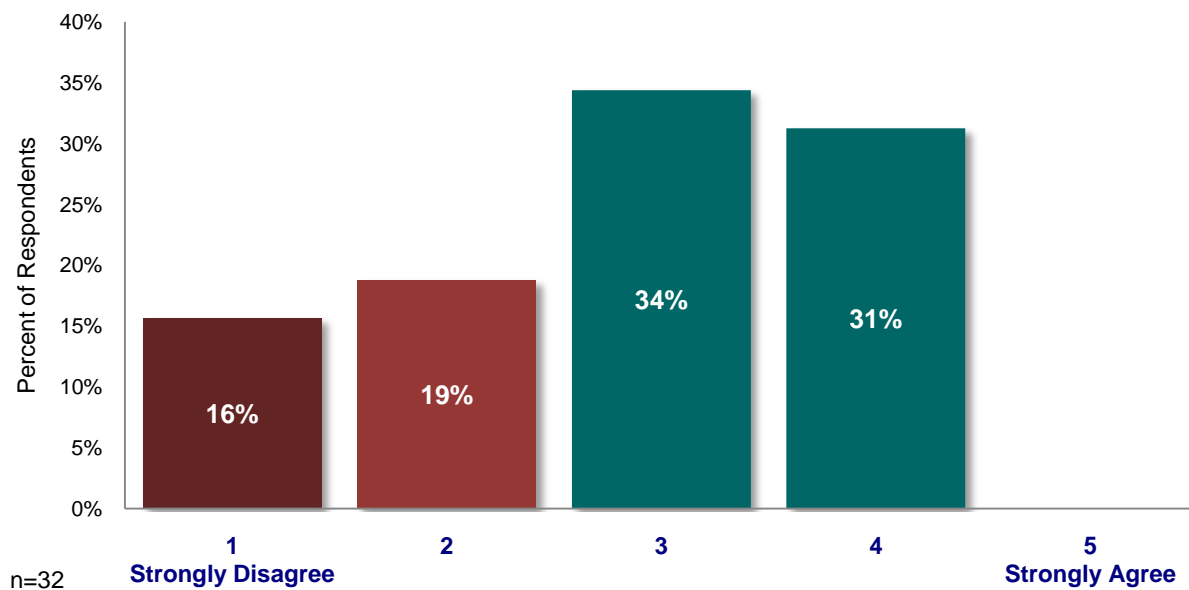
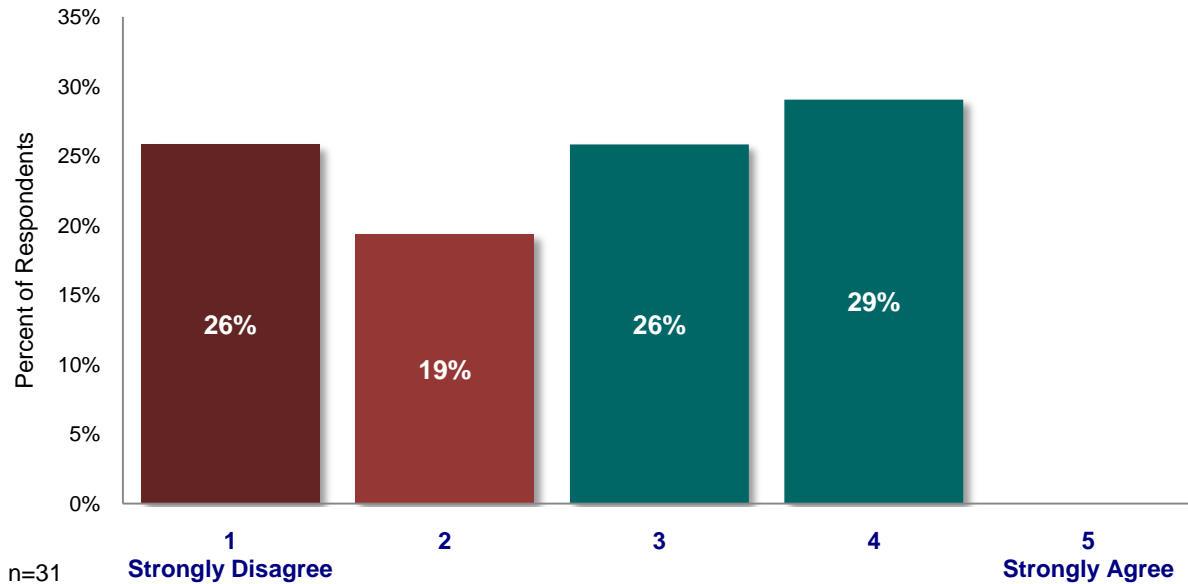


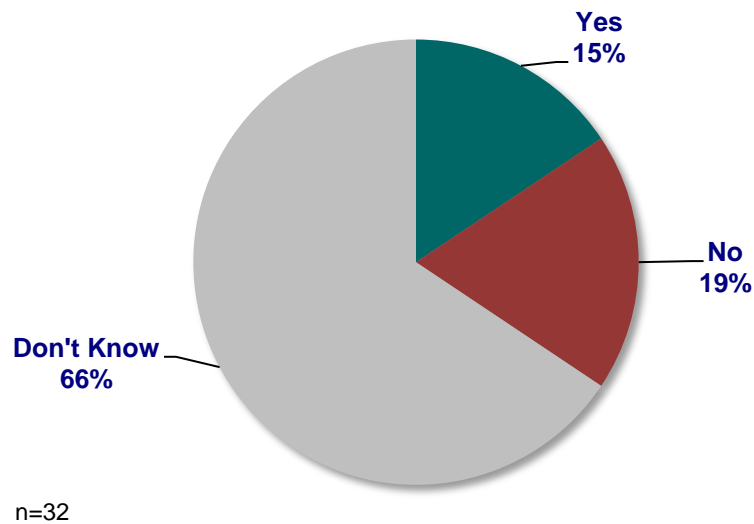
Figure 4.5: Amount of Administrative Work is Reasonable for the Benefit



Prescriptive Alternative to Duct Sealing: A Key Issue

When asked if a prescriptive approach to duct sealing would better serve the region, a large portion of utility program managers answered they do not know whether it would, as illustrated by Figure 4.6.

Figure 4.6: Would a Prescriptive Approach to Duct Sealing Better Serve the Region?



Although the utility contacts have pondered whether the region is best served by a prescriptive or performance-based approach to duct sealing, they have not come to resolution on the question. The following quote from one utility contact aptly summarizes their ambivalence:

- *“Although a prescriptive approach sounds easier, I think it is important that the systems are actually tested to demonstrate the requirements are met.”*

Quality assurance is a key concern for utility program managers and the testing protocol associated with PTCS duct sealing appears to reassure them that contractors are doing good work. In addition, some utility program managers were concerned that a shift to prescriptive duct sealing may upset contractors who have invested time and money in equipment and certification. One utility contact said a change to prescriptive would “hurt those guys who made the effort.”

Summary of Participating Utility Perspective

Utilities are somewhat satisfied with the program in general, but find the program specifications and requirements unnecessarily complex. They would like to see more clarity on PTCS specifications (particularly on the duct sealing side), an improvement in communication with the implementation contractor, a more effective Site Registry database, and a simplified and faster process overall.

THE PRESCRIPTIVE DUCT-SEALING UTILITY PERSPECTIVE

In addition to participating utility program managers, we talked to two Northwest utilities who implement non-PTCS energy efficiency programs for ducted heat pump systems – one BPA customer and one investor-owned utility.

It is important to note that these were only two interviews and should not be viewed as representative viewpoints of all utilities choosing not to offer a PTCS program. However, both interviews provided an important “outside” perspective on the advantages and disadvantages of various program approaches, as these two utilities elect to implement a prescriptive duct sealing program. We will refer to them as *prescriptive duct-sealing utilities*. We asked the program managers at these two utilities to provide their point-of-view on the different options for program design and to explain their rationale for choosing a design different from PTCS.



When asked for their opinion of PTCS, both contacts viewed PTCS as costly and time consuming, and both mentioned the 50% duct leakage threshold as a deterrent.⁷ They both believed this threshold “doesn’t necessarily result in completely sealed ducts,” saying:

- *“When the contractor has only a certain amount of time to do a job, you want them to do the job correctly. Once it reads below a certain threshold, they pack up and leave.”*

The prescriptive duct-sealing utilities mentioned a few other PTCS drawbacks as well. One was the method of inspection/quality control. Both of these utilities prefer visual inspection because they believe they can catch more leaks than a leakage reading, which does not tell you *where* the duct is leaking. One contact also said the testing equipment is complicated, referring to it as a “time sink,” and believes that it gives inconsistent results. Therefore, this contact believed that a program focused on good sealing techniques, rather than testing procedures, yields better sealed ducts.

Finally, the prescriptive duct-sealing utilities agree with PTCS participants that inspection is necessary to ensure contractor work quality, but they disagree on the best inspection methods. Both utilities believed in the merits of inspecting every job rather than a random selection of a percentage of jobs and again rely on visual inspections rather than leakage readings.

THE TRADE ALLY PERSPECTIVE

We completed ten in-depth interviews and 125 email surveys with PTCS-certified trade allies. Of these, almost all (111) were active PTCS participants, with the exception of 14 survey respondents who indicated they had not completed any PTCS jobs since obtaining their certification. With these interviews and surveys, we sought to learn what the trade allies think of the PTCS program with regard to satisfaction, program effectiveness, and the benefits and drawbacks of program participation for their companies.

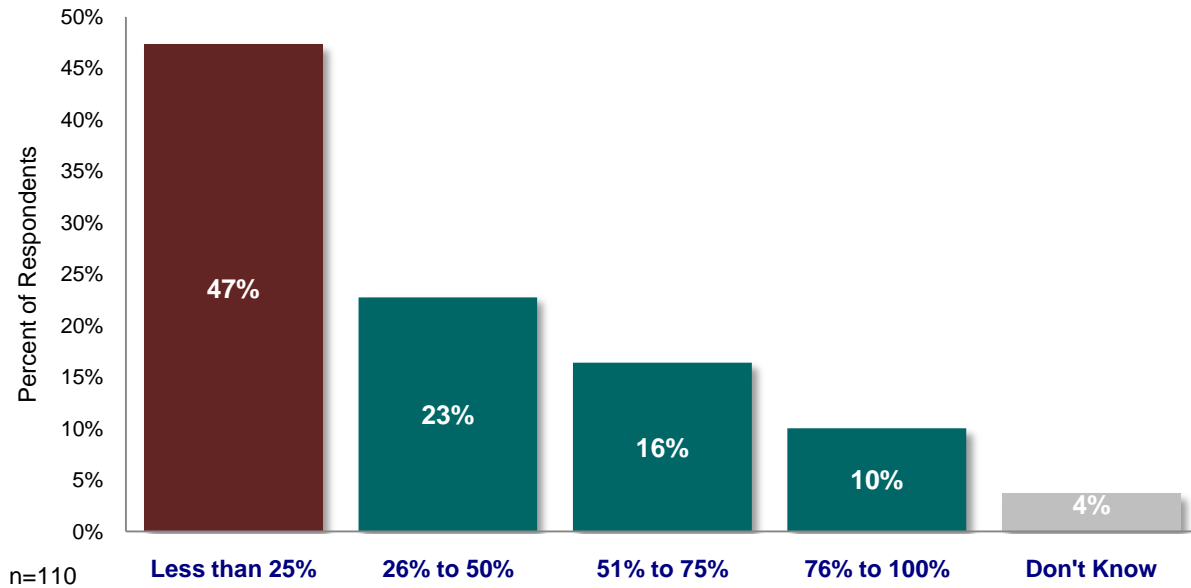
Participating Trade Allies

The majority of responding trade allies indicated that PTCS jobs comprise less than 25% of their total workload, as illustrated in Figure 4.7.

⁷ Although PTCS requires that ducts test below a flow rate in cubic feet per minute (CFM) that is generalized as a percent of floor area *OR* that there is a 50% reduction between pre- and post-duct-leakage measurements, the 50% reduction requirement is viewed as a program barrier by many program stakeholders, participants, and nonparticipants.

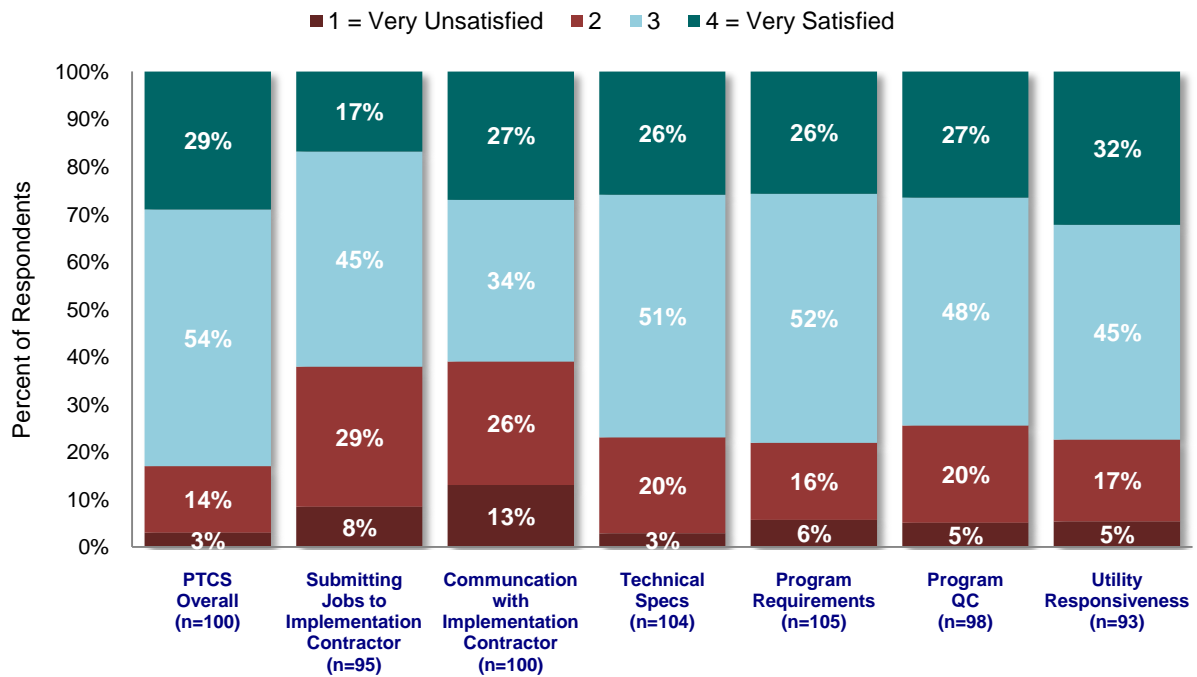


Figure 4.7: Percent of Trade Ally Jobs that are PTCS



Participating trade allies rated their satisfaction with seven aspects of PTCS on a four-point scale, with “1” being *Very Unsatisfied*, and “4” being *Very Satisfied* (see Figure 4.8).

Figure 4.8: Trade Ally Satisfaction with PTCS



Trade allies generally expressed satisfaction with PTCS overall, but were less satisfied with some of the specific program aspects. Trade allies were least satisfied with communication with the implementation contractor (36% dissatisfied, a rating of “1” or “2”). Follow-up comments elaborated on sources of dissatisfaction:

- “[The implementation contractor] is very busy. It is hard most of the time to get through to a person when you call.”
- “[The implementation contractor] has not returned my phone calls for the last seven weeks. They are very spotty on answers by e-mail as well.”

Trade allies also gave relatively low satisfaction ratings for the process of submitting jobs to the implementation contractor for approval (34% dissatisfied). Many trade allies described this process as “time consuming,” and often noted redundancies between the requirements of the PTCS implementation contractor and their local utility. Trade allies were pleased that jobs can now be entered into the implementation contractor’s database electronically; however, some noted that their local utility still requires hand-written forms, resulting in extra work for them.

Trade allies offered comments such as the following regarding the technical specs:

- “Flex duct specification is a bit ambiguous.”
- “Why are some of the specifications and testing protocols are on the PTCS website, while others are only at the RTF website? This is much too confusing.”⁸
- “Please standardize specifications for PTCS, state, and utility programs.”
- “Please shorten and simplify the specs.”

These comments indicate a general level of contractor confusion and a sense that things are more complicated than they need to be.

Trade allies also offered a lot of feedback regarding program quality assurance and control QA/QC procedures. Some trade allies appeared satisfied with the QA/QC, with one contractor saying, “It’s a good thing. It shows any shortcomings.” However, many trade allies expressed various frustrations with the inspection process. Representative comments include the following:

- “You need to do a better job of inspecting and correcting bad actors. It takes too long to ID companies doing things wrong and either correct them or kick them out.”
- “The inspector should know why it needs to be at a certain number, not simply that the number is just there and not within their parameters.”

⁸ In fact, the resources and links available to contractors differ between BPA’s PTCS website and the Regional Technical Forum’s website, with the exception of two documents that are present on both sites – the heat pump and duct sealing technical specifications documents – though they are named differently on each site.



- *“QA is spotty. Sometimes jobs fail for minor things.”*
- *“QA verifiers need to be in touch with local utilities more. Customers do not appreciate having to be put out multiple times for inspections that if scheduled responsibly could be done all at once.”*

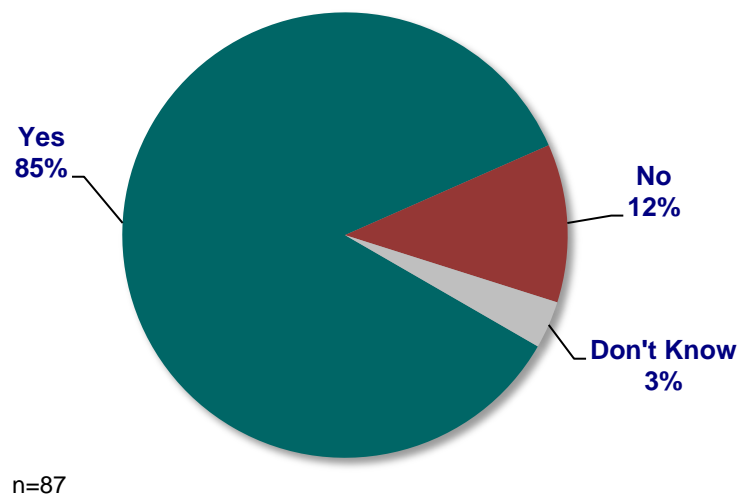
Overall, trade allies seem pleased with PTCS and are glad to be program participants. However, they desire simplification of several program attributes, including technical specifications, standardization across states and utilities, consistency between what they see on BPA’s website and what they see on the RTF’s website, and quality inspections.

Trade Allies: PTCS Saves Energy

Participating trade allies overwhelmingly agreed (85%) that PTCS saves energy over standard heat pump installation or duct sealing (see Figure 4.9). Several trade allies elaborated with comments such as the following:

- *“To make sure they are running to peak performance is a good thing.”*
- *“Yes, PTCS does, because the system is tested and, if needed, modifications are made. Duct sealing is always good. Who wants to heat the crawl space or cool the attic?”*
- *“The results are verified by a third party. PTCS offers quality control.”*

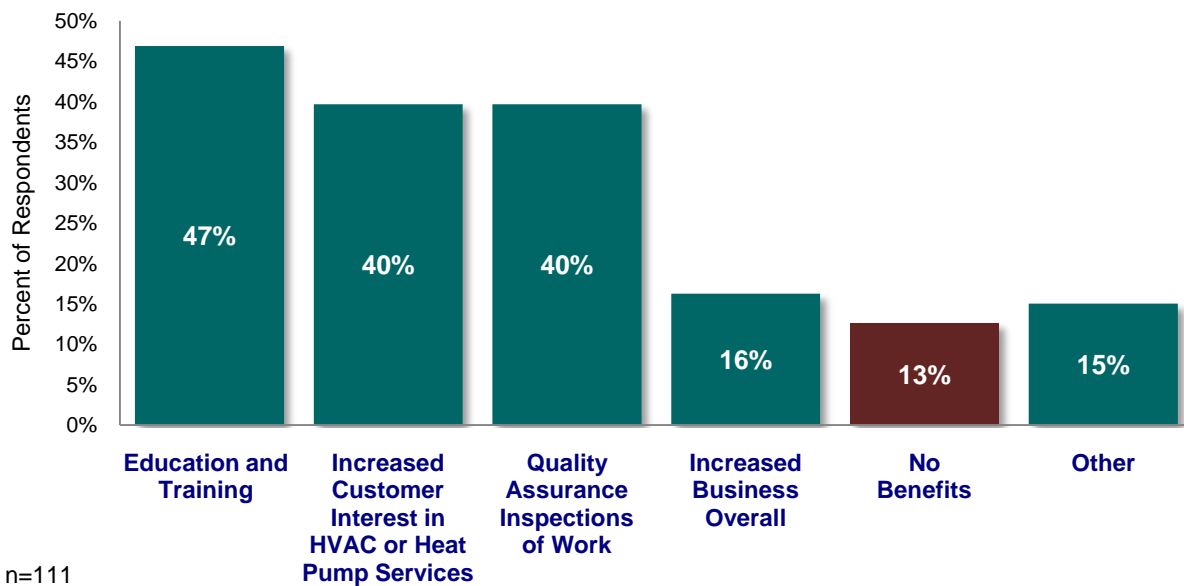
Figure 4.9: Does PTCS Save Energy over Standard Heat Pump Installation or Duct Sealing?



Perceived Benefits and Drawbacks of PTCS Participation

Trade allies perceive several benefits from PTCS participation, including education and training, increased customer interest in HVAC or heat pump services, quality assurance inspections of work, and increased business overall. Trade allies value the education and training opportunities most of all, with nearly half (47%) of respondents indicating as such (see Figure 4.10). Respondents did not think increased business opportunities from PTCS constitute a very prominent benefit, with only 16% selecting this option. However, several trade allies said they believed PTCS gave them an “edge over other contractors,” and gave customers, “peace of mind,” suggesting that the certification and quality control protocols lend them credibility with their customers.

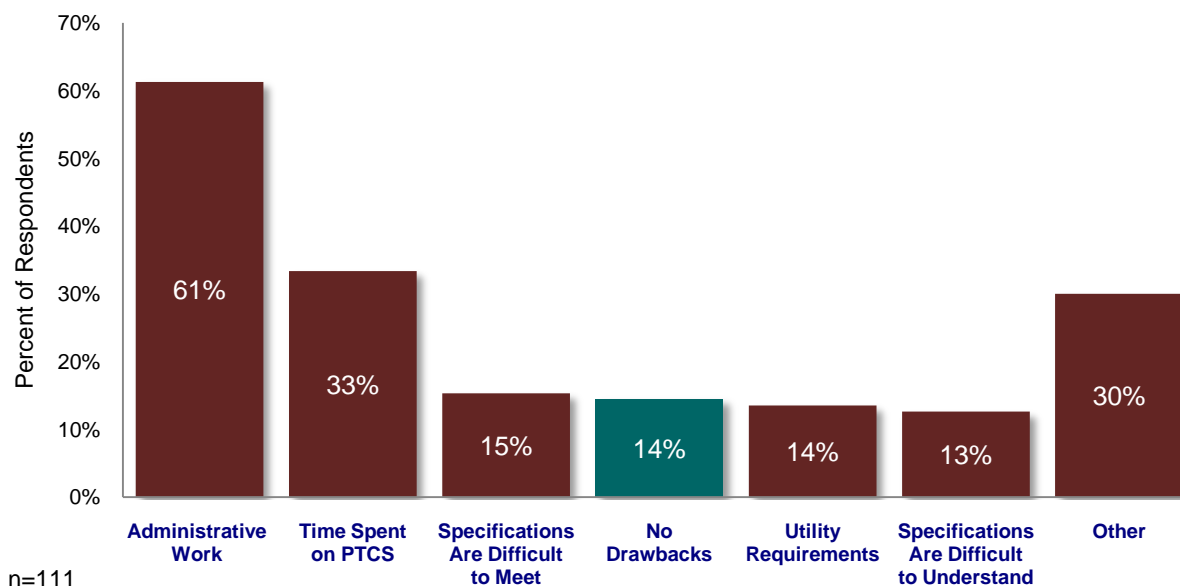
Figure 4.10: Trade Ally Perceived Benefits of PTCS Participation



On the other hand, we also asked contractors to tell us about the drawbacks of PTCS for their companies. Trade allies very clearly answered: It is the administrative work. Sixty-one percent of survey respondents indicated that administrative work negatively affects their experience, followed by the amount of time spent of program requirements (33%). Many trade allies (31%) cited “other” drawbacks as well, such as, “cost to perform PTCS usually exceed customer rebate,” “there are too many unanswered conditions and scenarios,” and “uneven playing field between utilities.” Figure 4.11 displays trade ally responses regarding PTCS drawbacks.



Figure 4.11: Trade Ally Perceived Drawbacks of PTCS Participation



Nonparticipant Trade Ally Perspective

Of the 125 responses we received from the trade ally email survey, 14 were from contractors who had been through the certification training but had not gone on to complete any PTCS jobs. Although this group consistently found the training to be well-done and valuable, all 14 cited a lack of qualifying customers in their area as a reason why they had not completed any PTCS jobs.⁹ Nonparticipating respondents also cited equipment costs, program requirements, and a variety of *Other* responses, including the economy, being busy, having a new company and not being ready, etc.

Summary of Trade Ally Perspective

Trade ally participants were generally satisfied with the PTCS program overall, but offered many comments and suggestions for ways the program could work better for them. They appreciate PTCS mostly for the training opportunities, increased customer interest, and added credibility it provides. The aspects of the program they find most frustrating are the paperwork requirements, a perception that forms and specifications change too frequently – making it difficult to keep up – and inconsistencies in requirements and processes between utilities.

⁹ A qualifying customer would be a residential customer of a utility with a PTCS program offering. Many rural areas in the Northwest don't have a large enough qualifying population to support a PTCS business venture.



Participating trade allies offered an array of suggestions for program improvement, but most of these suggestions fall under one of four themes: *simplification*, *standardization*, improved *communication*, and *access to technical support*.

Nonparticipating trade allies unanimously cited a lack of qualifying customers in their area as the primary reason for not completing PTCS jobs after becoming certified.

PEER UTILITY BEST PRACTICES

In addition to our research with regional contacts, we spoke with three national utilities outside the Northwest who implement ducted heat pump programs. The goals of these interviews were to glean further insight into best practices for heat pump and duct sealing programs, and to learn from a range of experiences with these measures.

We interviewed energy efficiency program managers at United Power in Brighton, Colorado, Sacramento Municipal Utility District (SMUD) in California, and Baltimore Gas & Electric (BGE) in Maryland (see Table 4.1). We asked these program managers to describe their program requirements for heat pumps and duct sealing, how they recruit and train trade allies, how they approach quality control and project approval, and what they view as program best practices. The following section provides a summary our findings from these peer utility interviews. Details of each utility's program design is provided in a series of tables in Appendix B.

Table 4.1: Numbers of Utility Customers and Heat Pump Installations

Utility	Residential Electric Customers	2010 Heat Pump Installations	Heating or Cooling Load
Baltimore Gas & Electric	1.1 million	2,659	Both
SMUD	450,000 to 500,000	~850	Cooling
United Power	47,000	~70*	Air source = cooling; geothermal = heating

* 450 customers participated in the program in 2005; the decline in participation is attributed to the economic downturn.

Heat Pump Requirements

Incentives

For air-source heat pumps, all three utilities offer a two-tier incentive structure for heat pumps, with requirements ranging from 13 to 15 SEER and 7.7 to 9 HSPF, and incentives ranging from \$200 to \$550. All three offer incentives for geothermal heat pumps, though the volume of geothermal heat pump installations is far lower than air-source. One utility, United Power, also has a minimum insulation requirement of R40 for ceiling and R14 for walls.



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Pre-Inspections and Sizing

Although in California, Title 24 requires a pre-inspection, the requirement is not enforced due to a lack of labor. Practically speaking, then, none of the three utilities interviewed has a pre-inspection or unit sizing requirement. However, Baltimore Gas & Electric offers an optional *Quality Installation* program, which includes accurate sizing, proper equipment selection, correct duct distribution design, proper refrigerant charge, and correct airflow. *Quality Installation* offers an additional rebate of \$200.

Post Inspection

The three utilities each have a different approach to post inspections, with BGE inspecting one in ten jobs, SMUD verifying approximately one in seven, and United Power inspecting 100% of heat pump installations.

Duct Sealing Requirements

One of the three utilities, Sacramento Municipal Utility District, has a duct sealing requirement with heat pump installation. Either the Title 24 duct sealing requirements or *Aeroseal* may be used, depending on the situation. Neither United Power or Baltimore Gas & Electric had a duct sealing requirement with heat pump installation, though BGE did offer a separate duct sealing program with a \$200 rebate. BGE's duct sealing program requires either: 1) post-test measurement with 50% reduction in total leakage from pre-test; or 2) achieve minimal total leakage of 150 cfm.

Trade Ally Qualifications

Aside from proper contractor licensing, none of the three utilities has a trade ally training or certification requirement for program participation. However, in California, *Aeroseal* must certify duct sealing. At United Power in Colorado, contractors must complete one heat pump installation and pass inspection in order to become listed on United Power's website as a preferred contractor.

Utility Described Best Practices

In random order, best practices offered by these utility contacts for heat pump and duct sealing incentive programs were:

- ➔ **Maintain a good contractor base**; they are the ones selling the equipment and the incentives.
- ➔ **Work with trade allies, do not become a competitor**. Trust your trade allies.
- ➔ **When starting a program from scratch, reach out to manufacturers**.



- **Offer a consistent program with clearly defined guidelines, specifications, and processes**, so the contractors know what is expected from the program and vice versa. (“We have a monthly meeting with our contractors to inform them on the program’s progress, new technologies, budget, and available training being offered.”)
- **Early in a program, do not make the requirements too onerous for the HVAC contractors**. Once relationships are established, there is more of an opportunity for market transformation with contractors.
- **Make it simple for the homeowner**, including the use of third-party inspectors who can vary their schedule more easily to accommodate the customers’ schedules; for example, they can work on weekends.
- **Maintain good communications with contractors and provide good customer service**.
- **Offer a simple rebate form and process**.

Best Practices Summary

Perhaps the most important theme emerging from the peer utility interviews was the notion of maintaining solid relationships – with both HVAC contractors and third-party implementation contractors. Utility program managers frequently mentioned the importance of building trust between utility staff and trade allies. Effective communication and program simplicity were also major themes.



5

REVIEW OF TRAINING MATERIALS

As part of this evaluation, we conducted a review of the training materials used for the three-day PTCS certification course. This review focused mainly on the duct sealing side of the curriculum, as this is the most complex aspect.

A well-designed training course assumes that its students possess a certain level of incoming knowledge and that through the course they will gain a set of take-away information. Our review of the PTCS training materials looked at the materials relative to BPA's stated assumptions of incoming student knowledge and desired outcomes of the training.

Our research indicated that some of BPA's implicit program goals affect the design of the training curriculum. For example, in hopes of certifying as many contractors as possible in the PTCS protocol, BPA offers an inclusive course open to all duct sealing contractors across the region. Therefore, the training course does not have any prerequisites and is designed to fit into a three-day time period to enable most contractors to attend. A desired outcome of the training is that certified contractors leave the course able to repair and seal ducts, as well as quantify duct leakage, which is required to complete program paperwork.

Our research also showed that PTCS certification endures, regardless of the number of jobs completed over any time period. Rural contractors, given few opportunities to work on PTCS jobs per year, are still expected to retain the knowledge they gained from the training course, with no refresher course required.

SCOPE AND GOALS OF TRAINING

During our review, we were first struck by the fact that the current scope of the training is quite large. It assumes that people enter the training with next to no knowledge and will leave the course knowing how to conduct house pressurization testing, duct pressurization testing, and combustion zone testing, as well how to seal and repair ducts, diagnose and repair combustion zone issues, and understand program issues such as qualification criteria and paperwork requirements. We believe it is an aggressive goal to take people from no prior knowledge to being fully trained and certified in a three-day training course. Therefore, our first recommendation is for BPA to examine the program goals and whether the training course supports these goals. For example, assess whether it's in the program's best interest to provide certification in perpetuity to all contractors equally, when some may only work on a few PTCS sites per year.

However, given these challenging training goals, we felt that the class materials were relatively well designed. The PTCS implementation contractor has made an effort to emphasize hands-on activities, which is critical for students to develop and remember the skills required by this



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program. The course materials contain several items, including a *PowerPoint* presentation, both delivered live during the class and given to students in a bound volume. Additionally, students are given several useful laminated reference guides with step-by-step instructions for conducting various tests and completing program forms.

POWERPOINT SLIDESHOW

Because the training is geared towards being a hands-on event and we did not attend a full training, it's difficult to fully judge the student materials. However, we did review the *PowerPoint* presentation and provided feedback directly to the implementation contractor with suggested edits. In our review, we noticed that the slideshow often asks questions which are not answered in the slides; rather, they appear to be used to elicit conversation, and presumably these ideas are covered in the conversation and/or hands-on activities. However, this was not clear.

One area where the slideshow could be improved is the discussion of the reasons for duct sealing. The training materials seem to focus on the benefit to the utility, with only the *Why Duct Seal?* slide directly addressing customer benefit. We suggest adding at least one slide for customer benefits (e.g., energy savings, improved comfort in some cases) and one for contractor benefits (e.g., potential for increased revenue, ability to qualify for utility rebates). Furthermore, the utility benefit could be more simply stated: *Energy efficiency – it is cheaper than building a new power plant.*

Ultimately, an efficient install backed by a PTCS certification must deliver value, both real and perceived.

REFERENCE MATERIALS

The new laminated cards are a good reference for the individual tests and the *PowerPoint* slides encourage the use of the *Energy Conservatory Duct Blaster* manual, which is a valuable reference for the duct-testing component. However, we recommend that new reference materials be developed for three training aspects: the duct sealing component; to provide a suggested inspection/install plan; and for common duct repairs. All the materials should be organized in a binder with a logical, easy-to-navigate structure so the technicians have all the information in one place, including the laminated cards. Although we think the laminated cards are helpful, we do not recommend producing many more, as too many cards will impede the ability to find the one of interest.

Given the large and complex scope of the training, we recommend improving the quality of the bound slideshow handout. The booklet contains no section dividers, despite being over one hundred pages and despite the fact that the trainers talk about the materials by section.

Beyond organization, though, we are concerned that if the slideshow booklet is intended to be used as future reference material, it may not be as effective as it could be. For example, much of the material is presented as leading or ambiguous questions that require follow-up discussion to



answer. The slides may function well as a live presentation, but we believe they are too incomplete to function as an effective reference document. That said, the structure of the slideshow does provide a good starting point for developing additional reference materials – perhaps the in-person slideshow and the handout slides should be different, each designed specifically for their intended function.

CONTINUOUS IMPROVEMENT

During the presentation of the materials, Ecos stated their goal to have an annual revision cycle incorporating feedback from contractors, utilities, and others. We agree that this is a good goal to help ensure continued relevance of the training materials.

During our review, we learned that contractor feedback is generally provided immediately following the class, and also in response to Quality Assurance inspections. We recommend adding a formal feedback process to elicit trainee input after a period of practice. This will allow for a more accurate assessment of those areas contractors are finding difficult and where in the training these areas can be addressed.

We also recommend adding a continual process improvement that solicits utility feedback and reviews basic program metrics, and to periodically ask whether the PTCS training course is effectively supporting the program goals.





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PERFORMANCE TESTED COMFORT SYSTEM (PTCS) PROGRAM

6

CONCLUSIONS AND RECOMMENDATIONS

For this evaluation, we talked to several PTCS program and HVAC market actors to understand and assist BPA in mitigating any program barriers that PTCS may be experiencing. Through interviews and surveys with key audiences – program stakeholders, participating utility program managers, and participating trade allies – we collected information aimed at supporting BPA’s ongoing programmatic review and, in particular, to identify ways to improve stakeholder and participant satisfaction with PTCS and increase PTCS measure activity.

KEY FINDINGS

Since BPA took over administration of PTCS in 2006, program participation has steadily grown, with over 10,000 PTCS jobs completed in 2010. PTCS certification training has been successful in reaching a wide audience of HVAC contractors (over 2,000), with more than 750 contractors currently participating. Of the nonparticipant survey responses we received, program inactivity was primarily due to a lack of qualifying customers in their area, though first costs for equipment was also cited a barrier.

Our study found that program participants widely believe that the PTCS approach to heat pump installations and duct sealing is more effective at saving energy over non-performance-based approaches. However, program participants – both utility program managers and trade allies – gave relatively low satisfaction ratings to several program aspects and offered thoughts and suggestions about ways in which PTCS could be improved.

CONCLUSIONS AND RECOMMENDATIONS

Program Implementation Barriers

- **Conclusion: Many program participants (both utility managers and trade allies) believe that the PTCS program is unnecessarily complex.** Program actors routinely expressed a desire to simplify many aspects of the program, including focusing program specifications on what’s most important to obtain energy savings in this climate zone, simplifying reporting requirements, and making the PTR measure list more user-friendly. In addition, some program participants perceive that program specifications are frequently changing, which leads to confusion. Finally, trade allies have noted that some of the program’s reference documents containing specifications and other helpful materials are either located on BPA’s PTCS website or the RTF website, but not on both. This makes it further complicated to keep track of information.



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- **Recommendation: Identify program areas where complexity can be reduced.** Examine program attributes with the help of a new program logic model to determine which elements are most critical, in distinction from those that are “nice to have.”
 - **Recommendation: Ensure consistency between the links, resources, and support documents that are available on BPA’s PTCS website and those on the RTF website.**
 - **Recommendation: Create a PTCS logic model to explicitly outline how program activities map to desired outcomes.** A PTCS logic model would also help clarify program goals (for example, *to establish proficiency with duct-testing equipment* versus *to achieve optimal duct sealing technique in the market*).
- ➔ **Conclusion: The technical complexity of PTCS requires easily accessible, knowledgeable, and reliable technical support.** BPA formed PTCS to be run by a third-party implementer, whose job was originally designed primarily as database administration and on-site QA/QC. When contractors have run into technical questions, they historically have turned to their utility for answers. However, not all utilities have the staff resources to meet this need and consistency in technical support across utility territories could improve trade ally understanding of how to meet the specifications in the field.
- **Recommendation: Create a technical support mechanism that will enable contractors throughout the region to have access to reliable technical support.** Regardless of location or utility service territory, PTCS trade allies should have equal access to consistent, knowledgeable HVAC experts who can help them make decisions in uncertain situations on the job.
- ➔ **Conclusion: While trade allies value the credibility PTCS testing and quality control provides to their customers, many have expressed dissatisfaction with the program’s QA/QC protocol.** Trade allies expressed several frustrations with the QA/QC process, including: that it’s too lax; concern that inspectors are not always knowledgeable; the perception that QA is “spotty” and inconsistent; and a sense that coordination with utility inspections could be improved.
- **Recommendation: Review the quality assurance/quality control processes for PTCS,** including inspector training and qualifications, consistency across inspections, and coordination between the implementation contractors and local utilities.

PTCS Contractor Training

- ➔ **Conclusion: The class materials were relatively well designed and included hands-on activities, as well as reference guides and a reference binder.** However, the reference binder should be accentuated to provide easier access to information after the training.



- **Recommendation:** Insert dividers into the reference binder for easier access to each section.
 - **Recommendation:** Add additional details to those slides that are discussed in class for the purpose of the reference binder.
- ➔ **Conclusion:** PTCS duct sealing is a complex job with a steep learning curve. The current training assumes that people enter the training with next to no knowledge and will leave the training knowing how to conduct house pressurization testing, duct pressurization testing, and combustion zone testing, as well how to seal and repair ducts, diagnose and repair combustion zone issues, and understand program issues such as qualification criteria and paperwork requirements.
- **Recommendation:** Consider the steepness of the PTCS learning curve together with expected contractor job volume when involving and supporting trade allies in PTCS. Investigate ways to help contractors maintain their skills during dips in work activity, such as recertification requirements and refresher courses. Focus on rural areas where contractors have less frequent opportunities to exercise their skills.
 - **Recommendation:** Research the feasibility of designing the course to address varying knowledge levels of incoming students – perhaps requiring some prerequisite knowledge for a more advanced course. Assess the program barrier this may cause contractors and determine if additional marketing to end-users could help increase the value for trade allies.
 - **Recommendation:** Trade allies should complete a certain number of jobs per year to maintain their certification.
- ➔ **Conclusion:** The program does not have a mechanism to elicit contractor feedback after completing jobs. Currently, contractor feedback is collected immediately after training, but contractors are not yet able to identify what problems they may encounter when implementing PTCS specifications in the field.
- **Recommendation:** The implementation contractor plans to have a yearly review of the program materials, with input from contractors, utilities and others. We agree with this approach.
 - **Recommendation:** We recommend adding a formal feedback process to elicit trainee input after a period of practice to more accurately assess those areas contractors are finding difficult and where training in these areas can be addressed.

Heat Pumps

- ➔ **Conclusion:** Program participants find the heat pump portion of the PTCS protocols to be relatively straightforward. Our research revealed very few comments



or complaints related to the heat pump requirements for PTCS. Participants widely agree that PTCS heat pump installations save energy over standard heat pump installations.

- ➔ **Conclusion: Program participants would like to simplify the information collected on-site for heat pumps.** Both participating trade allies and utility program managers feel that the level of detailed documentation that PTCS requires on heat pump jobs is onerous and may be unnecessary.
 - **Recommendation: Focus on-site data collection for heat pumps on what is most important to assure savings.** Review the paperwork required and consider removing the inclusion of information that is not necessary to document and evaluate energy savings.
 - **Recommendation: Explore data collection methods that make the process faster and easier for contractors.** Current technology, such as smart phone applications and live computerized reporting, might be an appropriate avenue to reduce the paperwork burden for trade allies.

Duct Sealing

- ➔ **Conclusion: Although two utilities in the Northwest offer a prescriptive duct sealing program, there is no research to estimate the relative impacts of prescriptive vs. performance duct sealing approaches.** The only duct sealing measure recognized by the Regional Technical Forum, the PTCS duct sealing protocol, requires test-in/test-out duct leakage measurements that are relatively labor intensive and time consuming. The PTCS duct sealing protocol requires a multi-day training course, as well as the use of complex leakage testing equipment requiring substantial training time in its application. An alternative approach is prescriptive duct sealing, which some utilities and stakeholders in the region favor. Impact evaluation numbers for prescriptive duct sealing installations will be available in 2011; a PTCS impact assessment would allow the actual field savings to be compared.
 - **Recommendation: Review the results of the upcoming impact evaluation for a prescriptive duct sealing program at one Northwest utility and consider conducting an impact evaluation of the PTCS duct sealing protocol to compare results with the prescriptive program. In addition, assess the cost implications of both implementation approaches.**
- ➔ **Conclusion: The 50% duct leakage reduction threshold required for PTCS job approval causes concern.** The PTCS specification requires that PTCS-certified ducts test below a CFM reading that is generalized as a percent of the floor area, or to demonstrate a 50% reduction between pre- and post-CFM measurements. In some homes, the 50% reduction path is the only viable path for certification, but because there is no way to verify a duct leakage pre-test reading, the difference between the pre-reading and the post-reading cannot be independently verified.



- **Recommendation:** Consider including the threshold requirement as a variable in a PTCS impact evaluation.

- ➔ **Conclusion:** Some program and market actors in the region feel that PTCS places a disproportionate emphasis on duct leakage testing rather than practicing proper duct sealing techniques. Generally, stakeholders identified the advantages of performance-based duct sealing as the ability to measure the effectiveness of the job and to collect field data in real time. Contacts often described this built-in measurement as a way of ensuring the quality of the job. However, due to the complicated nature of the duct leakage testing equipment, the amount of time it takes to learn how to use the equipment, and the time-intensity of using the equipment on job sites, many knowledgeable Northwest professionals are concerned that more time is spent on leakage testing than on actual duct sealing. This leads some stakeholders to question whether the program disproportionately focuses on the testing protocol.

- **Recommendation:** Determine whether the PTCS duct sealing protocol is optimally designed to achieve the program’s desired result.





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APPENDICES

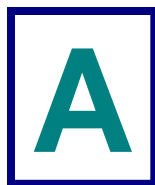
APPENDIX A: INTERVIEW AND SURVEY INSTRUMENTS

APPENDIX B: PEER UTILITY PROGRAM DETAILS



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PERFORMANCE TESTED COMFORT SYSTEM (PTCS) PROGRAM



INTERVIEW AND SURVEY INSTRUMENTS

PTCS STAKEHOLDER INTERVIEW GUIDE

INTERVIEWEE NAME:

DATE:

INTERVIEWER:

RESEARCH ISSUES:

- Stakeholders perceptions of program structure, goals, and clarity around specifications
- Response to program by utilities, certified contractors, and the market
- Recommendations for program improvement

Introduction

Thank you for agreeing to talk to me about your involvement with the Performance Tested Comfort Systems Program (PTCS).

PTCS Background and Program Goals

First, I'd like to ask you about how you're involved in PTCS, and learn some background about the program. [Let interviewee know that there may be some questions in this instrument they don't know the answer to, or don't feel qualified to answer. That's okay, if that happens, we'll just move on to the next question]

1. What is your role with the PTCS program?
2. Please describe your understanding of the program's goals. [i.e., in your own words, what's the purpose of PTCS?]
[To have well-trained contractors and a consistent set of protocols to achieve optimally installed HVAC systems in homes]

Market Demand / Market Response

Next, let's talk about the market response to PTCS services.



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3. Do you think there is a strong **end-user** demand for PTCS services? (Explain___)
 - a. Do you think there is a strong **utility** demand for PTCS services? [Probe for how utilities are responding to the program, the answer is usually “it varies”](Explain___)
 - b. Are you aware of any program marketing for PTCS?
 - c. [If yes to b] How effective do you think program marketing has been in increasing demand?
4. An alternative approach to PTCS would be to take a more prescriptive approach to duct sealing, and take away the testing. Contractors would just go in and seal the ducts. What are the advantages and disadvantages of these two approaches?
5. Advantages/disadvantages of prescriptive:
6. Advantages/disadvantages of PTCS (performance-based) duct sealing :
7. Hypothetically, does BPA have the authority to change its program to a prescriptive one, or does the RTF’s definition of duct sealing *require* test-in test-out performance testing?
8. The new WA energy code (which will require Heat Pump commissioning and performance-based duct sealing) has been described as a “game changer.” How will this change BPA’s PTCS program, both in WA and elsewhere in the NW?

Program Implementation

Now I’d like to ask you about how the program functions from an implementation standpoint. If there are any questions you don’t feel in a position to answer, just let me know.

9. Out of 140 utilities, 65 participate in PTCS. Are these numbers surprising to you, or is this what you would expect?
 - a. Please explain.
10. From your perspective, how clear are the program requirements **for utilities**? [*Probe for perceived confusion among utilities*]
11. From your perspective, how clear are the program requirements **for PTCS contractors**? [*Probe for perceived confusion among contractors*]
12. Beyond the sizing issue of installing heat pumps in manufactured homes (the closets are too small to accommodate the coils) are there any other challenges with PTCS in this or other housing types? Please explain.



13. According to BPA records, over 2,200 trade ally companies and 2,400 individual HVAC technicians have received PTCS certification. Of these, 462/874 have reported jobs to the PTCS database.
 - a. What is your perspective on why relatively few certified contractors actually complete PTCS jobs? [probe for barriers for trade allies to do PTCS jobs]
 - b. Are you aware of the geographic distribution of practicing PTCS contractors, and if so, does the distribution meet your expectations? Please explain.
14. Do the PTCS-certified contractors have any problems or issues with the program that you know of? [If not answered above]
15. How are manufacturers, distributors, and vendors supporting the program?
 - a. Has the program done anything to inform or engage them?
16. Do you have any ideas for how the reporting process could be streamlined and improved? Have you had any issues with the databases?
17. What could the utilities who offer PTCS programs do differently to make PTCS more effective?
18. What could BPA do differently to make PTCS more effective?

Suggestions for Improvement

I'd like to wrap up by getting your impression of program achievement and suggestions for improvement

19. Do you think the program is meeting its potential with respect to...
 - a. Program activity?
 - b. Achieving energy savings?
 - c. Market penetration into HVAC market?
 - d. Customer satisfaction?
20. [If no to any above] What, if anything, do you think is limiting program achievements?
21. Is the program perhaps targeting too comprehensive a change in current HVAC installation practices?
22. Does the program require too much administrative support? [If yes] How so?



23. Besides the site registry and PTR databases, are there any other areas where the program could be improved/streamlined?
24. Do you have any other thoughts to share?

Thank you for your time today.



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PERFORMANCE TESTED COMFORT SYSTEM (PTCS) PROGRAM

PTCS UTILITY INTERVIEW GUIDE

INTERVIEWEE NAME:

DATE:

INTERVIEWER:

RESEARCH ISSUES:

- Description of Utility’s HVAC program offerings
- Utility PTCS procedures, challenges, and successes related to the program
- Is the program perhaps targeting too comprehensive a change or necessitating too much administrative detail?
- Utility understanding of program goals
- Program participation and progress toward goals
- Utility perception of current program design (change from heat pump only, large incentive) to heat pump + ducts for lower incentive)
- Suggestions for improvement

Introduction

Hello, my name is _____ with Research Into Action. We’ve been contracted by BPA to conduct an evaluation of the Performance Tested Comfort Systems (PTCS) program. We’re hoping to learn how well the PTCS offer is working for utilities; your successes and challenges with PTCS; and your thoughts on ways it might be improved.

I’d like to start off by learning about your utility’s HVAC and PTCS offerings.

Background on Utility HVAC Offerings

1. Do you have a Heat Pump offer? Is it PTCS?
 - a. [Whether PTCS or non-PTCS] Describe the offering:
 - b. Customer Incentive:
 - c. Contractor Incentive:

2. Do you have a Duct Sealing offer? Is it PTCS?
 - a. [Whether PTCS or non-PTCS] Describe the offering:
 - b. Customer Incentive:
 - c. Contractor Incentive:



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[Note to interviewer: Be prepared to document customer incentive, contractor incentive, or both.]

3. Please list your other, non-PTCS HVAC offers:
- | | | |
|--|---------------------|-----------------------|
| <input type="checkbox"/> Non-PTCS Heat Pump | Customer Incentive: | Contractor Incentive: |
| <input type="checkbox"/> Non-PTCS Duct Sealing | Customer Incentive: | Contractor Incentive: |
| <input type="checkbox"/> Ductless Heat Pump | Customer Incentive: | Contractor Incentive: |
| <input type="checkbox"/> Thermostat | Customer Incentive: | Contractor Incentive: |
| <input type="checkbox"/> Room A/C | Customer Incentive: | Contractor Incentive: |
| <input type="checkbox"/> Whole house A/C | Customer Incentive: | Contractor Incentive: |
| <input type="checkbox"/> Other _____ | Customer Incentive: | Contractor Incentive: |
4. Do PTCS Measures in the PTR translate well into a comprehensive HVAC program on the utility level, or does the utility offer consumer rebates for which the utility does not get a BPA reimbursement?

PTCS Implementation/Processes

Next I'd like to talk a bit about how the PTCS offering works at your utility.

5. Please describe your role in implementing your PTCS Heat pump or duct sealing offer.
6. Are any other staff members at your utility working on this program? [If yes] Please describe their role.
7. How do you market your PTCS heat pump or duct sealing offer? [Probe for types of materials they've used, if they've used any of the materials Ecos developed, if they rely mostly on the trade allies to be "the face" of the program.]
8. What is the process for reporting a project in the PTCS database (the site registry operated by Ecos)?
- [Probes:]
- Are there any difficulties?
 - Do projects ever not make it in?
 - If not, why not?



9. What is the process for reporting a project in Bonneville's PTR database?
[Probes:]
 - a. Are there any difficulties?
 - b. Are you able to find the right measure to claim the job?
 - c. Do projects ever not make it in?
 - d. If not, why not?
10. What heat pump/duct sealing program services/assistance does your utility receive
 - a. From BPA?
 - b. From Ecos?
11. Compared to other energy efficiency program offerings, how would you categorize/compare the amount of time spent on implementing PTCS?
12. Do you feel the amount of work involved with PTCS is commensurate with the energy savings obtained by the offering?
13. Are HVAC measures in general worth this level of effort? Should we be focusing more effort on HVAC, or less, or on something different?
14. Have you had any difficulties implementing PTCS? If so, please describe.
15. How well do the PTCS Deemed Measures, available in the PTR, work in the marketplace? [Probe to determine how much of a barrier the deemed measure structure is to utility implementation]

Program Goals, Design & Achievement

Next, let's talk about the program itself – how it's designed and how it fits into your utility's energy efficiency goals.

PTCS Program and HVAC Goals

16. What are your residential savings goals for HVAC?
17. How has **total HVAC** program participation compared with goals at your utility?



18. What are your participation and savings goals **specifically for PTCS**? [Participation and savings goals may be related, or interdependent. Probe to find out what the goals are]
 - a. Participation:
 - b. Savings:How were these goals established?
19. Is the PTCS program meeting these goals?
 - a. Participation:
 - b. Savings:
20. What is your understanding of the big-picture goal of having a PTCS utility offering?
21. How does PTCS fit within *your utility's* HVAC approach and objectives?
22. How do you think PTCS fits within the *overall marketplace* for HVAC services?
23. Do you see much market demand, now and in the future, for PTCS?
 - a. Is there a strong end-user demand for PTCS? Other HVAC?
 - b. Is there a strong contractor demand for PTCS? Other HVAC?
24. What housing types or customer types do your **HVAC** offerings address [*e.g. manufactured housing*]?
25. What housing types or customer types does the **PTCS** offering serve?
 - a. Are there any challenges associated with some of the housing types?
 - b. Are there any heat pump design issues associated with manufactured homes?
Explain:
 - c. Are there any housing types that PTCS doesn't address well?
26. Are there any housing types you particularly want to target with PTCS, or have trouble targeting?

Program Design

Previously, the PTCS program required a heat pump installation to be accompanied by duct sealing, where appropriate (i.e., when a substantial amount of the duct system is outside the heated envelope). For the 2010 program year, BPA separated these measures.



27. What do you think of the PTCS program in its current design, from the both the perspective of...
 - a. ...energy efficiency for the region, and
 - b. ...practical implementation and achievability of the PTCS goals?

[Probe: ensure answer addresses both facets]
28. Do you see any difference in the uptake of the newer version of the program where PTCS and heat pumps are not bound together, compared with the previous design?
29. In 2011, a code change in Washington will require performance-based duct sealing on all new construction and any time an air handler is changed in existing buildings. A similar code could be on the horizon in Oregon. An alternative approach to PTCS would be to take a more prescriptive approach to duct sealing, and take away the testing (or do testing on a smaller sample independent from the duct sealing). Contractors would just go in and seal the ducts. What are the advantages and disadvantages of these two approaches?
30. How clear are the PTCS specifications for utilities, from your perspective?
31. How clear are the PTCS specifications for contractors, from your perspective?

Program Achievement

32. Does PTCS improve HVAC installation and save energy?
33. What is limiting program
 - a. Participation?
 - b. Energy savings?
34. Is PTCS targeting too comprehensive a change?

PTCS Contractors and Manufacturers/Vendors

This is our second-to last category of questions, pertaining to PTCS certified contractors.

35. Has the number of contractors receiving PTCS certification met your utility's expectations? What are barriers to getting additional trade allies certified?
36. Is the number of PTCS jobs meeting the expectations of certified contractors?



37. Do your contractors have access to duct sealing training other than the PTCS certified training?
 - a. *[If yes]* What training?
 - b. *[Ask all]* What do you see are the advantages to multiple types of training? The disadvantages?
 - c. Is there any advantage to moving towards only certified training?
38. Do you see any opportunity to upgrade existing duct sealing training to PTCS standards? Why? Why not?
39. Have you had any problems with the PTCS-certified contractors?
40. Are you aware of whether the PTCS-certified contractors have had any issues with the program?
41. Have you had any engagement with manufacturers, distributors, or vendors? How so?

Recommendations for Program Improvement

Finally, I'd like to ask about your satisfaction with the program and any ideas you might have for improvement.

42. How satisfied are you with the program? *[Probe for satisfaction with...]*
 - a. Structure
 - b. Ease of Implementation
 - c. Achievability of goals
43. Has your utility encountered any difficulties with the program?
 - a. What opportunities have you've noted for improvement?
 - b. Is anything stopping or slowing those improvements?
44. Have you experienced any communication issues with any other party involved in the program?
45. Do you have any recommendations to improve the program? What could BPA or Ecos provide to help improve your experience?
46. What else is out there for HVAC that your utility would like to offer?
47. If you could take a different market approach to HVAC, would it be PTCS-modified or would it look completely different?



48. If so, describe.
49. Where can BPA modify its PTCS offering to better meet market needs?
 - a. End-user needs
 - b. Trade ally needs
50. Do you have suggestions for other HVAC offerings?

Thank you for your time.



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PERFORMANCE TESTED COMFORT SYSTEM (PTCS) PROGRAM

PTCS TRADE ALLY INTERVIEW GUIDE

INTERVIEWEE NAME:

DATE:

INTERVIEWER:

Introduction

Hello, my name is _____ with Research Into Action. I'm calling on behalf of the Bonneville Power Administration to talk with you about your experience with the Performance Tested Comfort Systems (PTCS) program. I'm hoping to learn how PTCS jobs have worked at your company, how your interactions with program staff have been, and any thoughts you might have about ways the program can be improved.

Program Participation Experience

I'd like to start off by getting a sense of your involvement with PTCS.

1. What is your primary business?
2. What PTCS services do you provide?
 - a. PTCS Heat Pump installation and mini-splits
 - b. PTCS Duct Sealing
 - c. Both
3. How long has your company been participating in the PTCS program?
4. How many PTCS-certified technicians do you have in your company?
5. What portion of your jobs for HVAC installation are PTCS?
 - a. Less than 25%
 - b. 25%-50%
 - c. 50%-75%
 - d. More than 75%



6. What portion of your jobs for duct sealing are PTCS?
 - a. Less than 25%
 - b. 25%-50%
 - c. 50%-75%
 - d. More than 75%
7. Has the amount of PTCS work available in your area met your expectations?
8. How do you market the PTCS program?
 - a. Could any resources be made available to help you with your marketing?
Materials?
9. Tell me about the utility requirements for HVAC contractors and/or duct sealing contractors to participate in the PTCS program. [Probes: Do they do quality control?
10. Have you experienced an increase in customer interest or work as a result of having PTCS certified technicians on staff?
11. In your experience, what are the benefits of the PTCS program for your company?
12. What are the drawbacks of the PTCS program for your company?
13. Are you seeing customer demand for **other** HVAC services/program offerings? Please explain.
14. What are the barriers for customers to participating in the program?
 - a. Cost
 - b. Don't understand or know much about the program
 - c. Customers don't want the hassle
 - d. Others? Please explain.
 - e. All of the above.
15. Do you think PTCS saves energy over standard heat pump installation or duct sealing?
16. Are any types of homes better suited to PTCS (site built, manufactured, etc.)?

Training/Certification

Now I'd like to ask you about training and certification for PTCS.



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17. Why did you take PTCS training?
18. Did the training meet your expectations?
19. Did the training adequately prepare you for field work?
20. How could the training be improved?
 - a. Could the materials be improved?
 - b. Could the style of the training be improved?
21. What are the benefits and drawbacks to PTCS certification?

Program Interactions

Next I'd like to hear about your experiences interacting with program administrators.

22. Have you experienced any communication issues with parties involved in the program [ECOS, utility, BPA]? *[If yes, please explain]*
23. Have you ever had your work initially rejected by the program implementer (Ecos) for not meeting quality standards? [Ecos QC]
 - a. *[If yes]* What were the issues?
 - b. *[If yes]* How were the issues resolved?
 - c. Could the program materials be changed to avoid issues like this?
 - d. Could anything else be done to avoid issues like this?
24. Would you say the amount of administrative work required for PTCS participation is...
 - a. Very little
 - b. A reasonable amount compared to the benefit
 - c. Very taxing and time consuming

Please explain:

25. Have you had any issues entering jobs into the database?
 - a. Do all your jobs make it in quickly? [If no] Do you know why? How do you handle that?
26. Have you had any (other) problems with the PTCS program processes?
27. Do you have any suggestions that could improve those processes?



Recommendations

Lastly, I'd like to ask you for any suggestions you have for improvement of the program.

28. Overall, how satisfied are you with PTCS as a whole?
29. How satisfied are you with Ecos?
30. Do you have any other recommendations for how to improve the program overall?
31. Is there anything more that BPA or the program implementer (Ecos) could do to improve the program?

Thank you for your time.



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PTCS UTILITY EMAIL SURVEY INSTRUMENT

INTERVIEWEE NAME:

DATE:

INTERVIEWER:

RESEARCH ISSUES:

- **Current offerings**
- **Communication issues - communication problems with the implementer**
- **Amount of work involved in PTCS, from the utility perspective**
- **Perception of new program compared to old version**
- **Suggestions for improvement**

Email Script

BPA has hired Research Into Action, an independent research firm, to evaluate the Performance Testing Comfort Systems (PTCS) Program. As part of this evaluation, we are asking participating utilities to offer their feedback on the program and suggestions for possible improvements.

The online survey should take about 10 minutes to complete.

To complete the survey, please click on the link below and enter your 4 digit reference key.

Your reference number is %Key 1%

Survey link:

If you have any questions about the survey or technical issues please call April Armstrong, at Research Into Action, at 503-287-9136. If you have questions about the evaluation please contact Carrie Cobb at BPA, 503-230-4985.

Thank you in advance for your cooperation with research that is intended to improve the effectiveness of PTCS.

Background on Utility HVAC Offerings

1. Including yourself, how many people at your utility work on PTCS related activities?
2. Which response best describes your utility's approach to a PTCS Heat Pump Offer?



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- a. Consumer gets incentive for PTCS Heat Pump
 - b. Contractor gets incentive for PTCS Heat Pump
 - c. Both consumer and contractor get PTCS Heat Pump incentive
 - d. We do not have a PTCS Heat Pump Offer
 - e. Other
3. Which response best describes your utility's approach to a PTCS Duct Sealing Offer?
- a. Consumer gets incentive for PTCS Duct Sealing
 - b. Contractor gets incentive for PTCS Duct Sealing
 - c. Both consumer and contractor get PTCS Duct Sealing incentive
 - d. We do not have a PTCS Duct Sealing Offer
 - e. Other
4. Please check all of the other HVAC measures your utility offers:
- a. None
 - b. Duct Sealing (non-PTCS)
 - c. Heat Pumps (non-PTCS)
 - d. Ductless Heat Pumps/ Mini-splits
 - e. Ground Source Heat Pumps
 - f. Thermostats
 - g. AC
 - h. Other

PTCS Program Implementation

5. How do you market your PTCS heat pump or duct sealing offer(s)?
- a. My utility does most of the marketing
 - b. We rely primarily on the trade allies to do the marketing
 - c. Marketing is done by my utility and the trade allies
 - d. Other
6. Are there any additional resources you would like BPA to consider offering to assist your marketing efforts:



7. On a scale of “1” to “5” with “1” being “**very unclear**” and “5” being “**very clear**”, how clear are the PTCS specifications for utilities?
 - a. 1
 - b. 2
 - c. 3
 - d. 4
 - e. 5
 - f. Don’t Know
8. Optional comments on specifications:
9. Have you experienced any communication issues or other difficulties with the program implementation contractor, Ecos?
 - a. Many issues
 - b. Some issues
 - c. No issues
 - d. Don’t Know
10. [If Yes or Some] What issues did you experience?
11. Have you had any difficulties implementing PTCS?
 - a. Many difficulties
 - b. Some difficulties
 - c. No difficulties
 - d. Don’t Know
12. [If Yes or Some] Please describe these difficulties:



Database

13. Do you encounter any difficulties in the process of reporting a project in the **PTCS database (the site registry operated by Ecos)**?
 - a. Many difficulties
 - b. Some difficulties
 - c. No difficulties
 - d. Don't Know
14. [If Yes or Some] What PTCS database related difficulties have you experienced?
15. Do you encounter any difficulties in the process of reporting a project in **Bonneville's PTR database**?
 - a. Many difficulties
 - b. Some difficulties
 - c. No difficulties
 - d. Don't Know
16. [If Yes or Some] What difficulties?
17. Do you have any difficulty finding the correct measure in the PTR?
18. [If yes] What would make the measure description easier to use?
19. What changes could be made to improve the reporting process overall?
20. Please indicate how strongly you agree or disagree with the following statements on a 1 to 5 scale where 1 means "strongly disagree" and 5 means "strongly agree"
21. The amount of *overall* work associated with PTCS is reasonable for the benefit.
 - a. 1- Strongly Disagree
 - b. 2
 - c. 3
 - d. 4
 - e. 5- Strongly Agree



22. The amount of *administrative* work associated with PTCS is reasonable.
- 1- Strongly Disagree
 - 2
 - 3
 - 4
 - 5- Strongly Agree
23. Optional comments:
24. Do you think PTCS is achieving its intent to improve HVAC installation and save energy?
- Yes
 - No
 - Don't Know
25. Do you think the region might be better served by a prescriptive approach to HVAC installation and duct sealing?
- Yes
 - No
 - Don't Know
26. Optional comments:

PTCS Program and HVAC Goals

27. Is the PTCS program meeting your utility's goals or expectations:
- Yes
 - Somewhat
 - No
 - Don't Know
28. Are there any barriers or difficulties to PTCS meeting your goals or expectations?
- Yes
 - No
 - Don't Know



29. [If Yes] What barriers or difficulties?

Program Design

Previously, the PTCS program required a heat pump installation to be accompanied by duct sealing, where appropriate (i.e., when a substantial amount of the duct system is outside the heated envelope). For the 2010 program year, BPA separated these measures.

30. Is the current version of the PTCS program more, less, or equally as effective as the previous version in terms of saving energy?
- Less effective
 - The same
 - More effective
 - Don't know
31. Why do you say this?

PTCS Contractors

32. Are there enough PTCS certified contractors available to meet your utilities needs?
- Yes
 - No
 - Don't Know
33. Is the number of PTCS jobs meeting the expectations of certified contractors in your service territory?
- Yes
 - No
 - Don't Know
34. Have you had any problems with the PTCS-certified contractors?
- Yes
 - No
 - Don't Know
35. [If Yes] What issues? How were these issues resolved?



36. Are you aware of any barriers or difficulties contractors are experiencing with PTCS? (n
- Yes
 - No
 - Don't Know
37. [If Yes] What barriers or difficulties?

Satisfaction and Recommendations for Program Improvement

38. On a scale of “1” to “5” with “1” being “very unsatisfied” and “5” meaning “very satisfied”, how satisfied are you with:

PTCS Overall

The program implementer (Ecos)

Communication with the program implementer

PTCS technical specifications

PTCS Program requirements

BPA's responsiveness to questions/concerns about PTCS

- 1
 - 2
 - 3
 - 4
 - 5
 - Don't Know
39. Is there anything else for HVAC that your utility would like to offer?
40. Do you have any other thoughts to share?

Thank you for your time.



PTCS TRADE ALLY EMAIL SURVEY INSTRUMENT

INTERVIEWEE NAME:

DATE:

INTERVIEWER:

Introduction

BPA has hired Research Into Action, an independent research firm, to evaluate the Performance Tested Comfort Systems (PTCS) Program. As part of this evaluation, we are asking contractors to offer their feedback on the program and suggestions for possible improvements.

To complete the survey, please click on the link below and enter your 4 digit reference key. It should take 10 minutes or less to complete.

Your reference number is %Key 1%

Survey link:

If you have any questions about the survey or technical issues please call April Armstrong at Research Into Action, at 503-287-9136. If you have questions about the evaluation please contact Carrie Cobb at BPA, 503-230-4985.

Thank you in advance for your cooperation with research that is intended to improve the effectiveness of PTCS.

Screening Question for Participants vs. Non-Starting Contractors

1. Which of the following best describes your Performance Tested Comfort Systems (PTCS) experience:
 - a. I am a PTCS-certified contractor and I've completed PTCS jobs
 - b. I am a PTCS-certified contractor, but have *not* completed any PTCS jobs

Program Participation Experience

2. What PTCS services do you provide?
 - a. PTCS Heat Pump installation
 - b. PTCS Duct Sealing
 - c. Both
 - d. Neither [If “neither” skip to Q13]



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3. How long has your company been participating in the PTCS program? _____
4. How many PTCS-certified technicians do you have in your company? _____
5. What portion of your jobs are PTCS?
 - a. Less than 25%
 - b. 26%-50%
 - c. 51%-75%
 - d. More than 75%
6. Do you do any marketing for PTCS?
 - a. Yes
 - b. No
 - c. Don't know
7. Could any resources be made available to help you with your marketing? If so, what resources?
8. In your experience, what are the benefits of the PTCS program for your company [check all that apply]?
 - a. No benefits
 - b. Increased customer interest in HVAC or Heat Pump services
 - c. Increased business overall
 - d. Training and education
 - e. Quality assurance inspections of your work
 - f. Other: _____
9. What are the drawbacks of the PTCS program for your company [check all that apply]?
 - a. No drawbacks
 - b. Administrative work
 - c. Time spent
 - d. Specifications are difficult to meet
 - e. Specifications are difficult to understand
 - f. Utility requirements are problematic
 - g. Other: _____



10. Do you think PTCS saves energy over standard heat pump installation or duct sealing?

Training/Certification

11. How satisfied were you with the PTCS duct sealing training?

- a. Very satisfied
- b. Satisfied
- c. Not very satisfied
- d. Not at all satisfied
- e. Don't know/NA

12. How satisfied were you with the PTCS heat pump training?

- a. Very satisfied
- b. Satisfied
- c. Not very satisfied
- d. Not at all satisfied
- e. Don't know/NA

13. Did the PTCS training adequately prepare you for the field work?

- a. Yes
- b. No
- c. Don't Know

14. Do you have any suggestions for how the PTCS training could be improved?

15. Have you had any PTCS jobs inspected?

- a. Yes
- b. No
- c. Don't Know

16. [If yes] Were you given enough information on the inspection status and how to correct issues, if any?

17. Any comments on the quality control/ inspections?



Satisfaction

18. On a scale of 1 to 4 with 1 being “very unsatisfied” and 4 being “very satisfied”, how satisfied are you with:
- PTCS overall
 - The process of submitting jobs to Ecos for approval
 - Communication with Ecos
 - PTCS technical specifications
 - PTCS program requirements
 - Program quality control
 - Your utility’s responsiveness to questions/concerns related to PTCS

Non-Participants

19. How satisfied were you with the PTCS duct sealing training?
- Very satisfied
 - Satisfied
 - Not very satisfied
 - Not at all satisfied
 - Don’t know/NA
20. How satisfied were you with the PTCS heat pump training?
- Very satisfied
 - Satisfied
 - Not very satisfied
 - Not at all satisfied
 - Don’t know/NA
21. Do you have any suggestions for how the PTCS training could be improved?



22. What barriers have prevented you from doing any PTCS jobs?
- a. Program requirements
 - b. Lack of consumer demand in my area
 - c. Equipment costs
 - d. Other: _____
23. Any comments on barriers?

Recommendations (both part and non-starting)

24. Do you have any recommendations for how to improve PTCS overall?

Thank you for your time.



PTCS PEER UTILITY INTERVIEW GUIDE

INTERVIEWEE NAME:

UTILITY:

DATE:

INTERVIEWER:

RESEARCH ISSUES:

- Advantages and disadvantages of prescriptive vs. performance duct sealing
- Sizing of HPs – who does it and how much does size affect efficiency?
- Program requirements and procedures: including implementation, tracking, and quality control
- Program marketing
- Opinions on key issues and best practices for Heat Pump and Duct Sealing programs

Hello, my name is _____ . I'm with research Into Action in Portland, Oregon. We have been hired by the Bonneville Power Administration to assess its protocols for Performance Tested Comfort Systems especially in regard to installation requirements for heat pumps and duct sealing practices. To help BPA identify best practices for those activities, I would like to ask you a few questions about your utility's heat pump and duct sealing programs. Do you have 20 minutes to a half hour to talk to me at this time, or would you prefer that I call back another time? [Proceed as appropriate]

Heat Pumps

1. What are the program requirements for your heat pump program? [If information not available from website review.]
 - a. HSPF requirement? [heating]
 - b. SEER/EER requirements? [cooling]
 - c. Is the focus of your program energy savings from heating, cooling, or both?
 - d. Coefficient of Performance (COP) requirement? [ground-source heat pumps]
 - e. Commissioning or set point requirement?
 - f. Controls? (outdoor thermostat and strip heat lock out)
 - g. Duct sealing requirement?



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- h. Weatherization requirement or incentive bonus?
 - i. Other _____
2. About how many heat pumps are installed per year through your programs?
3. [If information not available from website review] What are the program's incentive tiers?
4. Does your program offer financing? If so, what are the terms? How, if at all, has the financing impacted program participation?
5. Do you size heat pumps to maximize efficiency for the cooling load or the heating load?
6. Do you try to prevent over-sizing of equipment? Why or why not? How? Who specifies the size of the heat pumps on projects?
 - a. Utility
 - b. Contractor
 - c. Other _____
7. Please describe your duct sealing offer.
 - a. Prescriptive vs. performance?
 - b. [If performance based:] What are the leakage testing requirements?
 - c. Insulation requirements?
8. What is your process of project approval/quality control? Do you inspect heat pump installations and duct sealing jobs?
9. [If not addressed] What is your sampling protocol for inspections? That is, what proportion of installations are inspected, how many inspections occur, and at what points in the project?
 - a. All
 - b. Percentage _____%
 - c. Other _____
 - d. When in the process?



10. Duct sealing inspection requirements (or other system of QA/QC, if not already addressed)?
 - a. All
 - b. Percentage _____%
 - c. Other _____
 - d. When in the process?

Trade Allies

11. How do you recruit trade allies?
12. What are the requirements for contractor training and certification? [Probe for both heat pump installation and duct sealing and insulation work]
13. What training does the utility provide? What works particularly well? [Probe for type of training (hands-on, lecture, web-based), venue (home, lab, etc.), and for training equipment availability]
14. Who provides technical support to trade allies? Do trade allies have any difficulty with the installation procedures? With the application forms?

Administrative

15. About how many staff work on some aspect of the heat pump program (part time or full time, in-house staff and implementation contractor)?
16. What are their positions or roles?
17. About how many FTE is that? [Distinguish between in-house staff and implementation contractor]
18. Who records and tracks program data? [If implementation contractor] How does program staff access that data? [Probe for multiple databases] [If multiple databases] What impact does that have on program tracking and delivery?
19. Are you able to meet fluctuating participation levels, or are there bottlenecks in the process that limit your ability to quickly scale up if needed?
20. What types of problems have you encountered and what lessons have you learned?



Best Practices

21. What do you think are key issues for successful Heat Pump energy efficiency programs?
22. ...for Duct Sealing programs?
23. [If not addressed:] How do you approach these issues?
24. What do you think are the advantages and disadvantages of prescriptive duct sealing, vs. performance-tested duct sealing?
 - a. Advantages of prescriptive:
 - b. Advantages of performance testing:
25. What do you feel has worked well on your program?
26. What has not worked well?
27. Have you ever conducted any research on heat pumps and/or duct sealing—such as market research, impact analyses, technical or market potential, or studies supporting technical requirements? What did you find? Could we have access to the findings of this research?
28. About how many residential customers does your utility have?

Those are my questions. Thank you very much for your time.





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PERFORMANCE TESTED COMFORT SYSTEM (PTCS) PROGRAM



PEER UTILITY PROGRAM DETAILS

INCENTIVES

Ducted, Air-to-Air, Split-System Heat Pumps

Figure B.1: Ducted, Air-to-Air, Split-System Heat Pump Efficiency and Incentives

Tier	SEER	EER	HSPF	Other	Incentive
Sacramento Municipal Utility District					
Tier 1	14.5	12	8.5	—	\$400
Tier 2	15	12.5	8.5	—	\$500
United Power (Brighton, CO)					
Tier 1	13	11.5	7.7	Ceiling insulation=R-40; walls=R-14	\$400*
Tier 2	14.5	12.5	9.0	Ceiling insulation=R-40; walls=R-14	\$150**
Baltimore Gas and Electric					
Tier 1	14	11.5	8.5	—	\$200
Tier 2	15	12.5	8.5	—	\$400**

* Plus \$150 per ton from Tri-State Generation and Transmission Association, Inc.

** This is a bonus from Tri-State Generation and Transmission Association, Inc. for ENERGY STAR®-rated units.



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Geothermal Heat Pumps

Note: The tables in this section address closed-loop systems.

Figure B.2: Geothermal Heat Pump Efficiency and Incentives

Tier	SEER	EER	HSPF / COP	Other	Incentive
Sacramento Municipal Utility District					
Tier 1	14	11	8	—	\$400
Tier 2	14	12	8	—	\$500
United Power (Brighton, CO)					
Tier 1	—	13	2.8	Ceiling insulation=R-40; Walls=R-14	\$2,500*
Tier 2	16	13.5	9.5*	Ceiling insulation=R-40; Walls=R-14	\$150 Bonus***
Baltimore Gas and Electric					
Tier 2	15	12.5	none	—	\$400

* The State of Maryland offers energy tax credits and rebates for geothermal systems. For more information, see <http://www.bairnecessities.com/energy-tax-credits-maryland.php>.

** Geothermal not formally allowed, so no COP requirement. BGE uses the Tier-2 rebate from air-source heat pumps for geothermal heat pumps because they have very few geothermal heat pump installations (11 in 2010).

OTHER PROGRAM PARAMETERS

Inspections

Figure B.3: Pre-Inspections and Heat Pump Sizing

Utility	Utility Approach
Baltimore Gas & Electric	Pre-inspection and heat pump sizing is part of a separate optional <i>Quality Installation</i> program, which includes accurate sizing, proper equipment selection, correct duct distribution design, proper refrigerant charge, and correct airflow. Quality Installation offers an additional rebate of \$200.
SMUD	Pre-inspection is required by Title 24, but not enforced because of lack of labor. New contractors, problem contractors, and those who are doing many jobs are the focus of inspections. They try to inspect 5% of all jobs and every contractor at least once a year.
United Power	No pre-inspections; contractors size the heat pumps.



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Figure B.4: Final Inspections

Utility	Utility Approach
Baltimore Gas & Electric	10% inspections through a third-party implementer. BGE staff QA person does field inspections to assure job was done: verifies 10% of jobs for completion of paperwork and accuracy of numbers.
SMUD	Inspections conducted by Home Energy Rating System (HERS) raters on approximately one in seven, randomly selected jobs of each contractor.
United Power	100% of rebated heat pumps are inspected to verify installation of heat pump rather than merely AC unit.

Duct Sealing Requirements

Figure B.5: Duct Sealing Requirements

Utility	Utility Approach
Baltimore Gas & Electric	No duct sealing requirement with heat pump; there is a separate duct sealing program with a \$200 rebate. Duct sealing program requires either: 1) post-test measurement with 50% reduction in total leakage from pre-test; or 2) achieve minimal total leakage of 150 cfm.
SMUD	Two ways to meet duct sealing requirement: 1) Title 24 requirements are used for new construction, for retrofits where more than half of ducts are replaced, and where no ducts previously existed; 2) AeroSeal may be used for other situations.
United Power	No requirements.

Trade Ally Qualifications For Listing On Utility Website

Figure B.6: Trade Ally Qualifications for Listing on Utility Website

Utility	Utility Approach
Baltimore Gas & Electric	Contractors must have HVACR license (state license) and meet insurance requirements. They also have annual participation agreement.
SMUD	Utility reviews contractor’s license, insurance, and bonding, but there are no training or certification requirements other than to provide references and a general description of training. AeroSeal must certify duct sealing.
United Power	Installation of one inspected, properly installed heat pump.



Utility Provided Training

Figure B.7: Utility Provided Training

Utility	Utility Approach
Baltimore Gas & Electric	BGE offers “some light technical training,” but primarily looks to manufacturers to provide a majority of the training.
SMUD	Contractors must attend a financing training class to be able to offer financing.
United Power	None provided.

Program Staffing

Figure B.8: Program Staffing

Utility	Utility Approach
Baltimore Gas & Electric	In-house: 0.33 FTE; Third-party contractors: 4 to 5 FTE.
SMUD	Total staff who touch program: 8 or 9. FTE: about 4 (loan processing done by utility staff).
United Power	Total staff that touch program: 8. FTE: about two or three.

