

FINAL REPORT

Building Tune-Up and Operations Program Evaluation

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Executive Summary

Energy Trust of Oregon's (Energy Trust) Building Tune-Up and Operations Program (BTO) has three primary services: 1) boiler tune-ups, 2) building tune-ups, and 3) retrocommissioning (RCx).¹ Boiler tune-up activities for the program are mostly complete, but building tune-up and retrocommissioning activities are still underway. This report describes the evaluation progress, results, and insights from program initiation in Summer 2005 through mid December 2006.

The overall goal of the BTO evaluation is to provide Energy Trust feedback on how the program is progressing towards achieving its goals and to offer actionable recommendations that will help improve current or future program structure and delivery. To achieve this goal, the evaluation collected and reviewed program documentation, conducted interviews with program staff, boiler contractors, retrocommissioning service providers and boiler tune-up participants, and joined boiler technicians on two ride-alongs to observe the boiler tune-up process. The evaluation results for building tune-up and retrocommissioning activities are preliminary. A final evaluation memorandum in Summer 2007 will add the results of these continuing activities.

Program Theory, Background, and Delivery

Program staff believe substantial energy savings can be achieved through improved operation and maintenance (O&M) in commercial buildings. The boiler tune-up portion of BTO provides a simple tune-up service that is expected to save approximately 2-5% of total annual boiler gas consumption. This contrasts with the other elements of BTO that are intended to take a more comprehensive look at savings opportunities from O&M improvements throughout the building.

The building tune-up and RCx services of the program presume that O&M services provided in the market place are not well defined or coordinated. To address this fundamental problem of defining and coordinating services, BTO markets a set of service definitions and a step-by-step approach that service providers can use to help deliver building O&M services. Energy Trust staff viewed BTO as a pilot program to help prove if cost-effective energy savings can be delivered through building operation improvements.

In 2005, Energy Trust hired Portland Energy Conservation Inc. as the Program Management Contractor (the PMC) to develop and manage the BTO. PMC staff report that the boiler tune-up portion of the program is a traditional design that draws on the experience of similar programs throughout the country. Boiler contractors drove boiler tune-ups, contacting customers, bringing in projects, conducting the tune-up, and filling out the paperwork.

¹ Originally, building tune-ups and retrocommissioning were combined into one service, but they are currently being delivered and reported on separately. The program also provides grants for Building Operator Certification, but this component is not considered in this evaluation.

The building tune-up element uses the Building Performance Services (BPS) approach, which had already been developed by the Northwest Energy Efficiency Alliance (NEEA). NEEA leads building tune-up projects through initial contact, information gathering, scoping, and diagnostics. Once a project gets to the implementation phase they coordinate with Energy Trust to provide incentives for implementing improvements and for measures that will help savings persist over time.

The RCx track was added to the program in February 2006 to help the program meet its performance goals as projected building tune-up projects would not deliver the savings needed. The PMC leads the initial steps of a RCx project, recruiting the participants and conducting enhanced screening to determine if sufficient opportunities exist for RCx. Once a project passes the enhanced screening phase, the client selects a service provider. The PMC develops the scope and a budget and the service provider conducts the building investigation to identify opportunities for improving building performance. The owner reviews the recommendations, selects measures to implement, and chooses who will implement the measures. The final step in the process is to implement a persistence strategy to help maintain the energy savings.

Summary of Findings

- While BTO had a slow start, the PMC and Energy Trust worked well together to adjust the program and move forward. This included working with NEEA to define goals and roles for delivering building tune-ups, adding the RCx track, adding budget to the boiler tune-up program to accommodate more projects, notifying boiler contractors the program would not be continued due to low savings, and creating a way to continue modest building tune-up and RCx efforts.
- The boiler contractors recruited enough participants to fill the boiler queue and the initial tune-ups were completed and incentives paid well before the end of the BTO program. Participants were very satisfied with the boiler tune-up program. However, the boiler tune-ups results were disappointing. The boiler contractors had significant difficulty completing the boiler incentive and completion certification forms, program staff were concerned about the accuracy of the data on the forms, boiler savings were much less than expected, and most of the tune-ups occurred at schools and universities, which tend to have smaller boilers that operate less than the boilers at other commercial institutions. While this helps explain the lack of savings, questions remain about the viability of the market for boiler tune-ups.
- Little progress has been made delivering energy savings from building tune-up projects, with only one new project being initiated since the start of BTO. Several other building tune-up projects started as part of the BPS Test, but they have taken years to complete and a couple have been discontinued. Explanations for the lack of progress include the split in responsibilities between NEEA and the PMC for delivery of tune-up projects, differences in the goals for NEEA (market transformation) and Energy Trust (resource acquisition and project delivery), the

lack of a well defined process to move projects forward to completion, and little motivation from trade allies to recruit building tune-up projects.

- The seven projects recruited for the RCx portion of BTO have successfully progressed through the investigation phase. These projects will likely deliver energy savings and help BTO meet its goals, although preliminary estimates show the levelized cost of the savings are above Energy Trust's benchmark. The PMC was successful recruiting participants from the target population of downtown Portland property owners, its enhanced screening worked well, and projects started in a timely fashion. Service providers have shown they can deliver the RCx services defined by the program.

Conclusions and Recommendations

1. **Conclusion:** Program staff described BTO as a pilot, yet the overall program was not sold to Energy Trust's Board as a pilot and it had resource acquisition targets and a 2-year performance-based program management contract like other Energy Trust programs. While some performance requirements were adjusted, the ability of the program to test approaches for obtaining energy savings from building operation improvements was limited because BTO was not set up as a pilot. Nevertheless, a lot was learned through the openness and diligence of program staff and contractors.

Recommendation: Energy Trust needs to consider whether or how it should conduct pilot programs. Conducting a pilot program with a small set of projects using a resource acquisition framework is not conducive to testing program alternatives, since resource acquisition documentation, reporting requirements, and performance goals draw significant resources away from the pilot effort. While a pilot program can deliver energy savings, it should be set up to test specific delivery approaches with clear research questions and methods. The Evaluation Team should be involved in pilot program development. This additional development and evaluation effort has a cost, but allows for a more thorough test of program delivery approaches.

2. **Conclusion:** The results show it is hard to justify a stand-alone boiler tune-up program or a program path that only offers boiler tune-ups. While some of the challenges in boiler tune-up program delivery could be addressed through improvements in the forms and data collection and with experience, it is not clear there is a market with sufficient savings opportunities for boiler tune-ups. The limited savings opportunity does not justify the investment in the program infrastructure to make the program successful.

Recommendation: If Energy Trust is able to more clearly identify a market for boiler tune-ups and can target the boilers with savings potential, focused attention on boiler tune-ups might be justified. Otherwise, boiler tune-ups should be one of the service options available within Energy Trust's Building Efficiency (BE) program and tune-ups should be used in combination with other measures to improve boiler and building efficiency. The incentive forms should be simplified as much as possible, with input from boiler contractors, to improve the consistency and quality of data

collected from the tune-ups. Continued experience with boiler tune-ups will help show whether further research and development of this service offering is warranted.

3. **Conclusion:** Ultimately, BTO has not been able to test the building tune-up process. Much of the program emphasis has been placed on RCx, where the PMC has more experience and control. It is not clear whether the tune-up process developed by NEEA can be a cost-effective way to acquire energy savings from O&M improvements in buildings.

Recommendation: Evaluation results suggest that testing the viability of building tune-ups requires a more comprehensive and integrated effort. This may be beyond the primary goals of Energy Trust, but defining and testing a tune-up approach that has the potential for quickly and cost-effectively delivering energy savings from O&M measures is clearly needed. Such a test could address these questions:

- Can tune-up projects be done in a timely fashion? Most of the BTO building tune-up projects took a couple of years to complete and experienced delays. For tune-up projects to be successful, does this process need to be significantly shortened?
- Are incentives needed to implement the recommendations from a tune-up investigation? The one completed BTO building tune-up project implemented the recommended measures without an incentive and the total payback was less than a year. Ideally a tune-up project should be finding low cost measures. Are such measures enough of an incentive for an owner to proceed?
- Is the tune-up process different from a RCx process? The steps in the BTO tune-up are similar to those used in the RCx process, but with somewhat less rigor. The tune-up service providers included some controls contractors, while the RCx service providers all had commissioning backgrounds. Should these two processes be more clearly distinguished from one another and if so, how?

4. **Conclusion:** The RCx approach being used by BTO appears to be a viable way to produce energy savings from O&M measures. While this type of program is a valuable part of Energy Trust's portfolio, the cost is higher than their other energy efficiency programs.

Recommendation: Energy Trust plans to incorporate RCx into the BE program. This is a good way to reduce the infrastructure costs of RCx, while continuing to offer the service. Energy Trust should continue to maintain a modest RCx approach to gain experience with the delivery of this service and to explore how it can integrate into existing service offerings. Energy Trust should track similar programs in other states as well as initiatives at NEEA to learn from their experiences.

5. **Conclusion.** Organizations involved with energy efficiency have pointed to the large energy savings potential from O&M improvements in existing buildings, but have had mixed success tapping this potential. Any existing buildings energy efficiency program that strives to significantly improve the performance of existing buildings will need to address building O&M. However, programs focused on O&M have

tended to be expensive and difficult to manage. The results for BTO are consistent with this experience.

Recommendation. One way Energy Trust can address this issue is to merge these services into the BE program. We believe Energy Trust should more fully explore how it can leverage existing program infrastructure to obtain energy savings from O&M services, asking questions such as: To what extent can O&M services be integrated with existing building efficiency and training programs? Like new construction programs, can there be a “whole buildings” approach for existing buildings that offers a comprehensive range of integrated services that aim to produce a high performance building? How should O&M be included with new energy efficient equipment programs to ensure the long-term reliability of energy savings? O&M services often have difficulty standing on their own because the energy savings are not large enough to justify the investment in the project. To survive, either the investment needs to be reduced, or the services need to be included in a more comprehensive package.

Energy Trust Staff Response to Evaluation Findings and Conclusions

The evaluation results support the Energy Trust's decision to halt the Building Tune-Up and Operations Program as it is currently conceived. The program has served its purpose as a pilot program showing that the two main services that were offered through the program either provided high savings that exceed the benchmarks established by the PUC in the case of retrocommissioning (RCx) or non-cost effective savings as a standalone measure in the case of boiler tune-ups.

Energy Trust has moved RCx services to the Existing Buildings (EB) program, but currently is not marketing them heavily. This allows Energy Trust to continue to gain experience in this area without incurring a large investment. Other areas of the country are mounting larger RCx programs and Energy Trust will be able to adopt successful implementation strategies once they have been proven in those regions. RCx is viewed by Energy Trust as an attractive component to the EB program. Energy Trust still needs to consider how to incorporate it effectively into the EB Program and decide to expand it when increased and stable electric funding in 2008 or later.

Energy Trust found that it is difficult to accurately estimate savings for boiler tune-ups. And that the savings that were estimated did not result in a cost effective stand alone measure.

Another interesting finding is that many commercial buildings' boilers seemed to be getting tuned on a regular basis. The participants that participated heavily in the initiative are facilities that may not otherwise be able to have their boilers tuned due to lack of funding (e.g. schools). For existing commercial gas boilers Energy Trust must do further research into what bundle of services can be cost-effectively offered. Controls, cleaning steam traps, and pipe insulation are measures and services that can be considered. For some systems early replacement with an efficient condensing boiler and "right sizing" the equipment might be a cost effective option. The primary challenge is how to develop an effective and cost-effective system to market and deliver these measures.

Northwest Energy Efficiency Alliance (NEEA) has been developing and testing a variety of building efficiency services in collaboration with Energy Trust and other regional utilities. NEEA's market transformation strategy leaves much of the marketing and project development in the hands of commercial O&M service contractors. Initially simple tune-up services were envisioned to be part of the Energy Trust program, but to prevent confusion in the market place these services were left to NEEA to promote as part of their Better Bricks program.. Few projects came about and were completed from these activities both due to a redesign of the program by NEEA and the general difficulty to get maintenance contractors and commercial customers to commit to engaging these types of services.

These services are also being promoted by BOMA and the EPA with online and local trainings through their BOMA Energy Efficiency Program (BEEP) program. As with RCx services, Energy Trust views this as a developing market that should be monitored to determine when or if we should do another foray with a standalone program into the market. Until that time Energy Trust is supporting a variety of research projects and limited RCx projects through existing programs that will support a future program focusing on commercial O&M services.

Chapter One: Introduction and Evaluation Approach

Evaluation Goal and Tasks

This report describes the evaluation progress, results, and insights from program initiation in Summer 2005 through mid December 2006 for Energy Trust of Oregon's (Energy Trust) Building Tune-Up and Operations program (BTO program).² The BTO program, delivered by Portland Energy Conservation Inc., the Program Management Contractor (the PMC), has three primary services: 1) boiler tune-ups, 2) building tune-ups, and 3) retrocommissioning (RCx).³ Boiler tune-up activities for the program are mostly complete, but building tune-up and retrocommissioning activities are still underway. A final evaluation memorandum in Spring 2007 will report on the results of these continuing activities.

The overall goal of the BTO evaluation is to provide Energy Trust feedback on how the program is progressing towards achieving its goals and to offer actionable recommendations that will help improve the program's structure and delivery. To achieve this goal, the evaluation includes the following tasks:

1. Document the structure and activities of the program's services
2. Document and analyze the program theory and logic
3. Review cost effectiveness assumptions
4. Review and assess the accuracy of boiler tune-up savings estimates
5. Review the quality assurance/quality control process
6. Analyze program delivery and management
7. Analyze satisfaction with the program

Summary of Evaluation Efforts and Methods to Date

Consistent with the tasks described above, the evaluation team has conducted the following activities:

- Attended evaluation kick-off meetings with program staff and the PMC, and an orientation meeting for boiler tune-up trade allies.
- Collected and reviewed program documentation, including the program's work plan and marketing plan; boiler and building quality control protocols; orientation session Power Points; monthly reports from the PMC; boiler tune-up energy savings calculations and quality assurance review; findings workbook, guidelines, MOU, forms, strategies, and other materials for retrocommissioning projects; boiler tune-up and retrocommissioning fact sheets; boiler tune application form and trade ally agreement; and Energy Trust website information on the program.

² The BTO program is viewed as a pilot program.

³ Originally, building tune-ups and retrocommissioning were combined into one service, but they are currently being delivered and reported on separately. The program also provides grants for Building Operator Certification, but this component is not considered in this evaluation.

- Reviewed program structure, theory and logic based on program documents and interviews.⁴
- Developed interview guides and conducted interviews in Spring 2006 (March and May) and December 2006 with appropriate management and staff from Energy Trust (2 interviews), the PMC (4 in first interview, 3 in the second), and the Northwest Energy Efficiency Alliance (NEEA – 2 interviews). These interviews asked about program history and development, market logic and understanding, program delivery, management, quality control, and cost effectiveness, program status and results, and other program evaluation issues.
- Developed interview guides and conducted interviews with representatives from the six organizations that participated in the boiler tune-up portion of the program. Most of the interviews were with facility managers or engineers and covered how they heard about the program, why they participated, satisfaction with program delivery, benefits received, changes in boiler practices, and recommendations for service changes.
- Developed interview guides and conducted interviews with representatives from the four Boiler Tune-up Contractors, including one owner, three sales representatives, and two managers. Interviews were conducted before the tune-ups and after they were finished⁵. Interview topics included contractor motivations for participating, program processes and requirements, program design and service delivery, views on marketing and market interest in program services, customer and contractor satisfaction, results, and suggestions for improvement.
- Joined boiler technicians on two ride-alongs to observe the boiler tune-up process and conducted one interview with a boiler technician asking about his experience conducting the boiler tune-ups.
- Developed interview guides and conducted initial interviews with seven Retrocommissioning Service Providers that were in the pool of RCx service providers for the BTO Program. Respondents included owners and principles, operations managers, and a sales representative. Interview topics addressed motivations to participate, the orientation session and their understanding of the program, delivery of RCx services, their views of the market for RCx services and suggestions for improving the program. We anticipate conducting interviews in the Spring of 2007 with retrocommissioning service providers and participants once their projects are complete.

All of these sources of information have been incorporated into this report.

⁴ Note: Information available on the theory and logic behind the boiler tune-up component of the program is minimal at this point.

⁵ One of the boiler contractors had already completed their tune-ups prior to the first interview and was not interviewed a second time. One contractor did not conduct any tune-ups, but a brief second interview was conducted.

Structure of Report

The remainder of this report is organized into these sections:

- Chapter Two: Program Logic, Description, and Background
- Chapter Three: Boiler Tune-Up Evaluation Results
- Chapter Four: Building Tune-Up Evaluation Results
- Chapter Five: Retrocommissioning Evaluation Results
- Chapter Six: Summary of Findings, Conclusions, and Recommendations

Chapter Two: Program Theory, Background, and Delivery

Program Theory and Logic

Boiler Tune-Ups

Boiler tune-ups were developed to capture gas savings in buildings on NW Natural commercial rate schedules. Boiler tune-ups focus on providing simple boiler tune-up services that are expected to save approximately 2-5% of total annual boiler gas consumption. In contrast to the other elements in the BTO Program, boiler tune-ups use a simple process and address one specific end-use. Energy Trust developed an initial program delivery model. However, through implementation experience and evaluation results, Energy Trust expected to learn how to streamline program delivery and maximize energy savings. Staff from the PMC and Energy Trust (program staff) expect the target market for boiler tune-ups to be a mix of commercial buildings and hospitals.

Building Tune-Up and Retrocommissioning

Program staff believe substantial energy savings can be achieved through improved operation and maintenance (O&M) in commercial buildings. This opportunity has received limited attention due to Energy Trust's focus on resource acquisition. However, interviews with program staff show they agree the time is right to begin addressing these market niches. They pointed to owners becoming more aware their buildings are not working as well as they could and that services such as RCx can be useful. In addition, they said some examples of successful programs and approaches exist, noting that Portland General Electric's retrocommissioning program provided some of the lowest cost energy savings among Energy Trust's initial program offerings⁶. But they also agreed that persistence and patience are needed.

Consistent with its goal of working with local partners, Energy Trust worked with NEEA on their Building Performance Services (BPS) Test to conduct some pilot projects among commercial customers in Energy Trust's service area. NEEA continues to develop, test and promote business practices and building operations services that improve building operating performance through its BetterBricks Initiative in the commercial sector. Providing services in this area continued this collaboration with NEEA.

The building tune-up and RCx services of the program presume that operation and maintenance services provided in the market place are neither well defined nor well coordinated. Program staff view the market for these services as very fractured with lots of segments and unclear incentives for improving building O&M. They think service providers need to believe and promote the value of delivering improved O&M services and building owners need to recognize the value of those services.

⁶ Private electric utility programs transitioned to Energy Trust when it was created.

Specific barriers to taking action include owners who have significant questions regarding the credibility of new services being offered by service providers who have traditionally focused on equipment sales; building operators needing training or being concerned about exposing operational issues; and owners not being acquainted with commissioning type services. All these factors make it difficult for building owners to know how to substantially improve building performance or obtain support from trade allies to do so. At the same time, service providers may not be prepared to offer these services given current staff and organizational structures.

To address the fundamental problem of defining and coordinating services, BTO is marketing a set of service definitions and a step-by-step approach that service providers can use to help deliver building operations and maintenance services. Energy Trust staff view BTO as a pilot program to help prove whether there are cost-effective energy savings from building operation improvements. There are energy savings targets for the program, but there are also some broader market transformation goals. They would like to raise awareness in the market about the program and building operations services, get contractors involved to help develop the infrastructure to deliver these services, and to provide quality service to help create a foundation for future demand growth.

Thus, in the short term these services are focused on delivering cost effective energy efficiency services and measures. In the long term, if these services are supported, Energy Trust expects that service providers will market and show the value of these services and building owners and managers will value and demand these services resulting in a market for enhanced building O&M, system tune-ups, and RCx that will increase and eventually become the industry norm.

Program staff view large commercial buildings as the target market for tune-up and RCx projects. For RCx the focus is on large office buildings in downtown Portland. The PMC emphasized that to encourage owners to participate they must pitch the resources the program can provide. Many building owners recognize they have problems and do not have the staff or resources to address the problems. Having a third party – a fresh set of eyes – come in and do a whole building assessment is attractive. The program incentives along with the persistence elements of the program help take away some of the risk for participating. In addition, many of the savings opportunities have short paybacks.

Program Background and Development

In 2005, Energy Trust issued a request for proposals (RFP) for a PMC to develop and manage their Building Operations and Tune-up Program. The RFP had four primary elements: building tune-up, boiler tune-up, compressed air systems, and HVAC roof-top unit tune-ups. The building tune-up element was essentially a continuation of the BPS approach. Boiler tune-up was added as a simple way to obtain natural gas savings from a specific piece of equipment (as opposed to the whole building). The compressed air system component of the program was dropped because it seemed to fit better in the existing Energy Trust Building Efficiency (BE) program. They also decided not to include HVAC roof-top tune-ups in the program at that time.

The PMC has had primary responsibility for program design. PMC staff report that the boiler tune-up portion of the program is a traditional design that draws on the experience of similar programs throughout the country. The building tune-up element uses the BPS approach, which had already been developed by NEEA. For building tune-up projects, NEEA takes the lead role and the PMC plays a support role. The retrocommissioning track was a late addition to the program in February 2006. The PMC and Energy Trust believed they needed this additional program delivery mechanism to bring in enough projects to meet their goals. The PMC developed the retrocommissioning service track for BTO over a three month period drawing on their experiences delivering retrocommissioning programs in other parts of the country.

Program Delivery

Boiler Tune-Ups

Boiler contractors drove boiler tune-ups, contacting customers and bringing in projects. The boiler contractors then conduct the tune-ups and complete the incentive forms. Both the contractor and owner sign a form showing the tune-up has been completed and agreeing to the terms and conditions set by the program, which includes conducting 2 more annual tune-ups on the boilers. The PMC reviews the completed form for completeness and enters the information into Energy Trust's tracking system. The incentive goes to the boiler contractor. It is intended to cover 100 percent of the tune-up cost in year one and two (up to a maximum of \$600) and 50 percent of the cost in year three (up to a maximum of \$300). The contractor deducts the incentive amount from what they charge the customer.

The PMC works with the contractors to support their delivery of boiler tune-ups. This includes orienting them to the program, responding to questions, checking with them to see how things are going, and tracking the boiler projects commitments so the program does not become over subscribed. The PMC also calculates the energy savings for each tune-up using a savings calculation they developed based on billing data and information collected during the tune-up.

Building Tune-Ups

NEEA leads building tune-up projects through initial contact, information gathering, scoping, and diagnostics. Once a project gets to the implementation phase they coordinate with Energy Trust to provide incentives for implementing improvements and for measures that will help savings persist over time.

Retrocommissioning

The PMC plays a lead role in the initial steps of a RCx project before handing off to the service provider. The PMC explained that once a potential client has agreed to participate, they, not the service provider, conduct an enhanced screening to determine if sufficient opportunities exist for RCx. This enhanced screening combines the screening and scoping step often used in RCx programs. Previous projects have taught the PMC that service providers can get bogged at this point, causing delays. With the PMC conducting these steps, they hope projects will move more quickly.

Once a project passes the enhanced screening phase, the client selects a service provider from the pre-qualified list the program provides; the list includes service provider qualifications. The PMC uses a template to develop the scope of work and a formula to calculate the budget for the building investigation, which is then presented to the service provider. Once the PMC and service provider agree, they sign a contract, and the service provider moves forward with the building investigation, identifying opportunities for improving building performance. The owner reviews the recommendations, selects measures to implement, and chooses who will implement the measures (i.e., the service provider, building staff, or another contractor). The final step in the process is implementing a persistence strategy to maintain the energy savings. These strategies might include training or follow up documentation depending on the project and what is appropriate for the customer.

At several points in the RCx process the building owner commits to moving forward or implementing certain actions. Once a building passes screening the owner signs a memorandum of understanding that specifies program incentives earmarked for the project. The owner commits to implement the measures identified during the investigation phase of RCx that will pay back in one year or less in exchange for the incentives that paid for the building investigation. To help the owner manage their financial risk, the program provides an implementation cost cap tied to the projected cost savings. Once the investigation is complete, the program can provide implementation incentives to buy-down the payback for measures with more than a one-year payback. This is included in an incentive offer the owner signs agreeing to implement the measures in a certain period of time. After the measures are implemented the program offers up to \$4,500 for the persistence strategies that the owner chooses to accept.

Quality Control

The PMC has developed a protocol for boiler tune-ups and RCx to track projects and accept and review forms. They created a table by deliverable that lists the review criteria, when it is submitted, who does the review, and the expectations. RCx projects also have documentation guidelines for 19 common measures. The guidelines provide information on identifying the problem, capturing the baseline, calculating savings, providing evidence of implementation, and collecting post-implementation data. For building tune-up projects NEEA has a system for tracking findings that shows costs and savings in different categories. The PMC reviews the reports from the tune-up service providers to determine eligibility for implementation and persistence incentives.

Coordination with other Energy Trust Programs

BTO could interact with other Energy Trust programs, particularly the BE program, since the types of customers and buildings being recruited are similar and participants in one program could be candidates for the other. The PMC has met with the PMC for BE and they agreed to maintain contact. However, since program funds for BE are “maxed out” and there are few BTO pilot projects, opportunities for interaction between BTO and BE are minimal.

Chapter Three: Boiler Tune-up Evaluation Findings

This chapter reviews the status of the boiler tune-up portion of BTO along with insights and feedback from boiler contractors, participants, and program staff. It concludes with a quality assurance review.

Boiler Tune-up Project Status

The boiler tune-up program got off to a slow start in the design phase and missed the first tune-up season in the fall of 2005. The program was about to send a mailing to recruit participants, but in March 2006 the trade allies informed the program they had recruited enough participants to fully subscribe the program and create a queue of 130 potential boiler tune-ups. By the end of the year, three of the four service providers involved with the program received incentives for 95 tune-ups (Table 1). The tune-ups for Portland Public Schools were completed in November 2006. All the others were done between March and May 2006.

Table 1 Boiler Tune-Ups Receiving Program Incentives

Trade Ally	Project	# of Boilers	Status
Boiler & Combustion Services	Reed College Swiss Cleaners & Tailors	3	Completed in April and May 2006
Siemens	Hillsboro SD	31	Completed in April 2006
Siemens	Willamette University	15	Completed in April and May 2006
McKinstry	Gresham Barlow SD	28	Completed in May 2006
McKinstry	Portland Public	18	Completed in November 2006
	Total	95	

Two boiler contractors conducted most of the tune-ups. By recruiting school districts and a university, they conducted a large number of tune-ups for several clients. One contractor conducted only three program tune-ups and another did not conduct any. This contractor worked with the Federal Buildings in Portland to arrange some tune-ups (the queue had 13 potential tune-ups, which dropped to three), but ultimately this potential client completed the tune-ups through their existing maintenance contractor. The remaining difference between the completed tune-ups and the original 130 in the queue can be explained by tune-ups that did not materialize or that were not eligible for incentives.

The program sent a memo to the boiler contractors in September 2006 informing them that the program would not be continued because the initial results showed the tune-ups were not cost-effective (this is discussed in more detail below). Boilers that have received tune-ups will be eligible for incentives for annual tune-ups in 2007 and 2008 as promised by the program.

Feedback from Boiler Contractors and Technicians

Motivations to Participate and Program Understanding

The PMC directly contacted three of the four boiler contractors about the boiler tune-up program and asked them to respond to a request for qualifications. The fourth contractor learned about the program from a customer. Contractors became involved in the program because boiler tune-ups are a service they provide and the program was an opportunity to get new customers and increase their business.

All four contractors said the PMC has done a good job explaining the program to them and that it has been responsive to the questions they have. Two of the four contractors said communication with the PMC has been very good, a third contractor was also positive, while the fourth described communication as adequate. This contractor had trouble getting a question answered when the primary PMC contact was out.

All the trade allies were open to participating in a boiler tune-up program if it were offered by Energy Trust in the future. However, the enthusiasm of the responses varied and some sounded as if they tried to take advantage of any opportunity offered by Energy Trust.

Marketing and Market Interest

Two boiler contractors used the boiler tune-up program to market their services. The bulk of the tune-ups were done by these two contractors. A third brought the program to the attention of some of their customers, but did not spend any time marketing the program. The fourth contractor did not market the program.

In many cases contractors successfully marketed tune-ups to existing clients, targeting schools and universities that were not already receiving boiler tune-up services. In a few cases, the PMC referred potential clients to the contractors. All three contractors said the customers participating in the program did not tune their boilers on a regular basis and that the tune-ups would not have happened without Energy Trust incentives.

The contractors had few suggestions about how to attract building owners to the boiler tune-up program. Generally, they thought Energy Trust should focus on getting the word out about the program. One suggested that Energy Trust should recruit participants for the program and refer clients to them. They noted they use multiple approaches to reach clients, including existing relationships and networks, referrals, and other service offerings. This seems to be a business where reputation is important.

They thought that schools, institutions, and building owners with multiple sites should be targeted. However, some contractors said those owners most interested in saving energy and with good savings opportunities already tune their boilers regularly. As one contractor noted, “those that get value from tune-ups are doing it.” They pinpointed challenges in both generating interest from owners not tuning their boilers regularly and in finding boilers with savings opportunities.

Service Delivery

The boiler contractors said the boiler tune-up program did not change the boiler service they normally provide except for completing the program paper work, which they found cumbersome and redundant. They said they had to gather information they do not normally collect – account and operation information from the customer, documentation about the boiler and tune-up from the boiler technician – and then accurately transfer that information onto the incentive and completion form. They said they had trouble completing Energy Trust forms and that tracking down missing information was time consuming. One contractor said the second round of tune-ups was better because they were clearer about the expectations and how best to provide the information.

The boiler contractors reported they bill for their services on a time and materials basis, figuring out the number of hours for the tune-up and applying an hourly rate. Two contractors said they charge a lower hourly rate for their regular customers and two mentioned extra costs like a vehicle service fee, for extended travel, and a combustion analyzer service fee. One contractor said he charged an additional administrative cost to complete the boiler tune-up paperwork, but the others included this in their cost of doing business.

Prior to conducting the tune-ups, all the contractors thought the program's incentive payments would cover the costs of most boiler tune-ups. One said the costs for tuning a really dirty boiler might be more and another said that other repair issues, which are beyond the scope of the program, could increase the costs.

The contractors were satisfied with the timeliness of the incentive payments once the paperwork was approved. They noted some cases where incentive payments for tune-ups were denied. One case involved the tune-up of electric boilers. The contractor noted that while it may be obvious to those familiar with the program that incentives were not paid for electric boiler tune-ups, it was not obvious to the boiler technician conducting the tune-ups. Other denied incentive payments were due to missing information on the incentive forms. In one instance, the wrong combustion analyzer tape was attached to the form. The contractor said this was an honest mistake and thought that a sign-off from the boiler technician completing the tune-up should be sufficient, but he also recognized that Energy Trust needed the information. In another instance, the contractor could not receive an incentive for work they did because the boiler needed a repair and the tune-up could not be completed.

Despite the challenges completing the paperwork, the contractors all said the PMC was responsive and good about communicating with them. One said the PMC was very patient and accommodating getting the reporting right. Another said the problems weren't with the PMC but with getting the program right. He thought there could have been more conversation with the trade allies during program development and that the program should have taken a broader approach to boiler energy savings by providing more technical/engineering analysis of savings opportunities.

When asked if the tune-ups they conducted met the program's average savings target of two percent⁷, one said yes, on average, but noted that some tune-ups created significant improvement while "a couple others were really bad" (in terms of efficiency gain). Another said he had "not calculated it out" but from what he heard the savings were below the target. He thought this might be because they were not doing the tune-ups during peak heating season and were having trouble getting a load on the boilers or that the boiler size threshold for participation was too small.

Feedback from Technicians and "Ride Alongs"

The evaluators had two opportunities to "ride along" with boiler technicians as they performed BTO boiler tune-ups. The boiler technicians for these two visits were fully cooperative and proud of the work that they did, displaying strong competence and care in every aspect of their craft. Each of the site visits took about four hours to complete testing on two boilers. All the boilers were induced draft – one set had hot water boilers serving space and hot water heating and the other set provided low pressure steam for space heating.

Much of the site work involved checking operation settings and safety controls. The boiler technicians took it as their prime responsibility to confirm the proper operation of all boiler safeties – of which there are approximately six on each boiler. One complicating factor in performing the combustion testing was the (relatively) warm spring weather. The small loads on each boiler meant that run time was short, making it difficult to establish stable steady state combustion performance.

For two of the three boilers observed, efficiency improvements were achieved during the tune-ups. One was substantial (about ten percentage points) and the other small (about one-half percent). The former situation appeared to be due to minimal inspection and maintenance over many years. In the second situation, a new burner apparently had been installed several months before, with no performance adjustment being made at that time. Boiler technicians expected that the performance improvements they made would remain for several years, but added that thorough periodic attention is needed.

As might be expected in commercial buildings, the boilers seen on the ride-alongs appeared to be oversized and probably never needed to be operated at maximum rated output. At one of the sites, the technician recommended that the control settings operate most of the time on low fire. At both sites it appeared that maintenance staff had spent little time on regular maintenance tasks, such as draining the mud legs of the steam boilers (removing entrained sediments) or cleaning of draft fans.

The technicians did not have a significant opportunity to review other potential efficiency issues in the boiler room and for auxiliary systems. However, they did review safety in the boiler room and provided written recommendations for improvements required by code, such as providing adequate combustion air.

⁷ On average, the tune-ups resulted in one percent savings.

The boiler technician we interviewed said he had no trouble meeting the program requirements for the boiler tune-up. He remembered some of the units being very temperamental, that they took forever to get tuned up, and that it was difficult to “get much more out of them than what they were putting out.” He noted particular issues with some atmospheric types, saying there was “not much that can be adjusted.” The technician had a little trouble collecting some information for the incentive forms because some of the boilers were “historic” and it was hard to read the nameplate information and most boilers do not have a way to read operating hours. He also mentioned that the form did not have a place to note boilers that only have high fire operation.

In addition to the tune-up steps, the technician addressed any critical safety issues he came across. He said he did not have much of a chance to address maintenance issues because he was only on-site for a few hours and was not familiar with the customer. The one energy efficiency opportunity he saw was installing new burners or replacing “old dinosaur” boilers that are only running at 70 or 80 percent efficiency.

Contractor and Participant Benefits

The boiler contractors had differing opinions on the value of the program to their firms. One saw it as “a legitimate tool to get in the door with customers.” The program provides credibility and “allows us to provide a service we could not otherwise provide to the customer.” By uncovering other “problems” they were able to provide additional value to the client and generate follow-up work. Another contractor said the program had not attracted new customers and noted that “labor is tight for us. We could have done more profitable work.”

The boiler contractors said they did not hear much feedback from their customers about the value of the program even though their customers benefited from free boiler tune-ups and energy savings on their gas bills. One contractor thought the program was especially valuable to the schools that participated because they have very tight budgets. He felt that even if the energy savings “do not pan out” the program helped educate participants about what needs to be done to keep their boilers running efficiently.

Suggestions for Improvement

One of the primary suggestions the boiler contractors made for improving the program was expanding program services to include burner and boiler replacement. They felt there were old, inefficient boilers that could be upgraded. One contractor suggested the program provide the technical/engineering support to evaluate those opportunities. Another thought the real savings come from looking at the building as a whole.

The contractors would like to see Energy Trust do more to target potential participants and educate those customers about the program. One contractor thought the program needed to “figure out how to target the right customers and make the savings targets.” Another felt the program needed to spend a little more time determining what they are looking for, what is out there and what is achievable. A third contractor felt the program should recruit participants and bring them to the contractor, ensuring there are

opportunities for savings before involving the contractor. If the contractor is responsible for identifying clients, “then you can’t be choosy about who we find.”

The contractors also suggested improving the program forms and the required program information, including making the forms electronic so they could be submitted on-line. This could improve the consistency of data entry, speed up the review process and help with correcting errors or filling in missing data. One contractor suggested providing them with the spreadsheet the PMC uses to document information submitted on the forms to help contractors track key information. One boiler technician suggested it would be easier to document the tune-up process if the forms were more of a checklist with items related to the functionality of the boiler. He thought this would benefit both the building owner and the program.

One contractor mentioned the codes and standards that exist for maintaining pressure vessels. He wondered whether boiler tune-ups could be mandatory every year or two for boilers over a certain size. He thought regulations like this could “make sense regarding both safety and good operations.”

The contractors also thought it was important for the program to provide a larger pool of incentive money and stable funding so they can consistently promote the program. One contractor wondered why the boiler tune-up program could not be included in the existing BE program rather than developing a whole new program.

Feedback from Boiler Tune-Up Participants

Motivation to Participate

Most of the participants heard about the boiler tune-up program from one of the boiler contractors, but one found out from the gas company, another received a brochure from the Oregon Department of Energy, and another learned about it at a lighting workshop. The incentives offered for the tune-ups were an important motivation to participate since as one said, “they virtually covered all the cost. It was a no brainer.” Several participants said getting their boilers tuned was just something that needed to be done and a few were interested in getting more efficiency out of their boilers to save energy and money. High gas bills motivated another participant and another participant said it was a good opportunity for their new boiler operator to observe a boiler tune-up.

Most the participants were a little unsure when their boilers were last tuned, estimating it had been between two to six years and in one case more than six years. A few were more sure, saying their boilers were last tuned two years ago and a year ago.

Satisfaction with Program Delivery

The six participants rated their satisfaction with the program in five areas:

- The quality and completeness of information provided about the Boiler Tune-up Program
- Scheduling the tune-up

- Quality of workmanship/service
- Interactions with the contractor completing the work
- Overall satisfaction with the program

As shown in Table 2, most participants were satisfied or very satisfied with all aspects of the program, saying it was very easy to participate, “We had to fill out some forms, but it was such an easy process. It was no problem at all.” Two participants were unsure about the quality of workmanship, saying they did not have a basis for making that judgment. They wanted more information about the results of the tune-ups from the contractor. Another participant was concerned about the contractor billing them “for the entire amount” of the tune-up when the contractor was supposed to receive an incentive from the program.

Table 2 Boiler Tune Up Participant Satisfaction Ratings

	1 Extremely Unsatisfied	2 Unsatisfied	3 Neutral	4 Satisfied	5 Extremely Satisfied
The quality/completeness of information about the program				3	3
Scheduling the tune-up				3	3
Quality of workmanship			1	2	2
Interactions with contractor				3	3
Overall satisfaction				2	4
N = 6					

Notes: Several people said they would give a rating of 4 or 5; these ratings were included under “Satisfied.” For quality of workmanship, one person said they did not have enough information to give a rating.

Benefits from Participation

Most of the participants said the primary benefit from having their boilers tuned-up was better energy efficiency. A couple mentioned the cost savings that goes along with higher energy efficiency. Other benefits identified included the ability to perform preventive maintenance that had been cut from their budget, peace of mind knowing the boilers were tuned and running well, that there would be no problems starting the boilers after the summer shutdown, and that staff received a training benefit. While the incentives from the program and an essentially free tune-up were an important motivation for participating in the program, the participants did not bring this up as a benefit.

Staff from participating organizations had little or no involvement in the tune-ups. One staff member shadowed the boiler contractor tech, but this was the exception. Several participants said they received a written report from the boiler contractor showing test results and identifying other things that needed attention. Two others were expecting a report, but had not received it. Others discussed the results with the boiler contractor. In one case the contractor recommended the boiler run continuously rather than starting and stopping and made the adjustments to accomplish this.

Changes in Practice

When asked whether they learned anything new about tuning up, operating, or maintaining their boilers as a result of the tune-up process, only one person said yes, noting it was a good “refresher course of things to look for and how to maintain the boilers efficiency.” A couple said they were too far removed from the process, but they hoped their staff learned some things.

Only one boiler was being operated or maintained differently as a result of the tune-up process, switching to continuous operation, as noted above. All the others said there were no changes, although a couple expected less of a maintenance workload.

Most of the participants could not identify specific energy efficiency improvements brought to their attention by the boiler contractor, although one thought there were some. One expected some suggestions in the report from the contractor once he received it. One said some boiler control deficiencies were identified that he was already aware of that they may act on.

All the participants said they planned to have their boilers tuned on an annual basis in the future. The Boiler Tune-up Program will provide two more annual tune-ups, although only two participants specifically mentioned that feature of the program.

Suggestions for Improvement

The participants had few suggestions for improving the program. One suggested that it would be nice if the program could come back in a year and check the boiler, not realizing this was part of the program. There were two other suggestions. A school district administrator thought a better job could be done getting information out about the program. His experience tells him there is a market for this service in schools where annual tune-ups are hit and miss. Another suggested providing more mechanisms in the program to encourage communication with the boiler contractor so they could get more details about the process and results. A couple were in favor of continuing the program.

Insights from Energy Trust and PMC Staff

Market Insights and Marketing

The program relied on trade allies to recruit participants. Program staff observed that the program did not attract the commercial buildings they expected, but that it really was not surprising that schools and universities were recruited by the trade allies. Because these institutions have large numbers of boilers that are not regularly tuned, they were most efficient for the contractors to pursue. Program staff wondered whether the commercial buildings the program hoped to attract and the buildings with the greatest savings opportunities are already tuning their boilers.

Program Delivery

Program delivery did not go as smoothly as program staff had hoped. Many of the problems involved completion of the incentive application and completion certification form by the contractors. The PMC indicated there was a lot of back and forth with the

contractors to obtain missing information. Contractors inconsistently transferred information from the combustion analyzer tapes for the tune-ups to the form. They also had difficulty collecting information that was not readily available such as hours of boiler operation or the percent of boiler energy use attributed to a natural gas meter.

To address some of these problems, the program made some changes to the terms and conditions in the incentive application and completion certification form last summer to clarify expectations on the information that was required. Program staff considered making more extensive changes to the form, but because the program was being discontinued they decided this was not justified. They recognize that if the program were to be offered in the future, they would need to consider reducing the amount of information collected on the form to improve the quality of information that is collected.

Program staff expressed concern that the boiler contractors were charging \$600 (maximum incentive amount) for almost all of their tune-ups. The PMC recommended lowering the incentive amount if the program is offered in the future.

Energy Savings

The PMC and Energy Trust staff were all surprised and disappointed at the boiler tune-up savings, which were significantly below program projections. Based on research showing typical boiler tune-up savings of two to five percent, the program conservatively assumed two percent savings. The actual savings were about half that amount. More significantly, the magnitude of savings was much less than the target of 900 therms.

Program staff said the primary explanation for the lower than expected savings is that most of the participants were schools, which tend to have smaller boilers that operate fewer hours than the large commercial boilers that the program had hoped to attract. Explaining the lower percentage savings is more difficult. The PMC said the correlation in the data between the percent savings and time of the last tune-up was weak, as was the correlation between the percent savings and size of boiler.

Program staff believe that because the savings estimates were so low, any inaccuracies in the calculations are likely to be insignificant. The greatest uncertainty in the accuracy of the savings estimates involves the data used in the calculations that was collected by the boiler contractor. Some of this information is not readily available and needed to be estimated. The PMC did not have confidence in the accuracy of some of these numbers. There is also the uncertainty in the combustion efficiency measurement themselves. When there is not much change in the pre and post measurements, there is a high degree of uncertainty.

Quality Assurance and Quality Control

Energy Trust hired Strategic Energy Group to conduct a quality assurance review of the Boiler Tune-up Program. The goal of the quality assurance review was to provide an assessment of the consistency and accuracy of project data from the boiler tune-up data, the ETO incentive application, and the boiler savings worksheet. To achieve this, project

documentation from a random sample of 36 boiler tune-ups was reviewed, analyzed, and compared. Summary findings included:

- Eighteen of 36 projects had at least one inconsistency across one or more documents. Inconsistencies were primarily related to pre- and post-tune-up efficiency values. None of these inconsistencies would constitute a “fatal flaw,” as informally defined by Energy Trust. The inconsistencies found would not affect incentive payments, and any resulting errors in savings are minimal.
- Inconsistencies in data transcription from one document to another appear to stem from inadequate labeling on the boiler combustion analyzer printouts. Addressing this inadequacy should cure most, if not all, of the inconsistencies we encountered.

In addition, the scope of this project included a brief analysis of savings data for the Boiler Tune-up program. Summary findings included:

- Total annual savings for the 77 boiler tune-ups as of August 1, 2006 was 15,330 therms (an average of about 200 therms per boiler).
- Based on annual therms saved and percent savings, those boilers with the greatest savings tended to be younger and smaller.
- There does not appear to be any correlation between savings and type of boiler controls or contractor performing the boiler tests.

The evaluation team also noted that among the first 77 tune-ups, the five tune-ups with the highest estimated savings accounted for over half of the total savings. Forty-six of the tune-ups had estimated savings that were less than 100 therms/year.

The quality assurance review recommends some simple labeling and documentation steps to correct most of the data inconsistencies it found.

- Ensure proper labeling of boiler combustion analyzer tapes
- Require that pre- and post-tune-up tests take place during the same visit
- Document boiler burn levels (to account for boilers with less than three firing rates)
- Initial and date hand-written changes on the Form820B (incentive application and completion certification form)

The findings of the quality assurance review reinforce the interview comments from program staff and contractors about data collection challenges. The PMC had procedures in place to review information on the incentive application and completion certification form and they worked with the contractors to get the best possible information. However, it is very difficult to correct data problems after the information is submitted because the correct information is not obtainable. If a combustion analyzer tape is not labeled it is not easy to tell if tapes have been mixed up and data is entered incorrectly on the form. Improved forms and processes, clear expectations, and experience would likely address these issues.

Chapter Four: Building Tune-up Evaluation Results

This chapter reviews the status of the building tune-up portion of BTO along with insights program staff.

Building Tune-up Project Status

Program staff indicated there have been challenges with the design, development, and coordination for the building tune-up portion of BTO, but they are moving forward, if slowly, with the current design. As shown in Table 3, all but one of the tune-up projects started in 2004 and 2005 as part of the Building Performance Services (BPS) Test⁸. Implementation of efficiency measures is complete on one project; an incentive offer to implement measures has been made for another; a third project was closed after the incentive offer expired; and a fourth project was discontinued. One new tune-up project is underway at Oregon Health and Sciences University (OHSU). Screening and scoping have been completed and the investigation (diagnostics) is underway.

Table 3 Building Tune-Up Project Status through November 2006

Tune-Up Provider	Project	Square Footage	Start Date	Status
Siemens	Columbia Financial Center (BPS)	82,000	Fall 2004	Implementation complete March 2006; Persistence plan proposed and persistence incentive offered
CCI	Willamette Falls Hospital (BPS)	217,282	Fall 2004	Investigation complete May 2005; Incentive package has been presented to owner, but most measures are not eligible for incentives
McKinstry	Lincoln Tower (BPS)	227,000	Fall 2004	Investigation complete August 2006; Incentive agreement with NEEA was not signed and expired on September 30, 2006 and the project was closed
CCI	Mt. Hood Community College (BPS)	450,000	2005	Discontinued; The organization was not able to proceed for a variety of reasons
Siemens	OHSU	278,875	March 2006	Investigation is underway
	Total	1,255,157		

Energy savings have resulted from one tune-up project. The contractor for Columbia Financial Center implemented twelve measures with estimated savings of 301,000 kWh/year. Measure cost was approximately \$20,000 and the total payback was less than one year. The owner implemented the measures without incentives from Energy Trust. An energy savings persistence plan has been proposed and Energy Trust has made a persistence incentive offer, but the owner has not responded to the offer.

⁸ NEEA initiated the BPS Test in 2003 to develop, test and promote business practices and building operations services that improve building operating performance. Energy Trust worked with NEEA to conduct some pilot projects among commercial customers in Energy Trust's service area.

One long-time BPS project is still alive. While significant savings from gas efficiency measures are available, this facility is on an industrial gas account and thus is not eligible for incentives from Energy Trust. An incentive offer for electric efficiency improvements has been made to the owner, but the electric savings are small.

Two other projects were discontinued. One organization was unable to proceed for several reasons, including some O&M problems that needed to be corrected and challenges collecting performance information from the controls system. Another project did not continue because of lack of interest from the owner. This project had been underway for a couple of years.

Program staff are hopeful that the other active project at OHSU will lead to energy savings. This is the only project that was initiated after the start of BTO. The PMC for BTO was involved in the initial meetings with the client and has been able to present the expectations and services available from Energy Trust. The investigation is underway and the participant is aware of the deadlines that must be met to be eligible for implementation incentives from Energy Trust.

Energy Trust has allocated budget for two more tune-up projects in 2007. This allows them to continue their relationship with NEEA. These projects will fall under the umbrella of the BE program.

Insights from Energy Trust, PMC and NEEA Staff

Progress has been slow with building tune-up projects. Initially, tune-up projects were intended to generate the bulk of savings from BTO, but so far only one has produced savings and the potential for more savings is relatively small. When it became clear that these savings were not likely to materialize, the PMC developed an RCx track to help meet the program savings goals.

The reasons why tune-ups fell well short of expectations hinge upon having two organizations with different goals and ways of doing business involved in program delivery. There was an expectation that the PMC “would figure out a way to work within the framework NEEA had established for their BPS test phase.” Ultimately this resulted in a split in responsibilities, with NEEA taking projects from initial contact through the diagnostics/investigation phase, and then coordinating with the PMC to provide incentives for implementing efficiency improvements and savings persistence over time.

Program staff identified a number of obstacles that made this arrangement for program delivery difficult.

- Energy Trust and Alliance have different goals. Energy Trust is a resource acquisition organization that has clear energy savings goals set by their board. NEEA is a market transformation organization that wants to overhaul markets for O&M services. NEEA is less project oriented and was not focused on delivering tune-up projects to meet BTO goals.

- When BTO started, NEEA was bringing in new staff and developing their new Commercial Sector Initiative (now BetterBricks), which includes an operations and maintenance component (the successor to BPS). Thus their attention was focused on program development, not program delivery.
- NEEA relies on trade allies to initiate projects. Trade allies were not bringing in projects. This lack of motivation may have been due to the amount of time the initial BPS projects were taking and uncertainty about the program.
- Most of the tune-up projects began as part of the BPS Test prior to the start of BTO. The projects had been underway for a while and in some cases had stalled for various reasons beyond the control of the program. The PMC was not at the table at the start of these projects to explain the expectations and requirements for obtaining incentives from BTO.
- Having two program managers is not efficient. No one was really driving the projects forward. No process was in place for the program managers to work together.
- Little experience exists to deliver energy efficiency tune-up services in the market place. This creates a significant learning curve for owners and contractors involved in these programs, which increases the time and effort needed to make them successful.
- Although NEEA, Energy Trust, and the PMC met to discuss ways to coordinate their efforts, and each party had good intentions, they were not able to generate a coordinated effort within the timeframe available for BTO.

The PMC also tried on its own to generate some activity with the tune-up projects. They met with the tune-up service providers to discuss what BTO requires and offers. The PMC reviewed the results of completed investigations and worked with the service providers to generate savings estimates that could be used to develop incentive proposals. They sent proposals to building owners along with reminders of program deadlines. They were at the initial meeting with OHSU and sent a follow up that reviewed the incentives BTO can offer. However they say their role is limited: “We can motivate people with incentives and a time line that has to be met. But our hands are kind of tied in being more effective.”

Ultimately, BTO has not been able to test the tune-up process. Much of the program emphasis has been placed on RCx, where the PMC has more experience and control. It is not clear whether a tune-up process can be a cost-effective way to acquire energy savings from O&M improvements in buildings.

Chapter Five: Retrocommissioning Evaluation Results

This chapter reviews the status of the RCx portion of BTO along with insights and feedback from RCx service providers and program staff.

Retrocommissioning Project Status

The RCx portion of BTO got underway in February 2006. The PMC recruited RCx participants through June until they met their goal. Eight buildings were screened and accepted into the program, but one dropped out because of planned changes to the building systems (see Table 4). Several other buildings submitted applications to the program, but the screening process showed they had limited savings potential. The primary criteria used to screen out these buildings were low energy use intensity, limited controls capability, not having a central mechanical plant, and just being too small.

Table 4 Retrocommissioning Project Status through November 2006

Commissioning Provider	Project	Square Footage	Start Date	Status
Mike Hatten Solarc Architecture & Engineering	SAIF High Street Building	118,273	March 2006	Master List of Findings presented to owner; Implementation incentive offer expected in December
Karl Stum Summit Building Engineering	Crown Plaza	256,581	February 2006	Implementation nearing completion
Darren Goody McKinstry Essention	US Bancorp Tower & Plaza	1,100,000	February 2006	Master List of Findings presented to owner; Implementation incentive offer expected in December
Darren Goody McKinstry Essention	Umpqua Bank Plaza	271,573	February 2006	Master List of Findings presented to owner; Implementation incentive offer expected in December/January
Karl Stum Summit Building Engineering	Standard Insurance Center	458,199	May 2006	Master List of Findings presentation to owner scheduled in December
Karl Stum Summit Building Engineering	Standard Insurance Plaza	216,220	May 2006	Master List of Findings presentation to owner scheduled in December
Mike Hatten Solarc Architecture & Engineering	Lloyd Center Tower	431,270	June 2006	Master List of Findings presented to owner; Implementation incentive offer expected in December
Karl Stum Summit Building Engineering	PSU Fourth Avenue Building	217,282	February 2006	Terminated in June 2006 by mutual agreement between PSU and the program due to planned changes in building systems becoming apparent after screening was complete
	Total	2,890,116		

The seven retrocommissioning projects have all completed the investigation phase of the RCx process and the findings have been presented to the building owner. Most are currently in the process of determining which recommendations they plan to implement before signing incentive offers from Energy Trust and proceeding with implementation. One project is nearly done with implementation.

The PMC is aiming to have implementation offers signed for all the other projects by the end of January so that implementation can be done in February and March. The final step in the process is implementing persistence strategies for maintaining the energy savings from RCx. The PMC is confident that all the projects will be wrapped up before BTO ends in June.

Energy Trust plans to include RCx services in the BE program. This will allow them to continue to offer this service without the cost of maintaining a separate program.

Since the RCx projects are still underway, the findings in this section are preliminary. They are based on interviews with service providers before projects started and on interviews with program staff at the start of the program and in December. Information in this section on project implementation is based only on information from program staff. Interviews are planned with the RCx service providers and participants once projects are complete this spring. Their feedback will be used to complete the evaluation of the RCx portion of BTO.

Feedback from Retrocommissioning Service Providers

The evaluation team conducted interviews with the seven pre-qualified RCx service providers in late April and May 2006. At the time of the interviews, they had not started any projects, although two had projects they were about to begin. Three of these service providers were selected by owners to RCx their buildings. A fourth was asked to conduct a project, but was not available.

Motivations and RCx Program Understanding

Most service providers said they were contacted directly by the PMC and asked to respond to the program's RFQ. One said he heard about the program through one of their other offices. The service providers decided to get involved with the program because RCx is a service they offer, they believe they are good at it, and it is core to their business model. Some said they really like doing RCx and they believe in the value it offers to their customers. A few also saw it as a way to get more work and expand their business.

The service providers all thought the program orientation session was useful and necessary. They said the PMC did a good job describing the program and they all said they had a good understanding of how the program works. They appreciated the big picture overview, the description of the program process and steps and the expected scope of work, and the time for questions. One noted that the big picture view is clear and that an orientation should not go into details. This view was shared by the other service providers, but one felt that the service providers doing projects could benefit from a more detailed description of the tools the PMC developed and the forms they need to

fill out. Generally the service providers liked the half-day format of the orientation session, but a couple thought it was a little drawn out and could have been shorter.

When asked whether they had any concerns about the process laid out by the program for RCx projects, four said they did not have any concerns at this time. Several commented they were not sure it was the best approach. A few thought the process was more detailed and burdensome when the primary goal was just energy savings and wondered if a simpler approach would provide better value. One wondered if there was enough funding for the work, one was concerned about how projects would be assigned, and a few commented that they may not get very engaged due to the small number of projects.

All but two of the service providers said they had not looked much at the program materials and did not expect to unless they were asked to do a project. They viewed the information and tools as useful, but could not comment on them. However, one service provider that had gone through the materials said they were very useful and that the clarity of the deliverables had given his firm confidence they could successfully participate in the program.

All the service providers thought the program and reporting requirements were not unreasonable based on what they knew so far. Several noted they would need to go through a project to really know. One thought it was fine for a pilot, but it would be a little administratively heavy for a full-blown program and another said it depended on how rigorous the energy savings calculations needed to be.

RCx Marketing and Market Interest

Only one of the service providers indicated they had talked to some of their clients about the RCx program. One indicated he had planned to do some marketing, but then got a couple of projects to work on. Most said they were already pretty busy and did not have time to market the program. A few mentioned they would market the program if it grew in the future.

The service providers expressed a range of views about how to attract building owners to the BTO program and encourage them to retrocommission their buildings. Several thought it was important to get information to owners about the benefits of RCx. This includes unbiased research, case studies, owner testimonials, targeted information (e.g. how it impacts tenant retention), and promotion from someone without a vested interest. One service provider said the primary owner motivation is having a problem that needs to be solved and another said they try to build relationships with their customers to help them solve their problems. Another suggestion was for utilities to use billing data to identify “energy hogs” and then offer free walkthroughs to determine which buildings are good candidates for RCx. Dependability of funding was another factor mentioned by one service provider.

Several of the service providers did not think the RCx program should focus on certain market segments. Others suggested targeting institutional buildings, owner-occupied

buildings, and long-term building owners of multiple buildings. One suggested there should be some recognition of NEEA vertical markets.

One of the reasons service providers gave for building owners not RCx their buildings is they do not have the understanding or information they need. They may be suspicious they will really benefit. They may not recognize that how they've been operating their building may not be the best way. Building operations staff may be afraid it will make them look bad. Or they may not have the money to do it. The service providers offered a couple of suggestions for addressing these obstacles to RCx: some mechanism for owners to see how their buildings stack up or a free check up from experts to see how their building is performing.

The service providers gave a mixed response to whether the BTO incentives were adequate to encourage RCx. Two thought they were and two were not sure. One thought they were attractive, but people were not lining up to get into the program. Another said incentives usually are not the main reason an owner does RCx; rather, it is a threshold issue and the incentive needed varies. One service provider did not think the incentives were adequate and thought more incentives should be available for implementing the improvements recommended from the investigation phase of RCx.

Most of the service providers believe the market for RCx will grow. They believe owner awareness and sophistication are growing and that programs like BTO are increasing interest. However, a couple of these noted that RCx is not easy to do and it is important to have the right mix of skills. One service provider said they have seen the demand for RCx grow (as a result of the PGE program) and shrink and he believes this cycle will continue in the future unless the value of RCx is more clearly demonstrated.

The service providers reported doing two to fifteen RCx projects a year. Some found this a little hard to define because they do a lot of diagnostic/trouble shooting work that could be considered RCx. For most of the firms, this represented 10 to 20 percent of their work. Most of the service providers said they do not focus on particular types of clients for RCx projects – “I will take them as they come.” A couple said they focus on their existing client base - customers they have relationships with.

RCx Service Delivery

We asked the service providers to describe the steps they typically go through to deliver RCx services to a client. Most of them described the basic components of investigation, implementation, and follow up. One gave this overall summary of his approach, which was similar to others: “it is setting a goal, evaluating current conditions, doing some level of testing and observation, making recommendations, [implementing] corrections, and hand off.” But there was variation in their philosophy and where they put the emphasis. Some put more emphasis on the investigation phase and the initial testing and diagnostics, while one focused on the follow up phase to ensure that the systems performed as intended after the recommended changes had been made.

All the service providers said they could adapt their approach for delivering a RCx project to meet the needs of the program, but they did note some differences. For example, the program sets the goal for the project – energy savings. Typically, the goals would be set based on the problems they were trying to solve for the owner (which might include energy savings). One service provider said the energy calculations required by the program are more detailed than they normally provide to an owner. Another service provider liked the ‘quick fix’ option in the program, which is a little different than the typical approach.

The average savings target Energy Trust is estimating for a RCx project is 10 percent and all the service providers thought this was reasonable. They noted that the actual amount for a particular building will vary, but they thought 10 percent was a safe average. One service provider said he could get 10 percent energy savings by doing a simple energy survey. He did not think there was a need to go through a more detailed RCx process. This sentiment was shared by some of the other service providers and they agreed that the value of RCx goes beyond energy savings.

The service providers charge for RCx projects like they would for other professional services. They develop a scope of work, estimate the time it will take, and apply their hourly rate schedule. One said they like to do the initial investigation on a time and materials basis and once they have determined what is there they can prepare a bid or continue to work on a time and materials basis. Three of the service providers did not think they would charge any differently for a RCx project going through the BTO Program and a fourth said he would have to wait and see. There were concerns that the energy calculations would increase costs, but one service provider thought this would be offset by the program bringing projects to them and having the scope already defined. Another service provider said they normally provide supervision for measure implementation that is not covered by the program.

Several of the service providers were familiar with the other two elements in the BTO program – boiler and building tune-ups. One is doing projects using all three elements and a couple of others would like to. They try to take a holistic approach to offering building services and they recognize that these three elements can support those efforts. The other service providers seemed less aware of the two other program elements and did not see them as services they might offer.

RCx Suggestions for Improvement

The service providers did not have suggestions for improving the program yet. They said they need to do some projects before they really know how it will work. This is consistent with their comments about the program design, materials, and tools. They have not spent time on the program and do not plan to unless they get a project to work on. Then they will have experiences to base their opinions on.

A couple service providers expressed concerns about the number of service providers involved in the pilot and the small number of projects. One of those noted that projects seemed to be going to providers that already knew people and that getting involved in the

program was not a good use of their time. One service provider suggested that a debrief be held with all the service providers at the end of the program to discuss the projects that were done and whether the program goals were met.

Insights from Energy Trust and PMC Staff

Marketing

Because of limited program funding, the PMC used a much targeted marketing approach. The PMC worked with an account representative from Portland General Electric to recruit the majority of RCx participants. He helped to arrange meetings for the PMC to present the program to some key downtown property owners. PacifiCorp helped to arrange a meeting with one of their customers. The PMC emphasized that one-on-one interaction is critical to market a program like RCx because owners are not familiar with the term or do not really know what it means. It is important to have an opportunity to present to the owner what RCx is about and how it can benefit them. The PMC had a high rate of success with the people they met with, which is partly due to the access the utility account representatives provided to key decision-makers.

The PMC said one of the building owners approached them about the program. The PMC thought they may have found out about the program on Energy Trust's website because the program did not do any other marketing besides a couple of presentations at peer organization events and a Portland General Electric workshop. The PMC received several other applications from organizations they did not directly recruit, but none of these passed through the screening process.

Program Delivery

The PMC held an orientation meeting with the seven service providers to introduce them to the program and the process and thought the half-day format worked well. The PMC has provided one-on-one assistance for the three service providers doing projects, responding to questions as they have come up. The PMC thought that if the program were to be implemented on a larger scale, a follow up "quality assurance" meeting with the providers to discuss their experiences and review the use of some of the program tools might be warranted. The PMC said the service providers like samples of calculations, reports, and measures and adding more examples could be one improvement to the materials they provided.

The initial steps in the RCx process include screening the building, selecting the service provider, developing the scope of work for the investigation, conducting the investigation, developing the list of findings, and presenting them to the owner. Program staff shared their insights with the evaluation team on how these steps went for the seven projects and opportunities for improvement.

The *screening* process is a tradeoff between collecting enough information to be confident the building has sufficient savings opportunities while avoiding doing work that is more appropriate for the investigation phase and that will have to be passed on to

or even repeated by the service provider. The PMC conducted the screening and felt they were able to find this balance and this was affirmed by ETO staff. At least so far, they are seeing close to the savings they expected and projects are progressing through the process. Only one project dropped out after the screening step and this was due to some information about future building plans not initially disclosed to the program.

In addition, screening was completed in a timely fashion. BTO melded the screening and scoping step into an enhanced screening conducted by the PMC. The results suggest this is effective.

The PMC felt the screening step also helps the customer feel comfortable making a commitment to move forward with the investigation. In exchange for the incentives to conduct the investigation, the owner agrees to implement all recommendations with less than a one year payback. This can be a substantial financial commitment.

Once a building passed screening the owner *chose a service provider*. The PMC made it clear to the owners that they were free to pick any of the pre-qualified service providers. The PMC provided the owners with a binder that contained information about each of the service providers to assist them in their selection. In many cases the owners had worked with or heard about one of the providers on the list and had a preference. The PMC said that the owners had a preference for working with local firms. All three of the firms selected by the seven owners to RCx their buildings were Oregon providers.

The PMC developed the *scope of work and budget* for the investigation using a template and formula based on building size and systems. The PMC indicated the service providers were comfortable with this in all but one case where the provider felt the budget was insufficient. The PMC told the service providers if they found opportunities beyond the initial investigation scope, they could come back and ask for additional budget. This occurred in one case. One service provider suggested some changes in the scope of work to ensure some budget was retained so that they could be paid for any support they provided in the implementation phase of the project.

Before beginning the investigation, the service providers were given information collected by the PMC during building screening. For most of the projects the PMC met with the service provider and gave them a complete download about what they did during screening, what they learned, and where they thought opportunities existed. The PMC thought this meeting was very important and was appreciated by the service providers.

The *investigation* “is the part of the process where the providers do their thing.” For the most part, program staff thought the investigation part of RCx has gone well. The owners have provided positive feedback to the PMC about their relationships with the service providers. With one exception, the service providers have been able to complete the work within budget. Program staff identified several issues that have come up.

- For some projects it has taken more than the three months the program anticipated to complete the investigation. This has usually been due to circumstances out of

the service providers control such as problems getting trend data from the building control system.

- The service providers have not taken advantage of the quick fix incentive for implementing simple corrective measures in the process of their investigation. No quick fix incentives have been provided. Program staff were surprised by this. One possible explanation is that service providers are confused about the difference between a quick fix measure and any other measure.
- The service providers needed clarification about the second reporting deliverable that provides guidance to the owner on the implementation of the efficiency measures. The PMC said the service providers were confused about what this deliverable was about and in some cases felt they had already provided the needed information. The PMC worked with them to meet this reporting requirement while staying within their budget limits.
- The PMC said there appeared to be significant variation in the comprehensiveness of the investigations conducted by the service providers. It is hard to know this without being in the building during the investigation. It is possible the service providers were comprehensive in their investigation, but only documented the places where they found energy savings opportunities. To address this, the PMC suggested using checklists or some other approach to document what the service provider looked at in their investigation and to ensure a minimum level of comprehensiveness.
- There were some questions about whether a measure was eligible for an incentive from the RCx program or whether it was really a retrofit measure and qualifies for incentives from the BE Program. The PMC sees this as a “gray area” and a continuing source of confusion for RCx type programs.

A key role of the PMC during the investigation phase is **reviewing** the results of the service provider’s work. The PMC reported that one part of the review process that worked very well was communication with the service providers. Even when the review comments were extensive, the PMC felt they were able to develop a good working relationship with the service providers and this enhanced the quality of their work. Some providers even began contacting the PMC prior to completing their reports to obtain guidance.

The PMC pointed out one challenge for the review process. To reduce the program requirements, the providers did not have to submit building system schematics. This made it more difficult for the reviewer because he did not have a complete picture of the building systems. It resulted in more back and forth conversations with the service provider to be clear on what should have been looked at and what was recommended. The PMC believes the scope of work for the service providers needs to require the submission of building system schematics.

After the PMC completes the review process, the service provider schedules a meeting with the owner to **present the master list of findings**. The PMC also attends this meeting and reports “the meetings have gone really well.” They reflect that good relationships have developed between the service providers and owners and that

“generally speaking everybody is on the same page.” The PMC said that ideally they would like to come out of the meeting knowing exactly what is going to be implemented so they can develop an incentive offer. This does not always happen because the staff attending the meeting may not have final decision-making authority, they may need to think more about some measures, or they need to review their budgets. This is the status for most of the projects.

One building owner is almost finished with *implementation* of most of the over 40 measures recommended. This owner has been very engaged in the process. The PMC thought the other building owners are interested in implementing a majority of the recommended measures, but in one building there was only one measure with less than a year payback so they may not implement many measures. It seems that some building owners were a little more committed from the beginning to follow through than others.

The PMC said it is hard to tell how much influence Energy Trust incentives are having on the measures being implemented, but they may be helping the owners extend their budgets and do more than they otherwise would have. However, the incentive for the investigation is more important than the measure incentives because it is hard for the owners to budget for a study.

Cost Effectiveness

A preliminary analysis conducted by program staff shows RCx cost-effectiveness “falling in at four cents [per kWh] levelized while our PUC benchmark is two cents.” Energy Trust sees value in RCx type programs, but the results show the program is expensive. While the RCx projects need to be completed to get more accurate cost estimates, it is clear there is a need to make the program more affordable.

Chapter Six: Summary of Findings and Conclusions, and Recommendations

This summary of findings reflects the information in previous chapters from contractors, service providers, and participants and our review of program documents. We have analyzed this information to develop conclusions and recommendations Energy Trust can act on to improve services aimed at generating energy savings from O&M measures.

Summary of Findings

While BTO got off to a slow start, the PMC and Energy Trust worked well together to make adjustments in the program and move forward.

- The PMC brought in a new program manager to lead a capable project team that has successfully managed program delivery.
- The PMC and Energy Trust worked with NEEA to define goals and roles for delivering building tune-ups. Although these efforts did not produce many building tune-up projects, NEEA and Energy Trust still have a strong desire to seek opportunities to work together.
- The program added an RCx track when it became apparent that building tune-up projects would not deliver the savings needed to meet program goals.
- When trade allies recruited more potential boiler projects than originally budgeted for, the program increased the budget and created a queue of boiler projects.
- The program made changes to the terms and conditions on the boiler incentive forms to clarify expectations and worked closely with the boiler contractors to eliminate the difficulties the contractors had completing the incentive forms.
- When it became clear that the savings from the boiler tune-ups were well short of expectations, the program notified the boiler contractors that the program would not be continued.
- Energy Trust adjusted some of the performance goals for the PMC, which focused on delivery of energy savings to reward progress in completing projects.
- Energy Trust is creating a way to continue modest building tune-up and RCx efforts.

The boiler contractors recruited enough participants to fill the boiler queue and the initial tune-ups were completed and incentives paid well before the end of the BTO program. Participants were very satisfied with the boiler tune-up program. However, results from the boiler tune-ups were disappointing.

- The boiler contractors had significant difficulty completing the boiler incentive and completion certification forms. While the boiler contractor completing the last set of tune-ups was successfully able to complete the forms the first time, collecting the data for the forms took much more effort than they expected.
- There were concerns about the accuracy of data submitted on the forms. There were transcription errors, inconsistencies in the data, and questions about how some of the data was estimated by the contractors.

- Boiler savings were much less than expected. A handful of boilers delivered about half of the savings and over half of the tune-ups had little or no savings.
- There was little evidence of the tune-ups influencing participant operation and maintenance practices or identifying other energy efficiency opportunities.
- Most of the tune-ups occurred at schools and universities, which tend to have smaller boilers that operate less than the boilers at other commercial institutions. This helps explain the lack of savings, but questions remain about whether there is really a market for boiler tune-ups. Boilers with the greatest energy savings opportunities may already be tuned on a regular basis.

Little progress has been made delivering energy savings from building tune-up projects. Only one new boiler tune-up project was initiated since the start of BTO. There were several other building tune-up projects that started as part of the BPS Test, but they have taken years to complete and a couple have been discontinued. There are several explanations for the lack of progress.

- NEEA and the PMC split responsibilities for delivery of tune-up projects. This is not an efficient program delivery model. More importantly Energy Trust and NEEA have different goals. NEEA focuses on market transformation and is less interested in delivering projects to BTO to meet Energy Trust's resource acquisition goals.
- The process for moving projects to completion was not well defined. The PMC tried to generate activity, but did not really have mechanisms to do this.
- The trade allies were responsible for recruiting building tune-up projects. However, they did not seem motivated to do this, which may reflect their uncertainty about the direction of NEEA building tune-up activities.

The seven projects recruited for the RCx portion of BTO are progressing well. It appears the projects will deliver energy savings and help BTO meet its goals, although preliminary estimates show the levelized cost of the savings are above Energy Trust's benchmark. Some of the initial successes include:

- The PMC had a high rate of success recruiting participants from the target population of downtown Portland property owners.
- The enhanced screening conducted by the PMC worked well and demonstrated this is an effective approach to screen participants and get projects started in a timely fashion.
- The service providers have completed all seven investigations and shown they are capable of delivering the RCx services defined by the program.
- Initial indications suggest participants will implement measures recommended in the investigations and complete projects on time. The actions of the participants will determine how successful the program is.

Conclusions and Recommendations

1. **Conclusion:** Program staff described BTO as a pilot, yet the overall program was not sold to Energy Trust's Board as a pilot and it had resource acquisition targets and a 2-year performance-based program management contract like other Energy Trust

programs. While some performance requirements were adjusted, the ability of the program to test approaches for obtaining energy savings from building operation improvements was limited because BTO was not set up as a pilot. Nevertheless, a lot was learned through the openness and diligence of program staff and contractors.

Recommendation: Energy Trust needs to consider whether or how it should conduct pilot programs. Conducting a pilot program with a small set of projects using a resource acquisition framework is not conducive to testing program alternatives, since resource acquisition documentation, reporting requirements, and performance goals draw significant resources away from the pilot effort. While a pilot program can deliver energy savings, it should be set up to test specific delivery approaches with clear research questions and methods. The Evaluation Team should be involved in pilot program development. This additional development and evaluation effort has a cost, but allows for a more thorough test of program delivery approaches.

- Conclusion:** The results show it is hard to justify a stand-alone boiler tune-up program or a program path that only offers boiler tune-ups. While some of the challenges in boiler tune-up program delivery could be addressed through improvements in the forms and data collection and with experience, it is not clear there is a market with sufficient savings opportunities for boiler tune-ups. The limited savings opportunity does not justify the investment in the program infrastructure to make the program successful.

Recommendation: If Energy Trust is able to more clearly identify a market for boiler tune-ups and can target the boilers with savings potential, focused attention on boiler tune-ups might be justified. Otherwise boiler tune-ups should be one of the service options available within Energy Trust's Building Efficiency (BE) program and tune-ups should be used in combination with other measures to improve boiler and building efficiency. The incentive forms should be simplified as much as possible, with input from boiler contractors, to improve the consistency and quality of data collected from the tune-ups. Continued experience with boiler tune ups will help show whether further research and development of this service offering is warranted.

- Conclusion:** Ultimately, BTO has not been able to test the building tune-up process. Much of the program emphasis has been placed on RCx, where the PMC has more experience and control. It is not clear whether the tune-up process developed by NEEA can be a cost-effective way to acquire energy savings from O&M improvements in buildings.

Recommendation: Evaluation results suggest that testing the viability of building tune-ups requires a more comprehensive and integrated effort. This may be beyond the primary goals of Energy Trust, but defining and testing a tune-up approach that has the potential for quickly and cost-effectively delivering energy savings from O&M measures is clearly needed. Such a test could address these questions:

- Can tune-up projects be done in a timely fashion? Most of the BTO building tune-up projects took a couple of years to complete and experienced delays. For

tune-up projects to be successful, does this process need to be significantly shortened?

- Are incentives needed to implement the recommendations from a tune-up investigation? The one completed BTO building tune-up project implemented the recommended measures without an incentive and the total payback was less than a year. Ideally a tune-up project should be finding low cost measures. Are such measures enough of an incentive for an owner to proceed?
- Is the tune-up process different from a RCx process? The steps in the BTO tune-up are similar to those used in the RCx process, but with somewhat less rigor. The tune-up service providers included some controls contractors, while the RCx service providers all had commissioning backgrounds. Should these two processes be more clearly distinguished from one another and if so, how?

4. **Conclusion:** The RCx approach being used by BTO appears to be a viable way to produce energy savings from O&M measures. While this type of program is a valuable part of Energy Trust's portfolio, the cost is higher than their other energy efficiency programs.

Recommendation: Energy Trust plans to incorporate RCx into the BE program. This is a good way to reduce the infrastructure costs of RCx, while continuing to offer the service. Energy Trust should continue to maintain a modest RCx approach to gain experience with the delivery of this service and to explore how it can integrate into existing service offerings. Energy Trust should track similar programs in other states as well as initiatives at NEEA to learn from their experiences.

5. **Conclusion.** Organizations involved with energy efficiency recognize the large energy savings potential from O&M improvements in existing buildings, but have had mixed success tapping this potential. Any energy efficiency program that strives to significantly improve the performance of existing buildings will need to address building O&M. However, programs focused on O&M have tended to be expensive and difficult to manage. The results for BTO are consistent with this experience.

Recommendation. One way Energy Trust can address this issue is to merge these services into the BE program. We believe Energy Trust should more fully explore how it can leverage existing program infrastructure to obtain energy savings from O&M services, asking questions such as: To what extent can O&M services be integrated with existing building efficiency and training programs? Like new construction programs, can there be a "whole buildings" approach for existing buildings that offers a comprehensive range of integrated services that aim to produce a high performance building? How should O&M be included with new energy efficient equipment programs to ensure the long-term reliability of energy savings? O&M services often have difficulty standing on their own because the energy savings are not large enough to justify the investment in the project. To survive, either the investment needs to be reduced, or the services need to be included in a more comprehensive package.

Appendix A: Retrocommissioning Projects Update

Retrocommissioning Projects Update Building Tune-Up and Operations Program Evaluation

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Introduction

When Dethman & Associates completed the Building Tune Up and Operations Program (BTO) Evaluation Report in March 2007, all the retrocommissioning (RCx) projects were still underway. The findings presented in that report were preliminary, based on interviews with service providers before projects started, and interviews with program staff at the start of the program and in December 2006. This report presents more in-depth findings about the RCx projects, based upon interviews with the three participating service providers; interviews with representatives of five of the six projects that implemented measures; and a review of program documentation provided by the Program Management Contractor (PMC), Portland Energy Conservation, Inc.

Retrocommissioning Project Status

The RCx portion of BTO got underway in February 2006. The PMC recruited RCx participants through June until they met their goal. They screened and accepted eight buildings into the program, but one dropped out because of planned changes to the building systems (see Table 1). The service providers completed RCx investigations for the remaining seven buildings and RCx measures were implemented in six buildings.⁹

It took the projects 12 to 20 months to go from the initial step in the RCx process, screening, to certification of RCx measures. Projects that took longer tended to experience delays in collecting the documentation needed to certify RCx measures had been implemented. Only one project has completed the last step in the RCx process – putting a persistence strategy into place – and one other project is in the process of implementing its persistence strategy. The remaining projects still need to get underway with persistence.

The three RCx service providers made 168 recommendations for improving building operations in the seven participating buildings. The nature of the recommendations for measures varied widely among the service providers, including average payback: 0.27, 2.36, and 2.77 years. One provider averaged almost 40 mostly low-cost operations and maintenance (O&M)-type measures per building. The two other providers recommended fewer measures and more than 20% of those measures had greater than five year paybacks. While some of this variation may be due to differences in the buildings and how the recommendations were grouped, a lot is likely due to differences in service provider approach and focus, how comprehensive their investigations were, and differences in their experience and expertise.

⁹ There was a change of ownership at the seventh building (Umpqua Plaza). BTO requires owners to implement all recommendations with less than a one year payback as a condition for paying for the RCx investigation. For Umpqua Plaza, none of the recommended RCx measures had less than a one year payback, so the new owner decided not to implement any measures.

Table 5 Retrocommissioning Project Status through November 2006

Commissioning Provider	Project	Square Footage	Screening Date	Status
Mike Hatten Solarc Architecture & Engineering	SAIF High Street Building	118,273	April 2006	Implementation completed and certified April 2007; persistence strategies being implemented
Karl Stum Summit Building Engineering	Crown Plaza	256,581	January 2006	Implementation completed and certified January 2007; persistence strategies implemented
Karl Stum Summit Building Engineering	Standard Insurance Center	458,199	June 2006	Implementation completed and certified September 2007; persistence will begin
Karl Stum Summit Building Engineering	Standard Insurance Plaza	216,220	June 2006	Implementation completed and certified September 2007; persistence will begin
Mike Hatten Solarc Architecture & Engineering	Lloyd Center Tower	431,270	June 2006	Implementation complete; expect certification in October 2007 and then persistence will begin
Darren Goody/Felix Kersting McKinstry Essention	US Bancorp Tower & Plaza	1,100,000	February 2006	Implementation complete; expect certification in October 2007 and then persistence will begin
Darren Goody McKinstry Essention	Umpqua Bank Plaza	271,573	February 2006	Investigation completed and findings presented to owner in October 2006; there was a building ownership change and no RCx measures were implemented
Karl Stum Summit Building Engineering	PSU Fourth Avenue Building	217,282	March 2006	Terminated in June 2006 by mutual agreement between PSU and the program due to planned changes in building systems that become apparent after screening was complete
	Total	2,890,116		

The evaluation did not analyze which measures participants implemented. Our interviews suggest that all feasible measures with less than a one-year payback were implemented. We suspect less than half the measures with more than a one-year payback were implemented.

Feedback from Retrocommissioning Service Providers

The PMC pre-qualified seven RCx service providers for the program. The participating building owners selected three of these, all from Oregon, to investigate their buildings. One service provider retrocommissioned three buildings and the others each did two buildings. In the next section we present service provider views of the RCx process, program support and benefits, and needed program improvements.

Program Process

In general, the service providers were satisfied with the process the program used for providing RCx services, but they indicated there was a learning curve. They found some of the tools and requirements a little “clunky,” were sometimes unclear what they were supposed to deliver, and had trouble matching their level of effort to the scope defined by the PMC. They said the process improved from the first to the second projects, and that with more projects they would likely be able to work out most process issues. The service providers made the following key comments about the process:

- They thought the PMC’s work to initiate projects and screen buildings was beneficial, saying that process and the hand-off of projects went smoothly.
- They found the RCx budget was not sufficient for some of the smaller buildings, due to a budget formula where the key component is building square footage. They said that smaller buildings can require a similar level of effort as larger buildings. They felt this budget issue needed to be resolved if smaller buildings are included in the program, or they would need to reduce their level of effort.
- They thought the RCx investigations went smoothly, and that they would become more efficient as they gained experience with the program’s spreadsheets and learned the data they needed to collect to meet the documentation requirements.
- They said they had some trouble figuring out where to focus their efforts within the budgets provided. The budgets sometimes prevented them from digging more into issues that came up in the investigation. They also said it took more time to prepare the energy calculations than they expected. Consistent with other findings, they said they were able to do more in the larger buildings because the budgets were larger.
- They thought the concept of quick fixes¹⁰ was good in theory, but in practice was difficult to implement. Although it is a way for them to get paid to make changes, they often did not have the authority to make the changes. They did mention things to staff and staff made changes, but felt that their informing staff about needed fixes was probably not worthy of payment. One provider also noted that having staff change things as he went through the building made establishing a baseline and documenting improvements more difficult.
- They thought the PMC’s review of RCx findings was positive and constructive, but noted there was a learning curve for them and the PMC. They noted that the review must have been time consuming for the PMC and that the iterations back and forth sometimes took longer than expected. In a full program roll out they thought this review process would need to be streamlined to prevent bottlenecks.
- They thought the presentations of RCx findings to their clients went very well, saying it was helpful to have everyone at the table including building staff, the PMC, and the service provider. One provider also recommended having the control contractor at the table since many recommendations involved controls. They cautioned that presentations can get long with a lot of technical information (e.g., graphs and trend logs) and recommendations, causing some in the audience

¹⁰ One of the features of the program was to provide funding to implement quick fixes to correct things identified during the RCx investigation.

- to “glaze over.” They suggested reviewing presentation approaches for building managers, facility staff, and decision-makers to see how they might be improved.
- Two of the service providers were not directly involved in implementing recommended RCx measures. One service provider said he sat down with the controls contractor to discuss the measures and thought that discussion should be a mandatory part of a project hand-off. He still wondered if measures may have changed because they could not be implemented as he had described them. The other service provider served as a prime contractor for implementing some measures. He noted there were challenges with their sub-contractor completing the measures and documentation in a timely fashion.
 - They felt the RCx provider should play a more significant role in documenting and verifying measures. While the owner was responsible for documenting that measures were installed, this responsibility often fell to those installing the measures. The RCx providers felt there should be a more formal testing phase at the end of the process to document and verify that measures were installed and to correct any problems. They thought this would ensure that savings were in place from day one and that it would help avoid some of the delays and confusion related to documentation of measure implementation.
 - The RCx providers all felt the persistence phase of the RCx process was important, but at the time of the interviews they had only just begun this process. They thought the persistence strategies they were pursuing would be helpful, but they were unsure if they were sufficient for maintaining savings.

PMC Relationship and Support

The RCx service providers were all very complimentary of the PMC. They said the PMC was accessible and responsive, available for meetings with clients, flexible in dealing with issues that came up, and helpful in keeping things on track. They pointed out that any delays in the RCx projects were not due to the PMC, but were due to the real world problems that often come up. The service providers did not have specific recommendations for improving the materials, forms, guidelines and spreadsheets provided by the PMC, but thought there were some opportunities for improvement. In some cases they had already suggested improvements to the PMC and said if the program continues they would like to have the opportunity to have further input.

Benefits

The RCx service providers all said participating in BTO was a good business decision. They are committed to RCx as part of their business and this was an opportunity to do work in this area and to continue to develop their skills and capability. While none of the projects has led to any immediate follow up work, they thought the relationships they developed or renewed would translate into future opportunities for work. All said they would promote an RCx program to their clients if it were offered in the future.

The RCx service providers thought their clients benefited in three primary ways: energy and operating cost savings; a much better understanding of how their buildings operate (educational benefit); and valuable input for addressing other building issues or future improvements. The staff in the buildings had different levels of sophistication, but in all

cases the RCx providers thought building staff would make some changes in how they operate their buildings.

Recommendations

RCx service providers recommended continuing to offer and improve the program. They felt they need more experience to iron out the rough spots and offer the service efficiently. They also recommended adding a post implementation phase where the RCx provider would verify and document the implementation and performance of the RCx measures.

One service provider thought RCx should be packaged with an existing buildings efficiency program to allow for economies of scale. Another noted that the RCx process is not set up to address plug load and lighting, which can be a significant portion of building energy use. He said the program should consider if occupant education and other approaches to reduce this load should be included in the RCx process.

Feedback from Retrocommissioning Participants

We interviewed four individuals representing five of the six buildings that implemented RCx measures. They held positions as the facility manager, facility coordinator, director of engineering, and building superintendent for their buildings. In the next section we analyze their responses to questions about why they participated, how well the process worked, the benefits and influences of the project, their overall satisfaction, and needed improvements.

Participation

Three of the people we spoke with said they had worked with Energy Trust in the past and heard about the program from their Energy Trust representative and/or were approached by the PMC. One participant heard about the program from their Portland General Electric sales rep and got a lot of information about the program from the Energy Trust website. Two of the contacts said they were familiar with RCx and the other two said it was new to them.

The respondents said the primary motivation for participating in the program was saving energy and reducing energy costs – *“We are constantly looking for ways to save energy and improve the performance of the building.”* The fact the program paid for the RCx investigation was another key motivator and important for decision-makers – *“It is easy for them to say yes when there is so much upfront benefit.”* Some of the facility staff also appreciated having someone with a fresh set of eyes look at their operations and all of their systems to identify opportunities for improvement.

Program Process

All the respondents spoke favorably about the RCx process, despite some problems. They said some problems were minor, like having to go back and forth to get an estimated measure cost and budget correct, not knowing exactly what was required to verify measures, or that working with the service provider during the investigation phase

took more time than expected. Only one respondent noted any significant problems. In this case, there were some difficulties collecting trend data in the investigation phase. There were also some delays during implementation and documentation, including contractor and sub-contractor availability and scheduling conflicts, a chiller rebuild that took longer than expected, and some seasonal factors that limited implementation and testing. Still, none of the problems detracted from the participants' positive views of the program.

The participants provided some important insights about the process.

- The success of the process depends on the quality of the commissioning agent.
- The factors that influenced the measures they decided to implement were payback, cost, and functionality/feasibility.
- All the participants said they implemented all the recommendations with less than a one-year payback and this program requirement was not an issue. One person said they would be comfortable increasing the requirement to two years.
- The incentives for measures with more than a one-year payback did not seem important because the dollar amounts were small. The participants emphasized that the important incentive was for the RCx study.
- It is important for the RCx service provider, the control contractor, and the facility staff to work together as a team during measure implementation.
- Even though there were some delays and back and forth in the process to document measure implementation, none of the participants thought the documentation requirements were unreasonable
- When we conducted the interviews, most of the participants either had not started or were just starting the persistence phase of the process. There was a mix of enthusiasm for this step from something that had to be done to something that was very important – *“putting in place the last piece of the puzzle.”*

Benefits and Influences

It is clear all participants had a favorable impression of RCx. They all said energy savings was a key benefit from having their buildings retrocommissioned. They said it was equally important to have a third party review their operations (*“a fresh set of eyes”*) and identify opportunities for improvements. One of the four participants acknowledged being a little skeptical of the RCx process at the beginning, but said the results were a pleasant surprise. Another participant noted the comfort benefits that come from improving building performance.

Three of the four said they were making changes to their operation and maintenance procedures. This included more closely monitoring some of their equipment, keeping better track of their energy use trends to identify when things get out of line, and making sure there is more documentation on operation protocols and preventive maintenance. While the fourth did not identify specific changes, he did say, *“the experience teaches the guys to be more analytical and thoughtful in how they work.”* Three participants said they would likely RCx other buildings they own and the fourth said he really did not have a good application for another RCx project.

Overall satisfaction

The participants rated their satisfaction with the program in five areas:

- The quality and completeness of information provided about the RCx Program
- Scheduling the RCx service
- Quality of the RCx service
- Interactions with the RCx service provider
- Overall satisfaction with the program

As shown in Table 2, most participants were satisfied or very satisfied with all aspects of the program; no one gave an unsatisfied rating. As one participant said, *“I do not think it was perfect, but it was very good. There were some minor obstacles, but there are always some things. Overall I feel good about it.”* Another noted that *“the experience is largely shaped by the contractors and not by PEGI (the PMC).”* In many ways, the satisfaction ratings reflect this.

Table 6 RCx Participant Satisfaction Ratings

	1 Extremely Unsatisfied	2 Unsatisfied	3 Neutral	4 Satisfied	5 Extremely Satisfied
The quality/completeness of information about the program				2	2
Scheduling the RCx			1	3	
Quality of RCx			1	1	2
Interactions with provider			1	1	2
Overall satisfaction			1	1	2
N = 4					

Recommendations

Most of the participants did not have any suggestions for program improvements. One matter-of-factly said, *“there is not more that could be improved. It was what it was. It was a good experience.”* One did suggest considering ways the PMC might have *“a little more teeth”* for encouraging service providers to finish work in a timely manner. One participant was very enthusiastic about RCx and felt more funds should be devoted to these programs. Others also mentioned keeping programs and services available.

Summary and Recommendations

Both participants and service providers had positive experiences with the RCx projects. The RCx process used by the program seems viable and the results suggest it provided value to both participants and the service providers. The following conclusions and recommendations summarize our findings.

6. **Conclusion:** The RCx approach being used by BTO appears to be a viable way to produce energy savings from O&M measures. The process moved smoothly through the investigation phase. In some cases it got bogged down during implementation, but more delays occurred during documentation of measure implementation.

Recommendation: The RCx process needs to more formally involve the RCx service providers in the implementation and documentation process. If the RCx provider is not implementing measures, they at least need to meet with the implementer and be available to respond to questions and issues that arise. Since the RCx provider developed the documentation requirements, they should also be involved with documenting proper implementation of RCx measures. For major RCx measures, some post implementation performance testing might be appropriate.

7. **Conclusion.** The incentive structure for the RCx program, which provides most incentives upfront for the RCx investigation, is very important for motivating building owners to participate. Providing incentives to pay for a third-party to look for opportunities to improve facility operations seems to be one of the primary values of the program. Participants are very willing to agree to the condition that they implement recommendations with less than a one-year payback before they receive the investigation incentive. Incentives for implementing measures with more than a one-year payback seemed less important.

Recommendation. Energy Trust should continue to provide incentives that cover the cost of the RCx investigation. Energy Trust should consider dropping incentives for measures with more than a one-year payback and provide some funding for the RCx service provider to be involved in the implementation and its documentation.

8. **Conclusion.** The budget formula for RCx smaller buildings does not seem to provide adequate funding for the scope of work that service providers are accustomed to providing.

Recommendation. Energy Trust needs to examine the budget formula to determine if it needs to be modified, if the building size threshold needs to be changed, or if some streamlined scope needs to be developed for smaller buildings.

9. **Conclusion.** Participants highlighted that service provider quality is a critical aspect of RCx program success. While all the service providers did a good job, they did vary in how they focused their investigations and in the type of measures they recommended. These differences could be important if the program were implemented on a wider scale.

Recommendation. Energy Trust should consider ways it can provide feedback to RCx providers to help improve the quality and consistency of their services. This should be systematically included in the RCx review process, but it could also include a post process review. Over time, metrics could be developed that show the relative performance of providers. Potential clients could even use these metrics to help them choose providers.

10. **Conclusion.** RCx projects take time – between one and two years to complete. RCx projects can also be difficult to manage and can experience delays from numerous

“real world” situations. The process can be complex because many different people are involved and an RCx program adds to this complexity. This is the reality that RCx programs must accept and plan for.

Recommendation. Energy Trust needs to be realistic about the timelines for delivering RCx services. While traditional energy efficiency programs have focused on ‘one-time’ interventions, building operation and maintenance is an ongoing activity. Energy Trust needs to take a long-term view, look for opportunities to leverage its RCx investment, and encourage participants to continue to improve the performance of their buildings.

11. **Conclusion.** While the levelized cost of the savings is above Energy Trust’s benchmark, RCx can be an important part of an existing commercial buildings energy efficiency program portfolio. The results of this more in-depth review of the RCx projects support the final conclusion and recommendation in our March report: that O&M improvements in existing buildings have great potential for energy savings, but that programs to tap these savings have had mixed success and have been expensive. These programs have difficulty standing on their own.

Recommendation. The Energy Trust should explore how O&M type programs like RCx can be integrated into existing building efficiency and training programs. RCx can be an important and attractive component of a comprehensive existing buildings energy efficiency program that takes a “whole buildings” approach to improving building energy performance.