arket Potential 72% Consumer Confidence % Brand Recognition 82% Energy Savings 69%
3% Energy Efficiency 27% Product Awareness 57% Customer Satisfaction 74% Market Share

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Final Report

BUILDING EFFICIENCY PROGRAM PROCESS AND IMPACT EVALUATION: END OF SECOND PROGRAM YEAR

Funded By:

Energy Trust of Oregon, Inc.

Submitted To:

Phillip Degens, Ph.D.
Energy Trust of Oregon, Inc.

Prepared By:

research/into/action inc

Marjorie R. McRae, Ph.D.
Jane S. Peters, Ph.D.
Research Into Action, Inc.

Mary Sutter
Equipoise Consulting, Inc.

Richard Ridge, Ph.D.
Ridge & Associates

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We also thank the Building Efficiency participants we interviewed, both in person and on the phone. Many people contributed their time so that the program might be understood from diverse perspectives.

Acknowledgements

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EXECUTIVE SUMMARY

The Energy Trust of Oregon, Inc. (Energy Trust) was incorporated as an Oregon nonprofit public benefit corporation in March 2001 to fulfill a mandate to invest "public purposes funding" for new energy conservation, the above-market costs of new renewable energy resources and new market transformation in Oregon. It receives funding from a three-percent public purposes charge to the rates of the investor-owned electric utilities in the state: PacifiCorp and Portland General Electric (PGE). Additionally, under a separate agreement with NW Natural, the Energy Trust administers funding for gas efficiency. The Energy Trust has responsibility to communicate with the Oregon Public Utilities Commission (OPUC) on how it is spending its funding and what it achieves.

The Energy Trust began operating the Building Efficiency (BE) program in early 2003. The program seeks to acquire large volumes of electric and gas savings at modest cost from a wide variety of efficiency strategies by providing positive financial, energy and related benefits for participating businesses and institutions. The program design is market-driven and builds on existing market relationships, which is consistent with best practices among resource acquisition and market transformation efforts.

The Energy Trust follows a continuous improvement approach to its operations and relies on timely evaluations of its activities. This report describes an impact evaluation conducted at the latter half of the program's second year and a process evaluation completed in early 2005. Previous to these efforts, a process evaluation was conducted half-way through the program's first year. The Energy Trust hired the team of Research Into Action, Inc., Equipoise Consulting, Inc. and Ridge & Associates to conduct these impact and process evaluations.

According to the program tracking database, by the end of December 2004 the Building Efficiency program had installed 796 projects saving 51,253,725 kWh (about 5.9 aMW) and 135,500 therms. The delivered savings exceed the terms of the PMC's 2003-2004 contract with the Energy Trust, which calls for electricity savings of 5.5 aMW. On an annual basis, the 2004 electricity savings are twice the 2004 goal. Considering all projects, regardless of their stage of completion, BE projects in the pipeline as of the end of 2004 totaled about 12.0 aMW and 322,567 therms.

The impact portion of the evaluation investigated projects completed from the program's inception in January 2003 through March 31, 2004 and found the program's gross realized savings equal 93% of estimated kWh and 80% of estimated therms. These estimates account for interactive effects from lighting efficiency measures: decreased cooling loads and increased heating loads.

The free-rider and spillover effects from participants' self-report of their actions and intentions correspond with a net-to-gross ratio of 83%. This single value was calculated independently for lighting and mechanical measures (both electric and gas); it is a coincidence that the net-to-gross ratio for the two end uses is identical.

Given the gross realization adjustment and the adjustment for free-riders and spillover, the program's energy net realization rates are 77% for kWh and 67% for therms. We estimate program net savings through March 2004 to be 14,390,716 kWh (1.65 aMW) and 38,915 therms. Applying these energy net realization rates (calculated for projects completed through March 2004) to the savings of all completed projects as reported by the program tracking database yields program net energy savings of 4.6 aMW and 89,430 therms for the 2003-2004 period. Thus study did not yield estimates of program demand savings.

The evaluation team estimates the Building Efficiency program increased the penetration of efficient lighting projects in the Energy Trust service territory in 2003-2004 by about 60% more than the penetration would have been in the absence of the program (from 17% to 27% of total installations weighted by project size in kWh). The program increased the penetration of efficient mechanical projects by about 20% (from 17% to 21%) from January 2003 through March 2004. Between April 1 and December 31, 2004, BE mechanical projects increased at a much faster rate than BE lighting projects. The team estimates that during the last nine months of 2004, the Building Efficiency program increased the penetration of efficient mechanical projects by about 40% (from 17% to 25% of total installations weighted by project size in kWh).

Energy Trust staff are pleased and PMC staff are justifiably proud of these accomplishments. The 2004 achievements result from the activities of the PMC to engage large institutional customers and, more importantly, the trade ally community in energy efficiency solutions. Because the trade ally community was engaged, as Oregon's economy improved throughout 2004, the rate of Building Efficiency projects increased as well. The growth in mechanical projects outstripped that of lighting projects in the latter half of 2004 as the program increased its outreach to mechanical contractors.

Participating customers, mechanical contractors and ATACs expressed high overall satisfaction with the program and with the processes required to participate in it. Respondents believed the program's overall simplicity is its strength. Many respondents had favorable impressions of the PMC staff. Contractors appreciated the PMC's efforts to reduce the burden of paperwork and hoped the PMC would continue to streamline the process.

The evaluation concluded that a number of positive changes had occurred in response to the findings of the first-mid-year process evaluation and found further changes are warranted in a few areas. It concluded the program is penetrating the mechanical market and is poised in 2005 to meet Energy Trust staff's desire that about 60% of program savings accrue to mechanical projects. The evaluation concluded that the models of using a PMC for program delivery and relying primarily on market actors (e.g., vendors) rather than program (PMC) staff are successful in meeting program objectives.

The evaluation developed the following recommendations.

RECOMMENDATIONS

1. The Energy Trust should ensure the Building Efficiency incentive budget is sufficient to support qualified applications.

From the program's outset, Energy Trust staff have recognized the importance of an uninterrupted stream of incentive money to support qualified applications. Now that the Building Efficiency program has succeeded in involving market actors (consultants, contractors and vendors) as its key delivery agents, the Energy Trust must ensure it funds the projects these market actors generate. An interruption in incentives likely would greatly undermine the contractor networks and have repercussions for years to come.

2. The PMC should develop a summary sheet for each custom mechanical project describing: the equipment to be changed out, its consumption, demand and operating parameters; the equipment to be installed, its consumption, demand and operating parameters; and the expected energy and demand savings.

The impact portion of the evaluation was slowed and potentially compromised by the lack of such a summary sheet for each custom project. In some cases, the evaluation team was unable to identify the equipment actually installed prior to talking onsite with the participant, as the project files contained multiple options, the characteristics of which (e.g., expected savings) matched none of the project information in the program tracking database.

3. The Energy Trust and PMC should continue efforts to streamline program application forms and provide tools to assist in project and application development.

Notwithstanding the praise offered by many contractors, vendors and participants regarding program processes and forms, respondents identified room for continued improvement. Requests were made for spreadsheet tools for additional prescriptive incentives and forms to be made available on the program website that can be filled out and submitted electronically for mechanical projects, similar to the forms the PMC created in 2004 for lighting projects. PMC staff noted that the Energy Trust has let one proposed tool for motor vendors remain unapproved for over a year.

4. The Energy Trust should investigate the savings from custom mechanical projects completed between March 31, 2004, and December 31, 2005.

The evaluation team had concerns with the documentation of nearly one-third of 21 projects completed by March 31, 2004 and investigated for the impact portion of the evaluation. In addition, the documents for two, and arguably three, projects contained errors that were evident from a file review, prior to a field visit. The Energy Trust should undertake a review of a much larger number projects and determine whether change is warranted in any of the program implementation procedures. The assessment should consider whether the quality of project documentation differs systematically throughout that prepared by ATACs, by vendors and by customers.

5. The Energy Trust should review indicators relating to whether the PMC Technical Manager role is understaffed and should consider how the structure of the PMC's contract affects project quality control.

Energy Trust staff should conduct an ongoing review of data (such as frequency distributions) indicating the elapsed time from the submission of a custom mechanical application to the award of incentives. The PMC should track the information necessary to support such a review. In addition, Energy Trust staff should seek the opinion of PMC staff as to the adequacy of the staffing level, as well as seek feedback on this and other program issues from occasional direct interactions with ATACs, vendors and participants.

The Energy Trust should also give thought to the PMC contract terms and the tension they create for the PMC in its efforts to minimize administrative costs while maintaining project quality control. The PMC's current contract with the Energy Trust sets program savings as the PMC's performance goal, and the upcoming contract to be let in 2005 will contain an incentive for reducing the levelized cost of savings. In addition, the Energy Trust asks the PMC to broaden the scope of participants by reaching traditionally underserved customers. Because the main driver of levelized savings cost—the cost-effectiveness screen—is outside of the PMC's control, the PMC will be able to meet these objectives only by devoting its staffing resources to developing new marketing approaches and implementation tools. As the Technical Manager has expertise directly relevant to these areas, he will no doubt be pulled in additional directions. Were this to occur, its likely consequences include reduced project scrutiny and longer average time to approve mechanical projects.

Thus, it is imperative that the Energy Trust carefully consider the methods the PMC might be expected to use to accomplish what the Trust asks of it, the structure of the PMC's financial rewards and the controls in place to ensure project quality.

6. The Energy Trust should consistently enter the utility account number (electricity or gas, as relevant to the project) of each Building Efficiency participant into its program tracking system and should develop a mapping of service territory zip codes to NOAA weather stations.

Utility account information would support an impact evaluation by enabling a consistency check on the estimated annual savings, by considering whether savings as a percent of total annual energy use is a reasonable number. The Energy Trust is currently working to enter the needed data. NOAA weather station data would be useful in interpreting estimates of HVAC-related savings from the project engineering algorithms, as well as from any regression models used in an impact evaluation.

1. INTRODUCTION AND BACKGROUND

The Energy Trust of Oregon, Inc. (Energy Trust) was incorporated as an Oregon nonprofit public benefit corporation in March 2001, to fulfill a mandate to invest "public purposes funding" for new energy conservation, the above-market costs of new renewable energy resources and new market transformation in Oregon. It receives funding from a three-percent public purposes charge to the rates of the investor-owned electric utilities in the state: PacifiCorp and Portland General Electric (PGE). Additionally, under a separate agreement with NW Natural, the Energy Trust administers funding for gas efficiency. The Energy Trust has responsibility to communicate with the Oregon Public Utilities Commission (OPUC) on how it is spending its funding and what it achieves.

The Energy Trust began operating the Building Efficiency (BE) program in early 2003. The program seeks to acquire large volumes of electric and gas savings at modest cost from a wide variety of efficiency strategies by providing positive financial, energy and related benefits for participating businesses and institutions. The program design is market-driven and builds on existing market relationships, which is consistent with best practices among resource acquisition and market transformation efforts.

The Energy Trust follows a continuous improvement approach to its operations and relies on timely evaluations of its activities. This report describes an impact evaluation conducted at the latter half of the program's second year and a process evaluation completed in early 2005. Previous to these efforts, a process evaluation was conducted half-way through the program's first year. The Energy Trust hired the team of Research Into Action, Inc., Equipoise Consulting, Inc. and Ridge & Associates to conduct these impact and process evaluations.

This chapter is organized into four sections:

- *Program Description*
- *Prior Program Evaluations*
- *Evaluation Objectives and Approach*
- *Organization of the Report*

PROGRAM DESCRIPTION

In August 2002, the Energy Trust Board of Directors approved the Building Efficiency program's design and committed funds to achieve 8.9 average megawatts (aMW) of energy savings by the end of 2004.[1] In July 2003, the program was amended to incorporate delivering natural gas efficiency services via funding provided by NW Natural's voluntary public purpose charge. The funding was expected to acquire 450,000 therms by December 31, 2004. In August 2003, the energy savings and incentive dollars associated with water and wastewater treatment were transferred from Building Efficiency to the Production Efficiency program, lowering the electricity savings goal for the BE program almost 40%—from 8.9 aMW to 5.5 aMW.[2]

According to the program tracking database, by the end of December 2004, BE had installed 796 projects saving 51,253,725 kWh (about 5.9 aMW) and 135,500 therms. The delivered savings exceed the terms of the PMC's 2003-2004 contract with the Energy Trust, which calls for electricity savings of 5.5 aMW. On an annual basis, the 2004 electricity savings are twice the 2004 goal.

In addition, the program had commitments from customers to install projects totaling about 1.9 aMW and 151,500 therms. Finally, projects identified but not yet committed to by customers totaled about 4.3 aMW and 35,500 therms. Considering all projects, regardless of their stage of completion, BE projects in the pipeline as of the end of 2004 totaled about 12.0 aMW and 322,567 therms. (Chapter 2 provides detailed information about project characteristics.)

In the fall of 2002, the Energy Trust released an RFP to select a Program Management Contractor (PMC) for BE. The Energy Trust relies upon a PMC model to implement a majority of its programs because this model is believed to provide a quick avenue to program launch and because it leverages the existing expertise in the marketplace that delivers energy efficiency. Aspen Systems Corporation (Aspen) was selected to run the program through this competitive process and entered into a PMC agreement for the development, implementation and management of the Building Efficiency program in December 2002.

The BE program leverages the relationships that exist between contractors and their customers through a market-based program design that relies on a network of

1 From March 5, 2003, *Briefing Paper: Building Efficiency Program Description*.

2 From *Amended and Restated Energy Efficiency Program Agreement Amendment #1*, August 1, 2003.

trade allies (vendors and contractors) to identify and deliver energy-saving projects for their customers. Their services and the information these trade allies bring relieves customers of the burden and potential confusion of negotiating the steps required to receive a rebate.

The program efficiency activities are divided into two groups: lighting and mechanical (including HVAC, motors, and projects that involve gas-fired equipment or measures). Projects may involve combinations of measures (for example both lighting and mechanical, or lighting and gas). However, extensive work on two building systems would constitute a major renovation and the project would be referred to the New Building Efficiency program for new construction.

The BE program provides for incentives in three main areas: for lighting retrofit projects, for electrically-powered mechanical projects (including HVAC and motors) and for projects that upgrade gas-fired equipment (including heating, cooking, domestic hot water and boilers). The program offers standard incentives (also known as prescriptive incentives) for each qualifying unit of lighting equipment, HVAC equipment or motors purchased. Custom incentives are available for efficiency measures not covered by standard incentives.

All measures must meet the cost-effectiveness criteria established by the Energy Trust. Prescriptive measures are pre-screened to ensure that they meet the criteria, while custom projects are screened as they are identified and require some level of technical review. The difference between custom and prescriptive projects is seamless for the customer, since both measures can be listed on the same application and both are analyzed using the same cost-effectiveness test.

The Building Efficiency program offered the following incentives in 2004:

- *Prescriptive Lighting Equipment*—incentives range from $4 to $50 per fixture for a variety of identified equipment, including T8 lamps and fixtures, compact fluorescent lamps and hard-wired fixtures, exit sign retrofits or new fixtures (LED, cold cathode or electroluminescent), high-pressure sodium or metal halide fixtures, and occupancy sensors.

- *Custom Lighting Equipment*—incentives cover 25% of total approved project cost (including equipment and installation).

- *Prescriptive Mechanical Equipment*—incentives vary depending upon the measure and include packaged AC equipment, air-to-air heat pumps, premium motors, and variable frequency drives (VFDs). Incentives cover approximately 80% of the *incremental cost* associated with high-efficiency equipment.

- *Custom Mechanical Equipment*—provides incentives for projects involving electrically-powered, non-lighting equipment, up to 35% of the total approved project costs.[3]

- *Prescriptive Gas Equipment*—incentives vary depending on the measure, which include efficient furnace, boiler, water heater, HVAC unit heater, radiant heater, fryer, and oven.

- *Custom Gas Equipment*—provides incentives for all projects involving gas-fired equipment or measures; $1 per each therm saved, up to a maximum of 50% of the total approved project cost.[4]

For the purpose of determining custom incentive levels, expected measure savings and paybacks must be estimated. Estimates may be determined by the vendor or participant, subject to review by the PMC Technical Manager, or estimates may be determined by a technical study. Technical studies are conducted in support of a specific project or at a facility interested in doing energy efficiency improvements to identify appropriate measures.

When a study is required, the program delivers it for free on the condition that the participant commits to installing at least one measure if any are found to have a payback shorter than 18 months. The PMC Technical Manager assigns one of three study types (a walkthrough audit, or a Level I or Level II study) to be conducted for the facility.

Qualified engineers and energy professionals under contract to the PMC perform the technical studies. The program refers to these contractors as Allied Technical Analysis Contractors (ATACs), whose role also includes assisting with marketing the program by identifying potential participants. The energy savings estimates provided by the studies are intended to be "reasonable," not perfect. The analysis reports take the form of short letters, with executive summaries that lay out the facts in support of the identified projects, including estimated costs, savings and incentives.

3 According to an April 6, 2005, Energy Trust *Briefing Paper: Building Efficiency Program Incentive Changes*, incentives for custom electric mechanical measures became the lesser of 35% of total approved cost or 20¢ per annual kWh savings.

4 The BE program launched incentives for gas measures with an Energy Trust Board Decision on July 2, 2003. Under the terms of the launch, gas custom incentives were 35% of total costs. The incentive was raised to 50% in 2004. Yet the Energy Trust website as of April 2005 continues to report a maximum custom gas incentive of 35% of total approved project cost.

The BE program uses three forms that the facility representative must sign:

- *Energy Release Form 110*—to release a facility's utility energy consumption data to the Energy Trust.
- *Incentive Application Form 120*
- *Completion Certification Form 140*

The facility representative may request a free technical analysis study; in this case, the representative must also sign *Form 105*. In addition to these forms, there is *Information Form 100*, by which the contractor conveys basic information describing the facility and its energy use; this form does not need the signature of the facility representative. The contractor or PMC staff complete the *Project Detail Form 103* (which differs by type of equipment) to verify and document all the details of a project, including the specific equipment installed.

PRIOR PROGRAM EVALUATIONS

The current evaluation follows a process evaluation of the program conducted at the end of its first six months of operation.[5] The first process evaluation offered four recommendations, included here along with a summary of the response to the recommendations that Energy Trust staff provided to its Board of Directors.[6] Chapter 9, Conclusions and Recommendations, draws conclusions on the current status of Energy Trust and PMC response to these recommendations.

Recommendations from the first process evaluation (italicized) with the summary of Energy Trust staff response are as follows:

1. *Develop a sales plan to be funded by additional resources.* The PMC developed an enhanced sales plan, conducted an evaluation of the existing network marketing and created a full-time position to develop and manage an active HVAC trade ally network. The Energy Trust provided additional funding for the increase in staff.

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5 The Energy Trust's website makes available this report, prepared by Research Into Action and entitled: *Building Efficiency Program: Mid-Year Process Evaluation*. See: Energytrust.org/Pages/about/library/reports/BE_Process.pdf.

6 December 11, 2003, memo to Energy Trust Board of Directors entitled *Response to Process Evaluation for Building Efficiency Program*.

2. *Direct the activities of Energy Trust administrative staff to change the culture towards providing fast, customer-focused response to Energy Trust staff responsible for programs.* The Energy Trust reported to its board: "Legal issues and contract development procedures have been addressed and are being resolved. Additionally, legal resources specializing in energy efficiency related contracts and forms are now being utilized."

3. *Clarify allied technical analysis contractor confusion about the Building Efficiency program and the ATACs' role in program delivery.* The PMC conducted a second training meeting for Level I ATACs. Program activity had ramped up and working relationships with active ATACs has improved. The PMC was to prepare and distribute an *ATAC Building Efficiency Operations Guide*.

4. *Follow up with customers who contacted the Energy Trust about efficiency programs prior to the launch of Building Efficiency.* The PMC contacted and resolved all issues identified for nonparticipating firms interviewed for the process evaluation. Further, it was determined that customer recollection of events as reported to the evaluators did not correspond well with information in the Energy Trust's Goldmine contacts database.

EVALUATION OBJECTIVES AND APPROACH

Evaluation Objectives

The current evaluation has three primary objectives:

- To provide a process evaluation update for the program after two years of operation;
- To develop adjusted savings estimates for completed projects and the associated program gross realization rate; and
- To estimate the extent of free-ridership and spillover effects and the associated net realization rate.

The statement of objectives uses a number of terms that warrant definition and elaboration. A project's *adjusted savings* is based on conditions observed in the field several months after its installation. The adjusted savings numbers revise the estimates of project savings reported in the program database, which were based on engineering and project planning data. The *realization rate* for the program is calculated as the ratio of total adjusted savings to total program-estimated savings.

The *free-rider rate* or ratio is the proportion of program savings that likely would have occurred in the absence of the program through the firm's installed efficiency measures without incentives.

These three primary objectives consolidate a number program research issues Energy Trust staff discussed with the evaluation team on several occasions. These research issues include:

1. Have there been any changes in the program in response to the findings and recommendations of the first process evaluation?
2. Are vendors informing their customers of the state tax credits available for energy efficiency?
3. How well is the program reaching the mechanical market?
4. How well is the model working of using a PMC for program delivery?
5. How well is the model working of relying primarily on market actors (vendors) for program delivery and secondarily on program staff (PMC)?

Evaluation Approach

This process evaluation is based in part upon in-depth interviews with Energy Trust and PMC staff members involved in implementing and managing the BE program, ATACs that support the program through engineering and technical review services, and mechanical contractors. These interviews took place in January and early March of 2005.

The evaluation team also conducted telephone surveys with customers in support of both the process and impact evaluation objectives. Projects examined on-site for the impact analysis were those completed from the beginning of the program through March 2004. The on-site investigations and telephone surveys were completed by the end of September 2004.

Chapter 7 provides a detailed discussion of the methods used to develop adjusted project savings, free-rider rates and savings realization rates.

ORGANIZATION OF THE REPORT

Following this introductory chapter are seven additional chapters.

- *Chapter 2, Program Status,* describes the program status as of December 31, 2004, including the number and type of projects, incentives paid, study costs, kWh and therm savings, and other information derived from the program tracking database.
- *Chapter 3, Program Implementation Activities and Experiences*, describes findings from interviews with Energy Trust and PMC program staff and ATACs.
- *Chapter 4, Mechanical Contractor and Vendor Feedback,* describes findings from interviews with participating mechanical contractors and vendors.
- *Chapter 5, Participant Feedback,* describes findings from surveys of participants with completed lighting and mechanical projects.
- *Chapter 6, Energy Impact Analysis Methods,* describes the data sources and analytical methods used to estimate the program's energy impacts.
- *Chapter 7, Energy Impact Results,* describes findings from the impact portion of the evaluation.
- *Chapter 8, Conclusions and Recommendations*, provides final analysis and recommendations arising from this evaluation.

Three appendices follow the body of the report:

- *Appendix A: Sampling Plan for Lighting Participant On-Site Investigations*
- *Appendix B: Lighting/HVAC Interactive Effects*
- *Appendix C: On-Site Findings for Custom Mechanical Projects*
- *Appendix D: Survey Instruments and Interview Guides*
  - Lighting Participant Telephone Survey
  - Mechanical Participant Telephone Survey
  - Technical Analyst (ATAC) Survey Guide
  - Participating Mechanical Vendors Survey

- Program Staff Interview Guide

2. PROGRAM STATUS

This chapter provides a summary of the information available in the Building Efficiency program tracking database as of the end of 2004.

PROGRAM OVERALL

From the inception of BE in January 2003 until the end of 2004, the program generated 1,637 projects (Table 2.1). About half (49%) of these projects are installed (i.e., completed). Only 6% are committed, meaning the participant has committed to doing the project and the Energy Trust has committed to providing a specific level of incentive for that project. The remaining 46% of projects are not yet committed, meaning they have been proposed by a contractor, with the potential program participants not yet having committed to going forward.

Table 2.1

TOTAL BE PROJECTS: ACCOMPLISHMENTS, BY PROJECT STATUS AND TYPE

DESCRIPTOR	PORTION PRE-COMMITTED	PORTION COMMITTED	PORTION COMPLETED	TOTAL
ALL PROJECTS				
Number of Projects	46%	6%	49%	1,637
KWh Savings	36%	16%	49%	105,395,795
Therm Savings	11%	47%	42%	322,567
Project Costs	27%	21%	52%	$36,750,826
Incentives	27%	27%	46%	$10,524,533
Study Costs	53%	17%	30%	$525,649
				Continued
LIGHTING				
Number of Projects	34%	3%	63%	833

DESCRIPTOR	PORTION PRE-COMMITTED	PORTION COMMITTED	PORTION COMPLETED	TOTAL
KWh Savings	45%	2%	53%	56,043,745
Project Costs	46%	2%	52%	$13,430,148
Incentives	44%	2%	54%	$3,295,921
Study Costs	17%	0%	83%	$1,616
MECHANICAL				
Number of Projects	58%	8%	34%	804
KWh Savings	25%	31%	44%	49,352,050
Therm Savings	11%	47%	42%	322,567
Project Costs	16%	32%	52%	$23,320,678
Incentives	19%	38%	43%	$7,228,611
Study Costs	53%	17%	29%	$524,033

Estimated electricity savings from projects at all stages amount to more than 105 million kWh, about half (49%) of which is associated with projects that are now complete. Gas savings from projects at all stages total about 323,000 therms, 42% of which are associated with completed projects. Projects at some stage of participation have received or are expected to receive about $10.5 million in incentives from the Energy Trust.

Study costs through 2004 amount to about $526,000, the vast majority of which paid for studies addressing mechanical systems. Studies have been performed for less than 1% of lighting projects and 39% of mechanical projects.

Table 2.2 displays the percent of total projects, lighting projects and mechanical projects in various size categories, in terms of estimated electricity savings.

Table 2.2

SIZE OF PROJECTS IN KWH SAVINGS, BY PROJECT TYPE

SIZE CATEGORY	LIGHTING	MECHANICAL	TOTAL
10,000 kWh or Less	23%	28%	25%
10,001 to 25,000 kWh	26%	12%	21%
25,001 to 50,000 kWh	19%	14%	18%
50,001 to 100,000 kWh	16%	13%	15%
100,001 to 250,000 kWh	10%	21%	13%
250,001 to 1,000,000 kWh	5%	11%	7%
More than 1,000,000 kWh	0%	2%	1%
Total	**100%**	**100%**	**100%**

STATUS BY MEASURE TYPE

The BE program encourages participants to undertake energy efficiency projects by providing incentives that can be either prescriptive or custom. A prescriptive incentive is a set amount to be given for installing a certain piece of energy-efficient equipment. Custom incentives are available for all cost-effective energy efficiency projects for which prescriptive incentives are not available or appropriate, such as controls for lighting and mechanical systems, large motors or HVAC systems, and other applications where flexibility is needed.

Table 2.3 shows the number of projects, electricity savings and gas savings by the type of measures projects address, along with what portion of the projects, kWh and therms are associated with prescriptive or custom incentives. Note that because some projects involve multiple types of measures, they are counted multiple times and some projects are excluded because no information about measure types or incentive types was available. Also, as some projects involve both prescriptive and custom incentives, row percentages sometimes sum to more than 100%.

About half (52%) of lighting projects are receiving custom incentives and these projects amount to almost three-fourths (72%) of estimated electricity savings for lighting. Overall, about 80% of both estimated electricity and estimated gas savings are associated with custom incentive projects.

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Table 2.3

PROJECTS AND ENERGY SAVINGS (KWH AND THERMS), BY MEASURE AND INCENTIVE TYPE

MEASURE TYPE	PORTION PRESCRIPTIVE*	PORTION CUSTOM*	TOTAL
PROJECTS			
Lighting	49%	52%	820
HVAC/Mechanical	39%	62%	163
Motors	42%	58%	189
Gas	47%	53%	43
Total*	**37%**	**64%**	**1,536**
KWH SAVINGS			
Lighting	30%	72%	56,460,018
HVAC/Mechanical	6%	94%	22,656,347
Motors	8%	92%	20,747,519
Gas	99%	1%	74,600
Total*	**19%**	**82%**	**100,310,617**
THERM SAVINGS			
Lighting	—	—	0
HVAC/Mechanical	12%	96%	29,615
Motors	3%	97%	116,432
Gas	33%	67%	161,239
Total*	**18%**	**83%**	**318,738**

* *For some projects, tracking data regarding measure type (e.g., lighting, HVAC, Motors) or incentive type (e.g., prescriptive, custom), were not available; these projects were excluded. In addition, some projects involve more than one measure type (e.g.,. lighting measures and HVAC measures), and some projects involve both prescriptive and custom incentives. Therefore, cells may sum to more than the actual totals, which are shown in the table, and row percentages may sum to more than 100%.*

STATUS BY UTILITY

The program tracking database identifies only one utility per project, so even though any given project may have both electricity and gas savings, the database identifies either the electric utility or the gas utility, but not both. PMC staff report that a project focused on saving gas usually had the gas utility identified in the database and a project focused on saving electricity usually had the electric utility identified, although this was not a strict rule. Accordingly, for all tables in this chapter that present data by utility, information should not be interpreted as a conclusive statement about projects in that utility's service area.

Table 2.4 presents the total number of projects, the number of lighting projects and the number of mechanical projects associated with each of the investor-owned Oregon utilities, along with the portion of projects at each stage of completion.

Table 2.4

NUMBER OF PROJECTS BY UTILITY,* PROJECT STATUS, AND TYPE

UTILITY	PORTION PRE-COMMITTED	PORTION COMMITTED	PORTION COMPLETED	TOTAL
ALL PROJECTS				
NW Natural	18%	18%	65%	17
PacifiCorp	41%	4%	54%	585
PGE	48%	6%	45%	1,023
Other	75%	0%	25%	12
Total	**46%**	**6%**	**49%**	**1,637**
LIGHTING				
NW Natural	—	—	—	0
PacifiCorp	32%	3%	66%	317
PGE	35%	4%	61%	511
Other	80%	0%	20%	5
Total	**34%**	**3%**	**63%**	**833**
				Continued

UTILITY	PORTION PRE-COMMITTED	PORTION COMMITTED	PORTION COMPLETED	TOTAL
MECHANICAL				
NW Natural	18%	18%	65%	17
PacifiCorp	53%	6%	41%	268
PGE	62%	8%	29%	512
Other	71%	0%	29%	7
Total	**58%**	**8%**	**34%**	**804**

* *Note that the program tracking database (from which these tables are derived) identifies only one utility per project, even though the service area of Northwest Natural overlaps with that of the electric utilities. Usually, projects whose focus was primarily saving gas are associated with the gas utility and projects whose primary focus was saving electricity are associated with the electric utility.*

Table 2.5 presents the total estimated electricity savings for projects associated with each of the major utilities, along with the portions of savings attributable to projects that are completed, committed or pre-committed.

Table 2.5

KWH SAVINGS BY UTILITY,* PROJECT STATUS, AND TYPE

UTILITY	PORTION PRE-COMMITTED	PORTION COMMITTED	PORTION COMPLETED	TOTAL
ALL PROJECTS				
NW Natural	0%	0%	100%	5,506
PacifiCorp	27%	13%	60%	33,261,385
PGE	40%	17%	43%	72,117,473
Other	25%	0%	75%	11,431
Total	**36%**	**16%**	**49%**	**105,395,795**

Continued

2. *Program Status*

UTILITY	PORTION PRE-COMMITTED	PORTION COMMITTED	PORTION COMPLETED	TOTAL
LIGHTING				
NW Natural	—	—	—	0
PacifiCorp	30%	3%	67%	19,762,181
PGE	53%	2%	45%	36,270,133
Other	25%	0%	75%	11,431
Total	**45%**	**2%**	**53%**	**56,043,745**
MECHANICAL				
NW Natural	0%	0%	100%	5,506
PacifiCorp	22%	28%	50%	13,499,204
PGE	26%	32%	42%	35,847,340
Other	—	—	—	0
Total	**25%**	**31%**	**44%**	**49,352,050**

* *Note that the program tracking database (from which these tables are derived) identifies only one utility per project, with the result that the table attributes kWh savings to Northwest Natural and therm savings to the electric utilities.*

Table 2.6 displays the sum of incentives received or expected to be received by projects according to the utility identified in the program tracking database.

Table 2.6

INCENTIVES BY UTILITY,* PROJECT STATUS, AND TYPE

UTILITY	PORTION PRE-COMMITTED	PORTION COMMITTED	PORTION COMPLETED	TOTAL
ALL PROJECTS				
NW Natural	13%	47%	40%	$125,551
PacifiCorp	22%	24%	54%	$3,114,189
PGE	29%	28%	43%	$7,281,556
Other	11%	0%	89%	$3,237
Total	**27%**	**27%**	**46%**	**$10,524,533**
LIGHTING				
NW Natural	—	—	—	$0
PacifiCorp	32%	3%	65%	$1,245,255
PGE	51%	2%	47%	$2,049,430
Other	29%	0%	71%	$1,237
Total	**44%**	**2%**	**54%**	**$3,295,921**
MECHANICAL				
NW Natural	13%	47%	40%	$125,551
PacifiCorp	16%	38%	46%	$1,868,934
PGE	20%	38%	42%	$5,232,126
Other	0%	0%	100%	$2,000
Total	**19%**	**38%**	**43%**	**$7,228,611**

* *Note that the program tracking database (from which these tables are derived) identifies only one utility per project, even though the service area of Northwest Natural overlaps with that of the electric utilities. Usually, projects whose focus was primarily saving gas are associated with the gas utility and projects whose primary focus was saving electricity are associated with the electric utility.*

Table 2.7 summarizes the information in Tables 2.4 through 2.6 by showing each utility's share of projects, incentives, kWh savings and therm savings. Note that 17 projects in the program tracking database had the utility identified as NW Natural.

These projects were focused on saving gas and together are estimated to save almost 98,000 therms, or about one-third (30%) of the total estimated program therm savings. Presumably, the remaining two-thirds of estimated therm savings are attributable to projects that primarily save electricity.

Table 2.7

COMPARING PROJECTS, INCENTIVES, AND ENERGY SAVINGS, BY UTILITY*

UTILITY*	PROJECTS		INCENTIVES		KWH		THERMS	
	COUNT	PERCENT	DOLLARS	PERCENT	KWH	PERCENT	THERMS	PERCENT
NW Natural	17	1%	$125,551	1%	5,506	0%	97,673	30%
PacifiCorp	585	36%	$3,114,189	30%	33,261,385	32%	57,532	18%
PGE	1,023	62%	$7,281,556	69%	72,117,473	68%	166,082	51%
Other	12	1%	$3,237	0%	11,431	0%	1,280	0%
Total	**1,637**	**100%**	**$10,524,533**	**100%**	**105,395,795**	**100%**	**322,567**	**100%**

* *Note that the program tracking database (from which these tables are derived) identifies only one utility per project, with the result that the table attributes some kWh savings to Northwest Natural and some therm savings to the electric utilities.*

STATUS OF PROJECT STUDIES

The program offers technical assistance to potential participants in the form of studies to identify opportunities for energy savings or to evaluate the cost-effectiveness of various measures being considered. Studies are offered for free on the condition the participant implements at least one measure should any measures be found to have a payback shorter than 18 months. Energy savings estimates resulting from a study are used to determine the level of custom incentives projects can receive from the Energy Trust (such estimates can also be provided by vendors or participants themselves, subject to review by PMC technical staff). Table 2.8 shows that, while 204 of the 354 studies performed through the end of 2004 were walk-through evaluations, about $440,000 of the total $526,000 in study costs have been paid for those at Level 2—the most complex.

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Table 2.8

NUMBER OF STUDIES AND STUDY COSTS, BY PROJECT STATUS AND STUDY TYPE

STUDY TYPE	PORTION PRE-COMMITTED	PORTION COMMITTED	PORTION COMPLETED	TOTAL
NUMBER OF STUDIES				
Survey	87%	2%	11%	204
Level 1	80%	2%	17%	81
Level 2	57%	16%	28%	69
Total	**79%**	**5%**	**16%**	**354**
STUDY COSTS				
Survey	87%	2%	11%	$28,661
Level 1	80%	3%	17%	$54,190
Level 2	48%	20%	32%	$442,798
Total	**53%**	**17%**	**30%**	**$525,649**

3. PROGRAM IMPLEMENTATION ACTIVITIES AND EXPERIENCES

This chapter describes the activities and the experiences of program staff and contractors responsible for implementing the Building Efficiency program. Findings from Energy Trust and the Program Management Contractor (PMC) staff were obtained from in-depth, open-ended interviews. Most of these interviews were conducted in person and lasted between one and two hours. Findings from Allied Technical Analysis Contractors (ATACs)—with whom the PMC contracts to conduct technical studies in support of (usually mechanical) efficiency projects—were obtained from telephone surveys lasting approximately one half-hour. The ATAC surveys included both open-ended and closed-ended questions. Unlike the findings from the Energy Trust and PMC staff, some of the ATAC findings lend themselves to presentation in tables.

The evaluation team conducted interviews and surveys in from January through early March 2005 with:

- Two Energy Trust program staff (in-depth interviews)
- Four PMC staff members (in-depth interviews)
- One coordinator of the lighting trade ally network who functions as an extension of PMC staff (in-depth interview)
- Eleven ATACs (phone surveys)

The 11 interviewed ATACs performed nearly two-thirds (64%) of the technical analysis studies (TAS) done for the program to date. To elicit the experiences of a variety of ATACs, we divided them into three groups based on the number of studies conducted and interviewed ATACs from each group. We also ensured we spoke with ATACs conducting each type of TAS.

This chapter is organized into the following sections:

- *Organization of Program Staff*
- *Lighting Activities*
- *Mechanical Activities*

- *Future Directions*
- *Implementers' Perspectives*

ORGANIZATION OF PROGRAM STAFF

The PMC Building Efficiency team includes three full-time in-house staff members—a Technical Manager responsible for managing the program's technical details including applications and studies, and two Business Development Managers. One Business Development Manager is responsible for recruiting and managing a network of mechanical trade allies and addressing gas-fired projects.[7] The other Business Development Manager is focused on large facilities, energy service companies (ESCOs) and large contractors.

The Technical Manager receives assistance from a part-time engineer. These personnel are assisted by three other PMC staff members who also support the Production Efficiency program, including the manager of the PMC office (who is the General Manager of both programs), an Operations Manager and an Administrative Coordinator. In addition to these staff, contracted staff—housed outside of the PMC office, yet functioning as an extension of PMC staff—coordinate the lighting trade ally network. The network coordinator staff equal one full-time equivalent (FTE) position.

The General Manager provides day-to-day oversight of the PMC staff. He directs the activities of all BE staff. In addition to developing program strategies and marketing approaches, and guiding staff to implement them, he describes fielding disruptive questions and completing administrative reports so that these requests do not interfere with the work of the program staff.

The PMC's Operations Manager supports the program by tracking program data, monitoring program status and contract compliance, and processing incentive and contract payments. He relies on a PMC-created spreadsheet to track completed forms and enters data into the Energy Trust's *FastTrack* database so that incentive

7 "Trade allies" is the general term used for firms that provide services, equipment and other materials to the business owner. In the context of this chapter, trade allies includes vendors, contractors, consulting engineers, ESCO, and distributors. The chapter uses the term "trade ally" interchangeably with the terms "contractors" and "vendors". The PMC contracts with a number of consulting engineering firms (one type of trade ally) to serve as program ATACs. In this chapter, the term "trade allies" does not include the PMC-contracted ATACs, but instead refers to the vendors, contractors and so forth that contract with the business owners.

requests and checks may be processed.[8] The third staff member is the Administrative Coordinator, who provides administrative support to the two programs the PMC implements and to the PMC office generally.

The program has experienced a significant increase in the rate at which projects are coming into the program—savings from completed projects in 2004 were nearly triple those in 2003—and this success has had repercussions for the staff. The Technical Manager acknowledged the biggest challenge at the end of 2004 was the delays primarily caused by not having enough staff to be as timely as he'd like: "If I had more time, I could get more projects through, but I'm swamped. I've got over 200 projects in process—I tell people to be a squeaky wheel."

This assessment was echoed by the lighting trade ally network coordinator, who noted the primary area for improvement was response time—a problem he attributed to a successful program with a relatively little staffing and implementation funding. The lighting network for both the PacifiCorp and PGE territories is managed by staff totaling one FTE.[9] The lighting staff report they strive to return all calls within 24 hours and to process forms within four to five days. They describe these performance targets as challenging, given the high volume of lighting projects.

Program staff and services are primarily organized around the type of project—lighting, mechanical and gas—rather than by the type of incentive. This organization reflects the program's desire to work within the market structure. The contractors and vendors who sell and install lighting tend to be an entirely different group than those who install HVAC, refrigeration and gas. Even among the mechanical sector, contractors and vendors typically specialize in one area, such as packaged AC or complex mechanical systems. This is especially true of trade allies serving urban areas, though less true of trade allies located rurally and trade allies that are large urban firms offering multiple services.

A new Energy Trust Program Manager for Building Efficiency started around the first of September 2005. He divides his time roughly equally between the Building Efficiency and Production Efficiency programs. He described his first six months with BE as dedicated to learning about the program: its design and implementation;

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8 According to the PMC, its database is considered to be very complete and accurate by Energy Trust staff charged with creating the *FastTrack* database. Energy Trust staff reportedly used the PMC's database to debug *FastTrack* during its initial implementation.

9 The lighting network coordinator reports that PGE formerly had three full-time lighting specialists serving its customers.

program metrics and characteristics (e.g., cost of power, levelized costs, payback timelines, types of equipment); and learning from the program experiences of his colleagues and supervisor.

On a weekly basis, the Program Manager reviews using *FastTrack*—the Energy Trust's project tracking system—all completed projects needing incentive payments. He checks the measures, project costs, energy savings and incentives: "These four project elements need to line up [be consistent]. With my background, I am able to look at a project and quickly assess whether they do. If necessary, I can look into the project details in *FastTrack*. For about one project a week, I go the PMC for additional information." By all accounts, participants receive incentive checks on a more timely basis now than previously in the program, an accomplishment credited to the Program Manager.

The Energy Trust Program Manager was described by PMC staff as "a jewel to work with," a "huge, positive thing," and "very responsive." Contacts at the PMC report being pleased with his willingness to problem-solve and to work with the PMC staff when clarification is required. PMC staff praised the Program Manager's ability to maneuver through the Energy Trust's processes to make decisions and get feedback to program implementers in a timely fashion: "He understands the need for quick decisions."

PMC staff also described being impressed with his technical knowledge: "He understands the nuts and bolts." "He has a wealth of experience doing what we are doing, and knowing how we need to do it." The mechanical network manager reported the Energy Trust Program Manager had accompanied her on some sales calls.

The Program Manager has worked with the PMC to improve program operation in "simple things, such as responding to questions and getting things signed." The Program Manager described his philosophy about the importance of holding contractors (such as the PMC) responsible, while simultaneously taking action to facilitate program activity. As an example, he mentioned his willingness to make decisions while in meetings with the PMC, rather than deferring decisions until he had consulted with his supervisor.

Energy Trust contacts recognize they will need to stay responsive to keep program activities and projects moving forward, and that responsiveness extends from simple things like signatures to working to keep the program's momentum up through cooperative activities and building mutual trust with program contractors.

The Energy Trust's Director of Energy Efficiency described staying in touch with the program and the market by attending meetings and events hosted for the commercial sector and trade allies, and by talking with the Program Manager, the PMC, NW Natural staff and others.

LIGHTING ACTIVITIES

Network for Lighting Contractors and Vendors

The trade ally network for lighting contractors and vendors is well-established, in part because the utilities had been operating similar lighting programs in the years prior to the launch of Building Efficiency. By mid-2003, 85 contractors and vendors had joined the lighting network. This number increased to over 100 by the end of 2004.[10] The network coordinator reported nearly 70 different companies conducted lighting projects for the program in 2004. He estimates about 80% of these firms had signed up to be in the lighting network.[11]

The lighting trade ally network immediately began bringing projects to the program after its inception. According to the PMC program staff, lighting projects have continued to flow into the program and have been a steady source of projects, with about 9 million kWh saved from completed projects in 2003 and close to 21 million kWh saved from completed projects in 2004.

The network coordinator conducted a workshop for lighting contractors in April 2004, at five locations around the state. Similar workshops were conducted in the program's first year.[12] The workshops review the BE program incentives and processes, as well s changes from the prior year, and include a presentation by Michael Lane of the Northwest Energy Efficiency Alliance's Lighting Design Lab. Additional training opportunities provided by the program include scholarships for trade allies to attend quarterly lighting training sessions conducted by the Lighting Design Lab in Oregon. The network coordinator maintains a listserve and publishes a newsletter for allies with program updates and information on other training opportunities in the state.

10 By March 30, 2005, 110 trade allies belonged to the network.

11 Membership in the network conveys some advantages to the trade ally, but is not a requirement for program participation.

12 The lighting network coordinator also conducted workshops in February 2005.

The network coordinator would like to see resources devoted to marketing the program to potential participants: "We have relied on trade allies to market the program and this is working, but we haven't had the time or resources to do much marketing on behalf of the allies. This is an opportunity for potential program improvement." The network coordinator described one marketing activity as "simple" and possible within the existing resource allocation—"doing a better job at getting the materials we do have into allies' hands." However, the coordinator noted that better marketing has its downside—increasing the number of projects strains already tight implementation staff resources and poses the potential of exceeding allocated program incentives.

The first process evaluation of the Building Efficiency program, conducted in mid-2003, focused on the implementation of the lighting portion of the program and included results from a survey of participating lighting contractors and vendors.[13] Those interviews did not identify any problems with the program. Indeed, three-quarters of the interviewed trade allies rated their satisfaction with the Building Efficiency program as greater than, or equal to, their satisfaction with utility programs in which they had participated. Over one-third described themselves a "much more satisfied." Virtually all contractors were satisfied with the participation forms and turn-around times. While 16% of contractors expressed some dissatisfaction with at least one aspect of the program, no one reported a high degree of discontent.

Lighting Project Development

The program website and printed program information sheets list lighting measures eligible for prescriptive incentives, which are based on a specified change-out (for example replacing T12 ballasts and lamps with T8s). Measures not on the list are automatically considered custom and are screened for cost effectiveness using a methodology developed by the Energy Trust. According to the lighting network coordinator, the custom incentives are valuable for three primary reasons:

- Custom incentives can be applied to projects where the type or number of fixtures to be installed is very different from what currently exists in the space and thus do not qualify for prescriptive incentives, which require that units of a specific piece of equipment be replaced with an equal number of efficient equipment.

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13 The Energy Trust's website makes this report, entitled *Building Efficiency Program: Mid-Year Process Evaluation,* available on its website, See: Energytrust.org/Pages/about/library/reports/BE_Process.pdf.

- Custom incentives give the marketplace options: for example, support for daylighting projects.
- Custom incentives provide a catch-all for new or emerging technologies that are not yet mainstream, but warrant analysis.

The lighting trade ally network coordinator and his assistant receive all applications for lighting measures. They review the project details and analyze the cost-effectiveness of custom measures in a process further described below. All prescriptive measures have already been determined by the Energy Trust to be cost-effective. The network coordinator is authorized to commit the Energy Trust to providing incentives for cost-effective projects.

In the latter part of 2004, the network coordinator developed and provided to network lighting trade allies a spreadsheet that enables the allies to estimate the incentive for a proposed project. By entering project details into the spreadsheet, trade allies can estimate the energy savings and the estimated incentive without contacting program representatives for help with the analysis. Although about half of all lighting projects are custom, only rarely does the PMC call in an ATAC to conduct a technical analysis study for lighting projects.

For additional administrative efficiency, the PMC has embedded the program application forms into the spreadsheet, enabling the network coordinator to automatically generate completed forms from the details input by the trade ally. The network coordinator generates a set of final forms for a project, comprised of all cost-effective proposed measures.

The spreadsheet tool has alleviated some of the pressure on the lighting network coordinator. Previously the coordinator had to input and analyze the project data, while the trade allies waited to learn if their projects would qualify and if incentives would be available for their customers.

Once the network coordinator has approved the application, participants receive a letter on program letterhead describing the project, its BE incentives, the BETC tax credit available and the expected payback. Attached to the letter is a one-page analysis sheet.

The lighting network coordinator described the program's communication and interface with the BETC staff at the Oregon Department of Energy as greatly improved from last year.[14] The BE staff and the BETC staff engaged in a number of conversations about how to ensure the lighting applications meet the needs of BETC, with the result that, "What had been a program weakness is now a strength."

MECHANICAL ACTIVITIES (ELECTRIC AND GAS)

Network for Mechanical Contractors and Vendors

The trade ally network for mechanical contractors and vendors has been more challenging to develop than the lighting network. The PMC, with the support of the Energy Trust, has done a number of things aimed at increasing the awareness of and participation in the program by mechanical contractors, vendors and energy service companies (ESCOs).

In 2004, the program offered a "sale" on variable frequency drives (VFDs), increasing the incentive from 35% to 50% of VFD cost in an effort to generate enthusiasm and interest among mechanical contractors.[15] This incentive level, when combined with the state's Business Energy Tax Credit (BETC) of 35%, dramatically reduced the cost of upgrading motor drives. According to program staff, it took several months for news of the increased incentive level to percolate through the market. By November, projects began "flooding in" and the staff worked to review and process applications and incentive offers in a timely manner.

The VFD sale was complemented by focused activity (described subsequently) on the part of PMC staff charged with building a mechanical trade ally network. In addition, in late November, the Energy Trust hosted a special breakfast event acknowledging twelve mechanical trade allies for their contributions to the program. These twelve allies had installed more than 80% of the program-incentivized rooftop AC units as of that time. The Energy Trust dubbed these twelve trade allies the *Corps of Champions*.

The Energy Trust provided bonus checks to the top three vendors in the amounts of $15,000, $7,500 and $2,500. The PMC staff learned about the checks at the time of the event. One of the staff commented, "The vendors clearly liked that. But I

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14 The evaluation team engaged throughout 2004 in ongoing assessment activities. Correspondence from the evaluation team to the Energy Trust evaluation manager noted difficulties and challenges in the relationship between the BE and BETC programs.

15 The incentive was offered for about eight months, ending December 31, 2004.

wonder if perhaps we've set expectations that we will give similar rewards in the future."

The PMC hired a Business Development Manager in October 2004 to work directly with mechanical trade allies for both electric and—especially—gas projects and to develop a trade ally network. When she began, 53 trade allies were in the network, of which she estimates 25 were active. As of the end of the year, about 70 mechanical trade allies belonged to the network, including about 40 active ones.

The Business Development Manager (hereafter referred to as the mechanical network coordinator) also focuses on moving projects through the process, for example by following up on missing pieces of information on paperwork (account numbers, signatures, etc.). She reports being in the office only a few hours a week, spending a majority of her time on the road meeting with potential and existing trade allies to discuss the program opportunity and/or potential jobs. To orient trade allies to the program, the network coordinator provides sample completed forms and assistance with paperwork.

The network coordinator organized the November special event honoring the *Corps of Champions* and worked with the Energy Trust to produce a news release for the event. She contacted the *Daily Journal of Commerce*, which wrote an article about one of the most active program contractors. The article included a discussion of the BE program. The network coordinator described having an effective working relationship with Energy Trust communications staff, with whom she works on press releases (such as for projects she's identified that are likely to have broad appeal), upcoming events and other activities.

The mechanical network coordinator works directly with the PMC General Manager to develop and refine marketing and outreach strategies, in addition to coordinating with the program and communication staffs at the Energy Trust. Communication between the parties was reported to be effective.

The network coordinator described reluctance on the part of some contractors to join the program's mechanical network or to promote higher efficiency options to their customers. She said some mechanical contractors do not even discuss the program opportunity with their customers because they assume the lowest bid will get the work, or because they may not know how to frame the choice for their customers. According to her, the successful ones have developed ways to show customers the options, to present both standard and efficiency options, factoring in available incentives and the BETC. For the others, she offers to accompany them on sales calls, especially to help close the deal and answer questions. She reports also being contacted by potential participants who think the proposed incentives are too good to be true and are calling to verify that their contractor is not deceiving them.

Because vendors report that high efficiency equipment typically must be special-ordered,[16] the network coordinator is considering ways to encourage distributors to stock such equipment instead.

The PMC Technical Manager concedes that mechanical vendors have been rather slow to embrace the program, but reports being confident that the efforts of the network coordinator will "get these people fired up."

Contacts were enthusiastic about the inclusion of gas incentives in the program, describing it as exciting, especially because of new measures like radiant heat.[17] PMC staff believe radiant heat—currently a relatively unknown technology marked by little consumer confidence—is likely through program efforts to reach a tipping point and become an established heating method. Nonetheless, vendors of gas-fired equipment have been especially slow to participate. "We're still in start-up mode with gas," said on PMC staff. "Gas trade allies are about one-and-one-half years away from being as strong a program network as we have for electric mechanical."

PMC staff characterized as slow the Energy Trust's progress to expand gas prescriptive measures, especially those suited to the restaurant sector: "We now have three items. I understand the Energy Trust needs to do analyses [of measures], and there may be things [analysis tasks] in the queue ahead of mine. But the Trust wants to serve this sector, yet we have little to offer customers." PMC staff described they are meeting with some PGE and NW Natural marketing representatives serving the restaurant sector to gain an entrance into that market.

The second Program Development Manager, identified in the section *Organization Program Staff,* contributes along with the network coordinator to the marketing of mechanical projects (electric and gas). This PMC staff member works directly with large facilities—such as hospitals and other institutions, ESCOs and large contractors to identify projects and shepherd them through the program. She serves as an account representative for key facilities and contractors, giving extra attention to the large jobs that require detailed technical study and bring in large

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16 Findings from mechanical vendors, given in Chapter 4, confirm this description of market conditions stated by PMC staff.

17 As part of on-going efforts to promote gas efficiency measures, on March 10, 2005, the network manager held a *Radiant Heat Technology* seminar to educate businesses on the technology.

quantities of energy savings. She helps participants move projects along toward completion.

The Technical Manager credits the efforts of this second Program Development Manager as contributing substantially to the attainment of BE savings goals. He described two of the ESCOs she works with as "combing the woods and bringing in projects."

The BE staff had sought the participation of ESCOs since the beginning of the program, yet no ESCOs became actively involved in the program until 2004. The program design had assumed ESCOs would be a major source of program projects. The mid-first-year process evaluation identified a number of reasons why ESCOs were not participating during the program's first year.[18] Although the PMC welcomes ESCO participation and the Program Development Manager still works to cultivate it, the Technical Manager summarizes: "ESCOs are not a great target for us at this point. We have a lot of projects, so we don't need to push hard. In fact, we're in danger of running out of incentive money."

The Technical Manager added, "In my opinion, we have the large commercial sector nailed. Our challenge now is how to get projects in Bend and Astoria, the perpetual challenge for energy efficiency programs. These projects don't bring in much savings, but they serve the Energy Trust's equity objectives."

Mechanical trade allies were interviewed for the current evaluation. Findings from these interviews are presented in Chapter 4.

Mechanical Project Development

Unitary AC systems, split systems and air-to-air heat pump systems can all qualify for prescriptive incentives, as can purchases of premium motors under 200 horsepower.[19] Rarely, the PMC may assign an ATAC to review a proposed prescriptive project.

All other cost-effective mechanical projects are eligible for custom incentives. As of the end of 2004, custom incentives were awarded to just over 60% of mechanical projects, comprising 94% of the anticipated mechanical savings.

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18 See the mid-year process evaluation of the BE program, available on the Energy Trust website.

19 Incentives for motors used in industrial production are covered by the Building Efficiency program, rather than the Production Efficiency program, as an outcome of the earlier start date for BE.

To determine whether proposed measures are cost-effective and qualify for custom incentives, the expected costs, energy savings, measure life and non-energy benefits must be determined. Custom incentive amounts for qualifying measures pay 35% of the total approved cost. Project cost and savings estimates may be determined by a program-sponsored technical study (see *Technical Analysis Studies* below), but vendors or participants may also provide the estimates; the PMC requires the estimates be demonstrated with "reasonable certainty."

The PMC Technical Manager is responsible for reviewing all savings estimates, including those produced by vendors or participants and those produced by program-sponsored studies (of course, estimates from program-sponsored studies are generally expected to be trustworthy). In carrying out his responsibilities, he may make adjustments to project parameters and analyses that can affect savings levels and incentive amounts, potentially affecting whether or not the project goes forward.

The PMC has developed a software tool to assist vendors of qualifying prescriptive AC equipment. Early program experiences had indicated that businesses were unable to wait on a replacement AC system while the program paperwork was approved. The software tool enables "one-stop shopping," whereby the vendor can specify and install qualifying equipment in one visit and the equipment will still receive an incentive.

The Technical Manager described having created, about a year ago, a similar software tool for motor vendors. This software has yet to be approved by the Energy Trust: "We tried to take the tool for the AC incentives and make it work for motors. Instead, we may need to develop a form the vendor can fill out and give to the customer, who then sends it to us." According to program staff, it is acceptable for firms to receive incentives for motors they keep in stock so that when a failure occurs, facility staff can pull one off the shelf. Program staff visit the sites of motor projects with incentives over $5,000 to ensure the motors are in place.

The Technical Manager strives to maintain good relationships with vendors concerning their applications so that they do not come to view the program as a hindrance. To reduce the likelihood of creating antagonistic relationships, he works to make sure expectations regarding the integrity of the project numbers and presentation of analyses are clear. PMC staff believes it is important for the program to strike the right balance among the interests of vendors, the interests of commercial establishments, the desire for cheap energy savings and the need for quick project turnaround times: "The vendors have learned they can't pull a fast one on us. If all you hear is praise about the program, the incentives are too high. But you will hear nothing but complaints if the program gets in the way of equipment installations."

The Technical Manager reviews vendor- and participant-produced savings estimates in several ways. He chooses how rigorously estimates are reviewed on a case-by-case basis, using his own judgment. Sometimes he uses *EZ Sim* software to get rough estimates, which are expected to be in the same ballpark as the estimate in question. Other times, the Technical Manager consults engineering manuals or manufacturer specifications available on the Internet. The PMC has also developed tools that aid in calculating savings and reviewing estimates for various measures. If the Technical Manager and his assistant agree an estimate is reasonable, it is accepted. If there is concern that a vendor is "padding" savings or the vendor is not qualified to determine a reasonable estimate, the Technical Manager may ask the participant to allow a program-sponsored technical study, which will result in new, more trustworthy estimates.

Responding to a finding of the mid-first-year evaluation report that ATACs were confused about PMC expectations for their work, the PMC developed a standardized reporting format for the technical analysis studies and held a meeting with ATACs to clarify their involvement in the program.[20] According to PMC staff and ATACs, the standardized format has improved the accuracy of the analysis studies and reduced the time spent by the Technical Manager on study review.

After review, any measures determined to meet the cost-effectiveness criteria (and therefore qualifying for custom incentives) are added to a program form for recording project details, which is kept in program files. (Records of measures failing to meet the criteria are also retained, in a different location in program files.) According to program staff, cases where no proposed measures are found to be cost-effective are extremely rare. Staff estimate that perhaps 10% to 15% of project files have some measures not included in the final project, either because they were found not to be cost-effective or were alternatives to the chosen measures.

Current program procedures call for each measure to be independently evaluated for cost-effectiveness, as opposed to assessing the cost-effectiveness of an entire proposed project. Both the mechanical and the lighting staff responsible for the cost-effectiveness analyses said they could see advantages to both approaches. Neither expressed a strong preference for one approach over the other.

20 The PMC also met with ATACs in February 2005.

Technical Analysis Studies

About one-third (36%) of the projects in the pipeline as of the end of 2004 had technical studies performed by program ATACs. ATACs may seek out customers for their technical studies (a form of program marketing) or they may have studies assigned to them by the PMC Technical Manager. Assignments are made, for example, when a facility contacts the program seeking to improve its energy efficiency, but having not yet identified a project, or when an equipment vendor lacks the engineering skills to make a case for a project's energy savings. Systems needing engineering design skills include controls, distribution and central plant systems.

ATAC-performed studies are free to potential program participants on the condition that the facilities commit to installing at least one recommended measure if their study identifies any measures with a payback shorter than 18 months.

The depth of technical or engineering review any given study employs varies according to the likely energy savings at the facility. When assigning a study to an ATAC, the PMC Technical Manager uses a spreadsheet to quickly assess the electric and gas usage for the facility and to determine the level of study required. The three types of studies are:

- A simple *walk-through* or *checklist* study, conducted on facilities in the small-size group.
- A *Level 1 study*, conducted on facilities in the medium-size group (analyzes facility consumption using the *EZ Sim* software program).
- A *Level 2 study,* conducted on facilities in the large-size group (a custom study typically focused on specific, complex measures).

Sometimes a walk-through study reveals the need for a Level 1 or Level 2 TAS, resulting in multiple studies for one project. Since the inception of BE, 354 technical analysis studies have been performed in support of 317 projects.[21] On the other hand, it is possible (though rare) for studies to find no custom measures with a payback that meets the program criteria, with the result that a few studies have been done for projects installing only prescriptive measures. While a study is not required for projects with custom measures (as stated above, consultants, vendors

[21] Multiple studies on the same project occurred as follows: 39 projects had two studies performed, 2 projects had three studies, and 1 project had four studies.

and program participants can provide savings estimates), the larger a project is, the more likely it is the project will have a technical analysis (TA) study performed.

Determination of the fees paid to ATACs for performing a study is related to the type of study being performed. For the "walk-through" studies, ATAC fees are prescribed amounts. Fees for higher-level TA studies are negotiated on a case-by-case basis between the ATAC and the PMC. The level of study appropriate for the facility is also sometimes negotiated by those parties.

Table 3.1 presents information summarized from the program tracking database about the attributes of studies performed as of the end of 2004. The mean total payment (including reimbursable expenses) for a walk-through study is $141. This includes reimbursable expenses; the fixed price for such a study is $100. The average payment for a Level 1 study is about five times greater than that for a walk-through, at $669 (inclusive of expenses). The average Level 2 study payment is about nine times greater than the average Level 1 study, at $6,346 (also inclusive of expenses). The type of study for some projects was not available.

Table 3.1

NUMBER OF STUDIES, COSTS, AND ESTIMATED ENERGY SAVINGS OF ASSOCIATED PROJECTS, BY STUDY TYPE

STUDY TYPE	NUMBER OF STUDIES THROUGH 2004	MEAN STUDY PAYMENT	MEAN KWH SAVINGS OF ASSOCIATED PROJECTS
Walk-Through	204	$141	30,605
Level 1	81	$669	17,467
Level 2	69	$6,346	269,050

When ATACs were interviewed for this evaluation, they were asked whether they had they had experienced any difficulty negotiating fees for their studies. None reported any difficulty; although one reported, "There seems to be pressure to reduce consultant fees." Only one of the ATACs said the fees were not generally appropriate to the needs of the studies. He said he is "simply not getting a reasonable hourly rate for [his] work on the projects," and further said PMC staff had acknowledged this to him. One other ATAC qualified his agreement that the fees are generally appropriate by saying he certainly isn't "making any money on the studies."

ATAC Marketing Efforts

All eleven interviewed ATACs had brought participants to the program. The percentages of studies done for their own customers (rather than for participants assigned to them by the PMC) ranged from less than 10% to 100%. One ATAC described himself as a "part-time employee" of the PMC; perhaps he did so because more than 90% of the studies done by him had been assigned to him by the PMC. Roughly one-third of the studies done by the remaining ten ATACs had been assigned to them by the PMC; conversely, about two-thirds of studies resulted from these ATACs' marketing efforts.

Roughly two-thirds of the ATACs (64%) reported they had actively marketed their analytic services prior to the existence of BE. This finding is relevant to an assessment of the program's success in meeting its objective to deliver the program primarily through established market actors, rather than primarily through program staff.

The contracts between the PMC and the ATACs do not specify the number of studies the ATAC will be awarded. Six of the eleven ATACs said the number of studies they had done for the program was fewer than they had expected, while another four said the number of studies had met their expectations (Table 3.2). One ATAC elaborated he had been told by PMC staff that "people don't get calls from [the PMC] to do jobs, because so many people are bringing in work, most of the work is spoken for."

Table 3.2

NUMBER OF STUDIES COMPARED WITH EXPECTATIONS

NUMBER OF STUDIES ASSIGNED	COUNT	PERCENT
Fewer Than Expectations	6	55%
Met Expectations	4	36%
Greater Than Expectations	0	0%
No Expectations	1	9%
Total	**11**	**100%**

Delivery of ATAC Studies to Participants

ATACs reported that the procedure for delivering a report to a participant varies by study type. They directly deliver walk-through study reports to the participant, usually immediately upon completion of the study. If a Level 1 or Level 2 study is done, the report is delivered to the Technical manager, who, after reviewing it, may ask the ATAC for additional information or modifications. After the review and any edits, the study is delivered to the participant.

For a Level 1 study, the PMC typically delivers the study to the participant, although the study may be returned to the ATAC for him to deliver, especially if the participant is geographically remote from the PMC. For a Level 2 study, the ATAC and the PMC jointly present the study to the participant, often with the participant's contractor in attendance.

ATACs' level of awareness of the reactions of participants to their studies was mixed. An ATAC's role is complete when the study is delivered to the participant, meaning there is no routine avenue for ATACs to receive participant feedback on the studies. Nonetheless, six of the eleven ATACs had received feedback from participants about their studies. The type of feedback received ranged from expressions of appreciation to a desire for additional details in response to an evolving project scope.

One ATAC said he tries "not to analyze anything the participant doesn't want to do." Even so, eight of the interviewed ATACs said program participants typically do not install all of the efficiency measures recommended in the study. However, most ATACs agreed participants install most recommended measures. An ATAC with a divergent view said participants install only 25% of the recommended measures. The remaining three ATACs said they did not know whether or not participants ultimately installed all of the measures recommended in the study.

The reasons ATACs most frequently mentioned as to why participants do not install all recommended measures involved funding availability and measure payback time—measures with higher costs and/or longer paybacks being less likely to be installed. ATACs offered other reasons for a participant not going forward, including participant skepticism about the accuracy of the ATAC's calculations and the disruptiveness of installing the measures.

Another reason participants may not install all of the recommended measures is that doing so will diminish the per-measure incentives paid to them by the Energy Trust. One ATAC gave the example of a project that might modify two or more major systems: such a project would no longer qualify for BE, but instead must apply for incentives under the New Building Efficiency program.[22] Under the latter program, incentives are lower and some equipment changes that would qualify for incentives under BE are not eligible. Thus, participants will occasionally install fewer measures than recommended in the study in order to remain qualified to receive BE incentives.

Commissioning

The program has established relationships with several firms offering commissioning services. These Allied Commissioning Oversight Contractors (ACOCs) are capable of evaluating the interaction among systems affecting the whole building in large retrofit projects. The original program design anticipated that these commissioning oversight contractors would: 1) ensure the efficacy of mechanical measures associated with more than $50,000 in program incentives; and 2) generate market awareness of the value of equipment systems commissioning.

In actual implementation through 2004, the commissioning contractors have been called into very few jobs. Only four projects in the program database indicated that a commissioning contractor had been assigned. The PMC Technical Manager acknowledged that he had not assigned commissioning contractors as frequently as he had anticipated and that he intends to increase the number of projects assigned ACOCs in 2005.

The evaluation team interviewed one of the three commissioning contractors who had been assigned BE projects so far. According to this contractor, the amount of work flowing from the program was low, but not lower than expected. His impression is that commissioning is slated for projects where more than one system is involved and there are interactions between the systems and whole-building impacts. He said the amount of work required for adequate commissioning is a function of the age of the building, the complexity of the project and the interactive effects of the systems.

FUTURE DIRECTIONS

Program staff report that projects are increasing in number and size, a trend they credit to the improved economy, as well as to the activities of program-allied

22 This program offers incentives for energy-efficient, non-residential new construction and major renovations.

vendors and contractors. The PMC expects the program to commit all currently allocated incentive money by mid-summer 2005. Energy Trust staff plan (as of early 2005) to transfer money to the Building Efficiency program that had been allocated for 2005 expenditure on the Efficient Facility Operations program, whose launch has been delayed.

Although the Efficient Facility Operations program will provide commissioning services to the same utility customer sector served by Building Efficiency, the Energy Trust plans to contract with a different PMC than implements BE. Energy Trust staff indicated this decision was driven by the Trust's goal of contributing to the development of the state's efficiency infrastructure. The Energy Trust plans to structure the program implementation contracts for PMCs serving a single market to reward coordination among the programs. PMC staff are concerned that multiple implementation contractors serving the commercial market may be confusing for contractors and businesses alike.

Energy Trust staff are concerned Building Efficiency may be missing some opportunities to address the common areas of multifamily buildings served by the Trust's Multifamily Residential program. Energy Trust staff are considering ways to capture those opportunities while ensuring the participants need only interact with one program.

Energy Trust staff recognize the need to further address the coordination between programs targeting the same populations. A specific efficiency measure may be eligible for incentives under more than one program and, in some cases, the offered incentives differ. Differing incentives for a single measure are confusing to contractors working across programs and in cases where a participant is eligible for multiple programs, confusing for the participant.

The original contract between the Energy Trust and the PMC expired at the end of 2004; in December, the parties signed a renewal of terms through September 2005. In early summer 2005, the Energy Trust plans to issue a Request for Proposals (RFP) for continued program implementation through a PMC. The current PMC (Aspen Systems) is eligible to submit a proposal.

Energy Trust staff indicated the 2005 PMC contract will include performance bonuses for meeting the "best case" program goals and for reducing the levelized cost of attained savings. The Energy Trust has developed best case goals for each program that collectively will meet the Trust's ten-year energy savings objectives and "high confidence" or conservative goals equal to 75% of the programs' best case objectives. According to Energy Trust staff, the upcoming contract's reward for lowering levelized savings costs will, among other things, encourage the PMC not to acquire more savings than the best-case quantity, as additional savings are likely to be more costly.

Energy Trust staff plan to work with the current PMC to possibly increase the measures covered by prescriptive incentives, re-align the gas and electric incentives and strategically reduce some incentives in an effort to lower the cost of energy savings without jeopardizing the attainment of savings goals. PMC staff described their attention as always directed to new technologies and changing federal requirements for equipment efficiency.

The PMC staff would like to see additional prescriptive measures "because they are so much easier for participants." In addition, the PMC's mechanical network coordinator would like to reduce the number of forms (currently, three) requiring a participant's signature. "The contractor selling the project may not be the person installing the equipment. Getting that last signature on the project completion form often delays the process. I sometimes resort to nagging the contractor."

IMPLEMENTERS' PERSPECTIVES

Program Staff Members' Perspectives

Energy Trust and PMC program contacts are proud of the program and described several major accomplishments to the evaluation team.

- Savings from the program's installed projects met the 2004 goals for electricity savings.
- The program has developed a network of energized and excited contractors and vendors capable of delivering an array of energy-saving projects ranging from lighting, to air conditioning, to mechanical system upgrades. ATACs also bring in projects. The program is effectively tapping into existing market relationships to deliver the program.
- Contacts were particularly proud of the increasing number of mechanical contractors and vendors and the steady increase in the number of mechanical projects being brought to the program. Mechanical projects accounted for 46% of the savings completed in 2004, up from 32% of the savings completed in 2003.

All of the interviewed contacts noted the Energy Trust appeared more stable and confident as an organization than it had during the program's start-up phase in

2003. Contacts reported the Energy Trust had matured through launching and managing a portfolio of programs and acquiring energy savings.

In addition, new staff in the legal department was credited by contacts for expediting the contracting process and providing leadership for the Energy Trust in negotiations with the parent organization for the PMC. Energy Trust program staff held the view that the Trust's legal and contracting support was meeting their needs and had improved greatly since the conditions described in the mid-first-year evaluation report. PMC staff did not hold as favorable a view, citing the lengthy process that led to the contract extension. The contract extension process began in late summer and concluded with a signed contract in mid-December.

As found in the mid-first-year report, PMC staff continue to hold the opinion that the Energy Trust (its staff and Board of Directors) need to clarify how competing program objectives are to be addressed by the implementation team. With the BE program launched and underway, the Energy Trust is pressuring the PMC to reduce the cost of delivered energy savings. Yet, in addition to the concern with cost reduction, the Energy Trust is pushing the PMC to extend the program's reach to more equitably serve the utility customers. Facilities that have been historically underserved are by definition "hard to reach"—thus necessitating specialized marketing approaches—and typically are small. Thus, the cost to serve hard-to-reach utility customers is likely to be greater than that of serving typical customers—project savings are smaller and fixed administrative costs per kWh saved are higher.

While clearly the PMC can try to hold down or reduce its administrative costs[23] and can try to innovate approaches for hard-to-reach facilities that don't result in increased marketing costs, two factors that affect cost in addition to equity concerns are also out of the PMC's control.

One, the Energy Trust has developed a cost-effectiveness criteria and measure-screening tool. The criteria include crediting the project with any identified non-energy benefits. The inclusion of non-energy benefits results in projects that would not pass the screening on energy benefits alone to be eligible for incentives, with the net affect of an increased average cost per kWh.

[23] The reader should note that the technical review of projects is among the PMC's administrative costs. Thus, the various components of administrative costs differ in the degree to which cost-saving actions will affect program outcome.

Two, the program pays custom mechanical projects 35% of total cost. PMC staff believe that a portion (35% or higher, perhaps) of *incremental* cost would be sufficient to motivate the market and would reduce the cost of energy savings. Staff would want the definition of "incremental" to include the replacement of an entire system as an alternative to replacing a key malfunctioning component (e.g., a burned out compressor in a seven-year-old chiller), where incremental cost would be defined as the entire system cost minus the cost of the replacement component. Projects that pass cost-effectiveness criteria using such a definition of incremental should be eligible for incentives.

If the program does maintain incentives calculated on total project cost, PMC staff believe a 30% incentive likely would continue to motivate the market.

PMC staff support the market-based theory driving the program, which calls for the program being marketed by those able to deliver projects. According to PMC staff, several vendors who prioritized the program have doubled their staff over the past two years and are clearly maximizing the opportunity.

The slow ramp-up of mechanical electric and gas-fired projects demonstrates the time it takes for program details to diffuse through the market and to involve trade allies that, as a group, have relatively little experience with efficiency programs. The quick ramp-up for lighting projects is credited to efforts by previous programs to develop a network of lighting contractors and vendors. BE is now building the networks of vendors specializing in mechanical and gas-fired equipment—something likely to pay off for the program in the future, as these networks slowly integrate the program offering into their activities and bring increasing numbers of qualifying projects to the program.

Program staff report being attentive to both maintaining interest and enthusiasm in the market *and* preserving the steady availability of program incentive funds. And while market-driven, trade ally-centered program delivery lies at the heart of the program's success, it also limits program staffs' ability to control the flow of new projects: program staff can adjust incentive levels, but the effect of these adjustments on project flow cannot always be predicted. PMC staff estimate the BE program could bring in 50 million kWh in 2005 (compared with 37 million kWh in 2004) without staff doing any marketing, but simply continuing to maintain relationships and assist with projects.[24]

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24 Furthermore, staff anticipate that mechanical projects could constitute 60% of these savings, attaining the hoped-for split between mechanical and lighting articulated by Energy Trust staff at the program's outset.

With so great a portion of available program funds already committed, staff concern has shifted from building up program capacity and flow of projects to monitoring the "burn rate," or rate at which BE's total incentive allocation is committed.

Utilizing the levers available to control the program's burn rate, such that the right balance is struck between maintaining market interest and maintaining the steady availability of program funds, will remain a key challenge for program staff. While all program contacts reported a desire for more effective marketing and outreach strategies, they also worry that projects generated by additional marketing of the program could overwhelm remaining funds and lead to an interruption of funding availability.

Staff members described wanting to maintain consistent program funding, without ramping up or down in response to annual budgets. PMC staff members are concerned about the effect of a program interruption on the trade ally networks, particularly the nascent mechanical network. "We've trained them to up-sell [actively sell to businesses]," said one contact, speculating on the consequences of an interruption in funding availability—"the best case is that they stop up-selling, the worst is that you've lost them for good." In addition, interruptions in incentive funding hurt potential participants who make capital budgeting decisions a year or two in advance and who have been told the incentive monies will be available for years to come.

The PMC's contract extension through September 2005 includes a goal of 20 million kWh. The program ended 2004 with commitments to projects underway of over 16 million kWh. That leaves uncommitted incentive money capable of funding 4 million kWh for the period, which would imply a burn rate of less than 20% of the 2004 rate. As stated, Energy Trust staff plan to shift funds for additional incentives into the BE program.

ATACs' Perspectives

ATAC perspectives on four topics follow:

- *Direction Received from the PMC*
- *Satisfaction with the Building Efficiency Program*
- *Assessment of Program Strengths*
- *Concerns*

Direction Received from the PMC

For the most part, the instructions and direction provided by the PMC for the studies has met the ATACs' needs. Eight of the eleven ATACs said the PMC has been clear in its expectations for the studies. One of the remaining ATACs made a qualified statement to this effect, saying "[The PMC] just made their expectations less murky." Of the two ATACs who said the PMC has not been clear in its expectations for reports, one said the PMC has "moved all over the map." He added, "It's a new program, so some changes are to be expected, but there are still too many changes."

Although seven ATACs said they have been asked by the PMC to revise their studies, they described requested revisions as "modest," usually confined to providing clarification or verification of items in the study.

All of the ATACs reported they had attended information or training meetings with the PMC. Some of these ATACs mentioned multiple ("quite a few," "several," and "three or four") such sessions. Others mentioned "lots of one-on-one meetings at the PMC's office," and another said the PMC has "come over and done a session in-house for us." However, one ATAC said there had been "very little" training and another referred to only one session, offered much earlier in the program.

Seven of the eleven ATACs reported they had received instructions or direction from the PMC on methods to use in their audits or about how to convey their findings. For example, one ATAC said he was told what models to use and said the PMC has been clear about the information it wants in reports. Only one ATAC said he would like to receive additional direction. He added, "We don't always know if we're supposed to look at everything."

Finally, one of the ATACs said he would like to have additional information from the PMC. Specifically, he would like to know which ATACs have done studies and the types and numbers of studies they have done. He wanted a means of assessing his level of program activity.

Satisfaction with the Building Efficiency Program

In assessing their overall program experience, seven of the eleven ATACs said their involvement in BE has met their expectations. Two ATACs, reporting that their involvement in the program had not met their expectations, said they had expected more work through the program. One of these ATACs added he was disappointed with the amount of money paid for the studies. (He was one of the ATACs who had earlier reported the fees for the studies were not appropriate to the needs of the studies.) He also believes many participants want an analysis study of expensive prescriptive measures to determine the paybacks before they will go ahead with their projects.

Table 3.3 gives the results of two measures of ATACs' satisfaction with the Building Efficiency program. ATACs rated their overall satisfaction with their involvement in BE on a five-point scale, where "1" means not at all satisfied and "5" means highly satisfied. ATACs also compared BE to other incentive programs with which they were familiar, using a similar five-point scale where "1" means much less satisfied and "5" means much more satisfied. All of the ATACs who had participated in utility incentive programs reported being equally or more satisfied with BE as compared to previous utility programs.

Table 3.3

INDICATORS OF ATAC SATISFACTION WITH THE PROGRAM

QUERY	SATISFACTION LEVEL				
	"1"	"2"	"3"	"4"	"5"
Overall, how satisfied are you with the Building Efficiency Program? (n=11)	—	1	3	3	4
How satisfied are you with the Energy Trust program compared to other utility programs (n=9)*	—	—	4	3	2

* *Two ATACs were excluded because they had no experience with utility incentive programs.*

The one ATAC who rated his overall satisfaction at "2" was unhappy with the PMC: when asked why he was not satisfied with the program overall, he stated simply and tersely, "All program involvement is through the PMC."

Other ATACs rating their overall satisfaction at less than "5" offered several reasons, including:

- Disappointment with the number of studies they had been able to do for the program;
- Unclear communication;
- Perceived disorganization of the program;

research/into/action inc

- Lack of timeliness in processing work orders and incentives;
- BE's awkward interface with the New Building Efficiency program; and
- Experience that the PMC has not always communicated to the participant who the ATAC was and why he was there before the ATAC arrived at the participant's establishment.

It is important to note that some of those who rated their overall satisfaction with their involvement in the program at less than "5" also made positive remarks about the ease of dealing with PMC staff and about the staff's willingness to accept ATAC input in refining aspects of the program.

Table 3.4 provides the reasons given by the ATACs for their rating (as shown in Table 3.3) comparing BE to other incentive programs.

Table 3.4

REASONS FOR SATISFACTION WITH BE COMPARED TO OTHER PROGRAMS

RATING	EXPLANATION
5	BE gives lots of money.
5	Utility programs had loopholes.
4	Utilities were just going through the motions.
4	BE incentives are more standardized.
4	Utilities had a hidden agenda of installing more energy-consuming devices.
3	Utility programs had no project payback limitations.
3	Utility programs had more marketing.
3	There was a learning curve for the ATAC with the BE program.
3	No explanation given.

Most of the interviewed ATACs had no suggestions for improving the forms required for BE and most generally believe the forms are effective and useful. Those offering suggestions said it would be helpful to be able to complete the forms electronically in *Word* or in a PDF format.[25] Also suggested was dropping the stipulated audit fee from the audit-fee agreement, because the fees vary (sometimes significantly according to this ATAC) from the form's options.

Program Strengths

All of the interviewed ATACs had good things to say about the program. Program strengths identified by the ATACs and other positive comments made by them, included:

- The BE program is relatively easy to understand; it has simple payback criteria; it is very organized, clear; "you know what to expect."
- Incentive levels are good.
- PMC staff are "good to work with," "very helpful," "knowledgeable and open"; staff have a sincere interest in saving energy.
- Analysis is comprehensive; it's good that participants are responsible for half the study fee if they don't implement measures; the program points participants in the right direction.
- A lot of good installation contractors are lined up.
- The program is proactive and built for speed to maximize the number of projects in the least amount of time.
- Reporting and communication are strengths of the program.

ATAC Concerns

While ATACs identified many program strengths, most (9 of 11) ATACs also expressed some concern about the program generally and about their participation

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25 Participating vendors and contractors also asked for the ability to complete forms electronically (see Chapter 4). While it is possible to create PDF forms that can be completed electronically, the PDF forms the program currently makes available electronically do not allow this. The technical manager reports that he is able to provide forms in *Word* format to those who ask.

in it. These concerns were varied and ranged from overall concern about the Energy Trust's continued existence to unsatisfactory experiences with some aspect of the program.

Two ATACs stated they believe the PMC is short-staffed. One ATAC worried, "[The PMC] may hit a wall in terms of the number of projects they can handle—review times may increase, potentially alienating participants." Five other ATACs implied a concern about program staffing levels at some point during their interviews. One of these ATACs said, "Even customers don't hear about their projects for months." Another said, "[The PMC] has been slow to respond in several cases." Another ATAC said there are "limited resources on study and engineering estimates." However, another ATAC noted such delays, but was not troubled by them, saying, "At times it seems like [the PMC] has too much work. Every once in a while stuff gets backed up, but it isn't a big deal."

One ATAC expressed concern about perceived inconsistencies in how the PMC applies the criteria to determine whether projects are eligible for funding. This ATAC said he had first-hand knowledge of projects that did not meet the program criteria that were funded under BE, while other projects which did meet the program criteria were not funded.

Two ATACs expressed concern regarding the expiration of the PMC's contract this year. One of them was fearful of a lengthy learning curve should a new PMC be hired, the other indicated a more generalized fear of the unknown surrounding the contract expiration.

One ATAC was concerned that his firm has not received any additional work since it had complained to PMC staff about incongruities in program administration. This ATAC inferred that his firm was being penalized for questioning the program.

Other miscellaneous concerns included:

- Seeing no evidence of a program marketing effort to reach prospective participants (two mentions).
- Changing, rather than constant, program criteria; inadequate information about the long-term plans for the program, especially regarding changes to incentives.
- Inadequate PMC technical competence concerning the needs of large, institutional participants.
- Inconsistent study quality from ATAC to ATAC.

- The sense that the PMC considers ATACs to be a "necessary evil."
- The "unnecessary" limitation imposed by the ten-year measure-payback criterion.

SUMMARY

The Building Efficiency program doubled its 2004 electricity savings goal and exceeded its combined 2003-2004 goal. Mechanical projects accounted for 46% of the savings completed in 2004, up from 32% of the savings completed in 2003. Two-thirds of all mechanical projects completed since program inception in 2003 were finished in the last nine months of 2004. Most PMC staff believe the program is positioned to achieve about 60% of its savings from mechanical projects in 2005, the target Energy Trust program design staff had hoped BE might achieve.

Gas-fired measures continue to lag the rest, but PMC contacts report their efforts to increase both the participation of trade allies and the interest of commercial facilities appear to be succeeding. PMC staff believe consumer and trade ally interest in the program is limited by the availability of few prescriptive gas measures (currently, there are three). Staff believe the restaurant sector, in particular, would be benefit from additional prescriptive gas measures. PMC staff characterized Energy Trust actions to analyze and approve additional prescriptive measures as "slow."

PMC staff also expressed feeling hampered by lack of Energy Trust response to a proposed software tool intended to assist vendors and participants in developing incentive applications for efficient motors. Additional lack of coordination between the Energy Trust and the PMC is evidenced by the Energy Trust rewarding high-performing vendors of packaged AC equipment with bonus checks without having first notified the PMC.

Even so, PMC staff described a "night and day" difference in Energy Trust responsiveness to program needs in 2003 and 2004. Staff credit the significant improvement to the newly hired Energy Trust Program Manager. Energy Trust program staff described a marked improvement with the support the program receives from the Energy Trust's legal and contracts staff. PMC staff believed limited improvement has occurred.

As found in the mid-first-year evaluation, PMC staff continue to want Energy Trust staff and its Board of Directors to address the implications for program operations of competing program objectives. In particular, the Energy Trust has asked the PMC to strive to lower the cost of delivered energy savings at the same time that the Trust has: 1) asked the PMC to extend the reach of the program to encompass facilities that typically do not participate in efficiency programs; and 2) designed the cost-effectiveness criteria to include non-energy benefits, while specifying that all cost-effective projects will receive incentives on a first-come, first-served basis. These objectives of low cost savings, equity and recognition of non-energy benefits are each admirable, but pose conflicts for staff charged with delivering the program savings.

The BE program is run with what contacts characterize as a limited staff and the success of the trade allies in identifying projects has occasionally meant slower-than-anticipated document review and approval. Program staff believe the work level appears manageable, especially given the potential for lowered incentives and limited funds in the future. Given the rate of projects conducted in the latter half of 2004, program staff are concerned about the possibility of any interruption in funding that might result from exhausting allocated funding. Controlling the program's rate of new projects without compromising market enthusiasm will be a key challenge for program staff.

ATACs point out many strengths of the BE program, including positive impressions of the PMC staff and the overall simplicity of the program for participants. They are generally satisfied with the amount of direction they receive from the PMC regarding studies and feel the forms are effective and useful. A majority of ATACs report their participation in the program has met their expectations.

When ATACs expressed concerns, they tended to focus on larger issues: program marketing, the viability of the Energy Trust and the prospect of a different PMC being selected this year. The most common concern was that the PMC is inadequately staffed. Several ATACs reported experiencing some problematic aspects in their relationship with the PMC.

ATACs report the studies they conduct are most often for participants they have identified and brought to the program. Only one ATAC reported receiving a majority of his program work via PMC referral.

There are several reasons participants choose not to install all of the measures recommended in a study. The most common reason is that costs are too high or the payback too long, but ATACs also report instances where participants have reduced the project scope from addressing several building systems to addressing a single system, to avoid being reassigned to the New Building Efficiency program, which offers lower incentives.

4. MECHANICAL CONTRACTOR AND VENDOR FEEDBACK

We sought the feedback of participating mechanical contractors and vendors through a brief (approximately 15 minute) phone interview in February and early March 2005.

Working from the program tracking database, the evaluation team identified 71 contractors and vendors associated with 159 mechanical projects.[26] (The program tracking database identifies contractors/vendors only when the trade ally is the project contact. Most projects in the database do not identify a trade ally.) The identified trade allies included four energy service companies (ESCOs). We completed interviews with 17 of these contractors, including two ESCOs, as shown in Table 4.1.[27]

Table 4.1

SAMPLE DISPOSITION

STATUS	FIRMS	PROJECTS
Completed Survey	17	81
Contacted, Not Reached	9	21
Over Quota, Not Contacted	44	54
Refused	1	3
Total	**71**	**159**

26 Excluded from the identified firms was one company that primarily sells motors to a Program Delivery Contractor (PDC) working for the Energy Trust's Production Efficiency program.

27 Some interviews were abbreviated when contractors were pressed for time. Thus, not all interviewed contractors answered all questions.

CHARACTERISTICS OF INTERVIEWED CONTRACTORS

The interviewed mechanical contracting firms had been established as recently as 1998 and as long ago as 1902, with a median age of 29 years.[28] The size of the firms varied widely, ranging from three to 38,000 employees. The 38,000-employee firm—a national manufacturer and vendor of HVAC equipment—was an outlier; if it is excluded, the number of employees at sampled firms ranged from three to 100, with a median value of 30.

To get a sense of the business activities of the mechanical contractors and vendors involved in the BE program, we asked contacts about the products and services they offer. The most common was HVAC-related services, including design-build, installation, maintenance and repair. Other services mentioned involved refrigerators and freezers, cold rooms, ductwork, boilers and tenant improvements. Two contractors specifically mentioned controls and two additional contacts worked for a full-service energy service company (ESCO) and reported developing and delivering comprehensive energy savings projects for customers.

Table 4.2 summarizes the HVAC products and services the interviewed firms provide, as well as indicating whether they address controls and motors and drives.

Table 4.2

PRODUCTS AND SERVICES OFFERED BY INTERVIEWED MECHANICAL CONTRACTORS

FIRM	PACKAGED HVAC	CHILLERS/ COOLING TOWERS	ENGINEERING	DISTRIBUTOR	CONTROLS	MOTORS/ DRIVES
1		X			X	X
2		X				
3		X			X	X
4		X	X			

Continued

28 In cases where a wide range of values or extreme values exist, the median (or value mid-way through a list ordered by largest to smallest) better suggests the characteristics of a group than the average (arithmetic mean).

FIRM	PACKAGED HVAC	CHILLERS/ COOLING TOWERS	ENGINEERING	DISTRIBUTOR	CONTROLS	MOTORS/ DRIVES
5		X	X		X	X
6		X	X			X
7		X	X		X	X
8		X	X		X	
9		X	X		X	X
10	X		X		X	X
11	X		X			
12	X	X		X		X
13	X	X		X		X
14	X				X	X
15	X				X	
16	X					
17			X		X	

PROGRAM INVOLVEMENT

Mechanical contractors most commonly reported first hearing about the program via professional relationships with other contractors and vendors. Other sources of initial information about the program included contact with program staff or utility representatives, or through connections to utility programs, including NW Natural Gas. A number of contractors explicitly mentioned recent positive interactions with the Business Development Manager (the mechanical trade ally network manager) who joined the program staff in the fall.

All but two contractors agreed that the program provides a good fit with the services and products they offer. The two contractors for whom the program is not a good fit provide packaged HVAC and controls (see Table 4.2); they described doing "a lot of preventive maintenance" and "primarily retrofit of high efficiency systems."

A majority (10 of 17, or 59%) began telling their customers about the program directly after learning of the opportunity. Several contacts noted that they mention the program to customers as applicable, but they have found it was taking several months to identify opportunities and/or their customers were selecting jobs that did not qualify for incentives.

The same number (10 of 17, 59%) reported all of their sales staff know about the program and understand how to participate. Several contacts qualified this by adding they were the lead contact for the program, implying the rest of the staff was less knowledgeable. In some cases, contacts stated they were the only one in their organization dealing with program-qualifying projects, without indicating whether this meant other sales people were not aware of the program.

Contractors reported two main ways of selling the program: offering it to everyone or targeting it to specific customers. One contractor described adding language about the Building Efficiency program to his boilerplate proposal/contract—something he said resulted in more contact with customers and increased participation because customers contacted him after noticing the clause about BE. Contractors who targeted customers described targeting those they found to be wasting energy, using older equipment, remodeling or retrofitting their facilities, and/or those concerned with quality and efficiency.

We also asked mechanical contractors about how they came to understand the procedures required to participate in the program. The most common answer (given by five contractors) was the participation processes became clear through trial and error during program ramp-up. Several contractors mentioned the program launched with processes that were a bit confusing and cumbersome, but that things have been streamlined and are clearer now.

Most of the contractors interviewed had little to say about learning program procedures; however, one contractor noted the difference between projects qualifying for prescriptive versus custom incentives, calling the custom incentive process "a different animal." Custom incentives require the project to have an energy efficiency measure payback of greater than 18 months, but less than ten years, and are subject to project cost caps that vary by measure.

SATISFACTION AND SUGGESTIONS FOR IMPROVEMENT

Contractors reported being satisfied with the steps required for program participation (of the 13 that answered this question, 11 reported being satisfied). None of the mechanical contractors said their paperwork submitted to the program had been returned for changes, nor did any report problems with the required paperwork. Several contractors noted that questions posed by program staff about projects and/or paperwork were reasonable.

Over half of contractors (8 of 13 responding) reported participating in previous efficiency programs run by the utilities. When asked to compare their BE program experience with their experience with other utility programs, those responding indicated that the program compared favorably to the utility programs. Evaluators asked contractors to rate several indicators of satisfaction on a five-point scale, where "1" is "not at all satisfied" and "5" is "very satisfied." Contractors gave very high marks to the program and its staff for courtesy and helpfulness, knowledge of program services, ease of paperwork and transactions, and problem resolution (Table 4.3).

Table 4.3

SATISFACTION MEASURES

MEASURE	SATISFACTION LEVEL				
	"1"	"2"	"3"	"4"	"5"
How satisfied are you with the Energy Trust program compared to other utility programs? (n=8)*	—	—	1	7	—
How would you rate the program staff's courtesy on the phone? (n=13)	—	—	—	1	12
How would you rate program staff's knowledge of program services? (n=14)	—	—	—	2	12
How would you rate the ease of your transactions? (n=13)	—	—	—	6	7
How would you rate your satisfaction with any issue that needed resolution? (n=4)*	—	—	—	1	3

* Eight contractors answering this set of questions had experiences with other utility programs; four contractors had encountered issues that needed resolution.

When asked what changes they would like to see in the participation process, most contractors could not identify any specific changes. Those offering suggestions tended to advocate continued improvement, particularly in paperwork processes—

spreadsheets for prescriptive incentives, forms that can be filled out electronically, and a desire for program forms in *Word* or *Excel* rather than in a PDF format.[29]

Contractors gave the program credit for improving the paperwork processes. "I want continued improvement in making the program as simple as possible…they are doing this, and it is welcome," said one contractor.

Similarly, contractors noted very few problems in participation for themselves or their customers. The issues that were identified included delays caused by the state's Business Energy Tax Credit (BETC) process and the lack of product availability from manufacturers and distributors, discussed in more detail below.

Two contractors desiring improvements focused mainly on time—the time required for the PMC to calculate and review savings, and the time it takes to get things in place for a given project. Three contractors spontaneously described their impression that the program appeared understaffed, particularly during several very busy weeks in December, and said this created some delays.[30] Even so, one contractor complimented the program staff for their cooperation in processing paperwork quickly when his customers had time concerns.

None of the mechanical contractors reported that program participation had resulted in delays for their customers, although one said, "Equipment supply is the issue, not program design per se." Contractors also did not mention any problems with timing in general.

Contractors offered several suggestions when asked about changes they would like to see in the program, including:

- Comments on eligible measures and incentives:
  - Include windows on commercial buildings.
  - Allow fuel switching.
  - Resume offering a 50% incentive for VFDs.

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29 Program ATACs also asked for the ability to complete forms electronically. While it is possible to create PDF forms that can be completed electronically, the PDF forms the program currently makes available electronically do not allow this. The technical manager reports that he is able to provide forms in *Word* format to those who ask.

30 The program incentives for variable frequency drives (VFDs) had been raised to 50% from 35% for the latter part of 2004; as of January 2005, VFD incentives returned to 35%.

- Increase incentives for gas measures.
- Allow modifications to older equipment—adding components to existing equipment to make it more efficient.[31]

➢ Comments on program processes:

- Inform the contractor about the timing of reimbursement for projects where the customer signs over the incentive to the contractor.
- Combine the BETC and Energy Trust processes so paperwork is less burdensome—satisfying BE should automatically qualify you for BETC.
- Continue improving program forms (provide spreadsheets for prescriptive measures; provide forms electronically).

➢ Comments on PMC activities:

- Keep turn-around time for paperwork to a minimum; the program appears to be short-staffed.
- Increase publicity to prospective customers.
- Identify and work with distributors willing to stock qualifying equipment; offer them preferred status or other benefits.
- Offer workshops to help inform contractors about the program and especially about the process of identifying projects that may qualify for custom incentives.

CONTRACTOR UNDERSTANDING OF CUSTOM MEASURES

Contractors' suggestions for program enhancements, above, included one suggestion of offering incentives to projects that modify existing equipment to make it more efficient. A footnote on this comment indicates that such projects, when cost-effective, are eligible for incentives. The PMC Technical Manager noted that cost

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31 According to program staff, the program accepts proposals for optimization projects of this type and will award incentives if the projects yield cost-effective kWh savings. For a further discussion of this theme, see below.

effectiveness is a function of expected measure life, which is shorter for older equipment. Thus, new equipment yielding the same annual expected savings might pass the cost-effectiveness criteria when adjustments to old equipment do not.

This section elaborates on this issue because of the following: In clarifying with the Technical Manager the accuracy of the contractor's comment on eligible measures, the Technical Manager acknowledged the likelihood that many participating contractors and vendors are unaware of the flexibility that custom incentives offer.

The interviews did not explore the accuracy of contractors' understanding of the flexibility of custom measures. Indeed, because people "don't know what they don't know," a survey might not be able to directly ask the extent of contractors' understanding, but rather would need to tease it out of respondents. Consequently, this section is augmented with recent experiences of members of the evaluation team involved in equipment decisions.

Research Into Action newly leased additional office space in January 2005. The heating system generates stratified heat conditions—too cold in the workspace and too warm toward the ceiling. The landlord's suggested solution was to turn up the thermostat, the method used by the previous tenants. A heating contractor indicated the problem could be solved by adding to the air distribution system and moving the thermostat. When asked whether Building Efficiency incentives might apply to the estimated $2,500 job, the contractor replied that incentives were only available for new HVAC systems and not for efficiency improvements to existing systems.

In a separate incident, a member of the evaluation team participated in a committee at his church charged with cooling the front of the sanctuary occupied by the minister and choir (the chancel). The team member advocated for a natural cooling solution and suggested the Building Efficiency program might be able to conduct a technical analysis study and provide project incentives. The church's contractor replied that the program did not address natural cooling, only efficient HVAC systems.

In neither of these instances did the evaluation team members contact the Building Efficiency staff to determine whether the program would consider the proposed efficiency solutions. However, both contractors' responses are consistent with the comment of the interviewed contractor who believes program incentives are restricted to new efficient equipment.

CONTRACTORS' VIEWS ON THEIR CUSTOMERS

Customer Awareness of Energy Efficiency

When asked about the proportion of their customers that seemed to be aware of the BE program or the Energy Trust before they mentioned either, contractors generally estimated awareness of both at between 10%-50%. One contractor based in the Portland metro area said his customers were very aware and estimated up to 100% had heard of either the Energy Trust or the program. Another contractor reported that the information about the Energy Trust is rippling through the industry and that customers with more experience are more aware of the opportunities. He noted that customers who pay attention to all of the opportunities can be overwhelmed though, as they try to sort through the various rebate programs.

While a few contractors agreed that a portion of their customers do ask whether there are incentives available for energy efficiency, it was more common for contractors to report their customers don't think about energy efficiency and incentive opportunities unless the contractor mentions it.

Contractors described varying proportions of their customers that independently raise the issue of energy efficiency and offered percentages that ranged from none or low (10%) to 75%. First cost remains a primary concern for customers of mechanical contractors. One contractor said he made sure all of his customers are aware of the program opportunity. According to another contractor, "It varies with the customer as well as with the promotion… if they're not inclined toward energy efficiency, then it doesn't matter. Most mechanical improvements that customers undertake have a payback of less than three years, yet their decision criteria involve much more than this payback horizon."

We asked contractors to estimate the portion of their customers who consider participating in the program after it is mentioned to them. Seven contractors provided estimates of the percentage who consider it. Their answers showed little consistency, ranging from 5% to 100%, and averaging just over half.

Several contractors commented on anticipated changes to national energy performance standards (requiring SEER 13), speculating on the effect these changes will have on supply and demand for high efficiency HVAC units.

Customer Considerations for Participating

Contractors generally reported that customers find the incentive levels persuasive, especially for electric measures, and that the range of eligible equipment is satisfactory. Although the incentives help, "the customer has to be sharp enough to understand the operating cost savings as well." Contractors typically describe several advantages to the efficient equipment and the BE program, but primarily focus their customers on the benefits of reduced operating costs resulting from lowering fuel and maintenance costs.

One contractor said, "We present alternatives and give them standard and high efficiency choices. Most appreciate seeing the choice, even if they don't go with it. They're not offended by the up-sell—they think we are trying to help them."

Other benefits contractors mention to customers who are considering energy-efficient options include improving property resale value, improved comfort, more automatic control of building systems and fewer service calls.

Contractors offered several reasons why customers may choose not to participate, the most common of which is that higher first costs mean the required payback or return on investment simply is not there. Other disadvantages included potentially higher long-term maintenance costs and the greater complexity of efficient equipment. One contractor described that the heavier weight of efficient HVAC systems, especially large systems, limits their applicability in rooftop applications.

Participation can also be unattractive for facilities with lease agreements. Who owns and maintains the HVAC system is a central question in choosing to go forward with a more expensive, but more efficient unit. According to one contractor, "If there are two years left on the lease, but the equipment must be replaced, the tenant will likely buy the cheapest. It depends on the arrangement, on who pays the utilities. If the guy who pays also benefits, the chance is 99% yes."

Finally, five of the seventeen interviewed contractors mentioned problems caused by lack of availability of qualifying equipment. They indicated the supply was limited due to low inventory levels at distributors and low manufacturing levels, which created a "constant problem." Of the five contractors describing a lack of equipment availability, two were firms offering engineering services and installation of chillers and cooling towers, two were distributors, and one sold packaged HVAC systems.

These contractors reported having to treat products meeting program criteria as special orders—something that may add four, six, or even eight weeks to the timeframe of a job. "Variable speed gas packaged units are hard to find.

Distributors don't stock them due to low demand so we wait for a production run from the manufacturer," said one contractor. "You can't convince the distributors to hold on to inventory when there's not enough demand from contractors."

One contractor described how he delineates in every bid the high efficiency option with the incentives available and the BETC, while warning customers of the four to six week equipment delay associated with the high-efficiency models. According to him, most of his customers cannot wait that long and choose other equipment.

SUMMARY

Mechanical contractors and vendors who have participated in the program include ESCOs, equipment manufacturers and distributors, and those offering packaged HVAC systems, complex mechanical systems, motors and drives, and controls. Interviewed firms ranged in size from three to 100 employees and were established between 1902 and 1998.

Mechanical contractors report high overall satisfaction with the program and with the processes required to participate in it. Contractors spontaneously noted the program was good for them and for their customers, and that rising oil prices should continue to create pressure to improve energy efficiency, helping to make projects cost-effective.

Many contractors spoke positively about interactions with the trade ally network manager. Few contacts had negative comments and some of those who did touched on issues outside of the program's control—for example, the BETC application process and the lack of availability of qualifying products.

Contractors appreciated the PMC's efforts to reduce the burden of paperwork and hoped the PMC would continue to streamline the process. Several contractors suspected the program might be short-staffed (especially at the end of the year), as the project approval turnaround times they experienced were longer than they would prefer.

The findings also suggest that some contractors do not understand the scope and flexibility of custom incentives. Among the suggestions offered by mechanical contractors were requests for workshops to train contractors in program procedures, saying these would be especially helpful for understanding custom incentives.[32]

32 The PMC has annually held a workshops for lighting contractors and plans in 2005 to offer workshops for mechanical contractors.

4. Mechanical Contractor and Vendor Feedback

5. PARTICIPANT FEEDBACK

This chapter provides information derived from telephone interviews with participants in the Building Efficiency program whose lighting and mechanical projects were completed as of the end of March, 2004. In addition to providing feedback on program processes, information gathered from these interviews was also analyzed and used to estimate free-ridership and net program impacts (Chapters 6 and 7 provide the impact evaluation methodology and results, respectively).

Interview questions addressed: project decision-making, especially the likelihood projects would have taken place without the program's help; firms' experiences participating in the program; and participants' satisfaction with program processes. The survey instruments used to interview participants with lighting projects and those with mechanical projects differ slightly and are given in Appendix C.

Interviews were conducted with contacts at participating firms between July 12 and September 8, 2004. Ninety-four of the 178 participants with one or more completed lighting projects and 51 of the 65 participants with one or more completed mechanical projects participated in the survey. The interviews took between twelve and twenty minutes, depending on the responses received.

Table 5.1 provides the sample disposition. The three participants with incomplete surveys terminated mid-way through the interview.

Table 5.1

SAMPLE DISPOSITION

DISPOSITION	LIGHTING	MECHANICAL
Completed Survey	91	51
Incomplete Survey	3	0
Refused	4	3
Bad Contact Information	8	6
Left Company	3	3
Called for Previous Evaluation	17	0
Not Reached	52	2
Total	**178**	**65**

SAMPLE CHARACTERISTICS

The program contact date for sampled projects ranged from mid-January 2003 to the end of March 2004 (Table 5.2).

Table 5.2

PROJECT INQUIRY DATES

CONTACT DATE	LIGHTING	MECHANICAL	TOTAL
First Quarter 2003	24%	8%	18%
Second Quarter 2003	31%	22%	28%
Third Quarter 2003	20%	31%	24%
Fourth Quarter 2003	19%	24%	21%
First Quarter 2004	6%	15%	9%
Total	**100%**	**100%**	**100%**

The cost of projects undertaken by sampled participants varied widely (Table 5.3). The least expensive was a lighting project costing $384, while the most expensive was a mechanical project costing $341,380. Projects under $10,000 comprise 58% of all lighting projects, compared with 30% of all mechanical projects. Projects over $25,000 comprise 16% of all lighting, yet 46% of all mechanical.[33]

Table 5.3

PROJECT COST

PROJECT COST	LIGHTING N=93	MECHANICAL N=49	TOTAL N=142
Under $2,500	19%	2%	13%
$2,500 to $4,999	22%	6%	16%
$5,000 to $9,999	17%	22%	19%
$10,000 to $24,999	26%	23%	25%
$25,000 to $49,999	3%	23%	10%
$50,000 to $99,999	10%	14%	11%
$100,000 to $199,999	3%	8%	5%
$200,000 or More	0%	2%	1%
Total	**100%**	**100%**	**100%**

Table 5.4 provides median values for project cost, incentive amount and incentive as a percentage of the project cost. The table further illustrates the cost differences between lighting and mechanical projects. The mechanical projects received a slightly lower rate of incentive than those for lighting (22% of project cost, compared with 26%).

33 Note that the projects whose characteristics are summarized in this chapter were completed by the end of March 2004. Thus, their summary characteristics differ from projects completed as of the end of December 2004, and summarized in Chapter 2.

Table 5.4

MEDIAN PROJECT COSTS AND INCENTIVES

PROJECT INFORMATION	LIGHTING	MECHANICAL
Median Project Cost	$18,865	$40,620
Median Incentive Amount	$4,655	$8,975
Median Incentive, as Percent of Project Cost	26%	22%

Manufacturing, retail and office structures participate in the Building Efficiency program more frequently than other types of facilities (Table 5.5). Lighting projects are most commonly done by retail establishments and mechanical projects by offices; manufacturing facilities were the second most common for both end-uses.

Table 5.5

BUSINESS ACTIVITY

FACILITY TYPE	LIGHTING N=89	MECHANICAL N=51	TOTAL N=140
Manufacturing	18%	24%	20%
Retail	24%	10%	19%
Office	12%	27%	18%
Warehouse/Wholesale	13%	2%	9%
Church/Community Events/Use	10%	6%	8%
Healthcare	7%	7%	7%
Food Service	4%	10%	6%
Automotive	4%	4%	4%
Municipal/Public Services	2%	6%	4%
Hotel	2%	4%	3%
Residential	4%	0%	2%

Total	**100%**	**100%**	**100%**

The number of people employed at interviewed facilities with Building Efficiency projects varies widely (Table 5.6). The contacts at three facilities (a laundromat and two community centers) reported no full-time-equivalent (FTE) employees; a healthcare facility had the most FTE employees—3,300. A majority of lighting participants (53%) had fewer than 25 employees, compared with 36% of mechanical participants.

Table 5.6

NUMBER EMPLOYEES AT FACILITY

NUMBER FTE	LIGHTING N=92	MECHANICAL N=51	TOTAL N=143
10 or Less	35%	17%	29%
11 to 25	18%	17%	18%
26 to 50	17%	10%	15%
51 to 100	11%	16%	13%
101 to 250	15%	4%	11%
251 to 500	2%	16%	7%
501 to 1,000	1%	10%	3%
More than 1,000	1%	10%	4%
Total	**100%**	**100%**	**100%**

AWARENESS OF ENERGY TRUST, OTHER ASSISTANCE

We asked participants whether they recalled the name of the organization sponsoring the Building Efficiency program. Interviewers had just introduced themselves as representatives of the program for the Energy Trust. About two-thirds of both lighting (64%) and mechanical (66%) participants claimed to recall the name of the program sponsor, responding "yes" to the yes/no question. However, closer to one-third (34%) of lighting participants and half (53%) of mechanical participants were able to correctly name the Energy Trust as the program sponsor (Table 5.7).

Table 5.7

WHO IS THE SPONSOR OF BUILDING EFFICIENCY, BY PROJECT TYPE

RESPONSE	LIGHTING (N=94)	MECHANICAL (N=51)	TOTAL (N=145)
Energy Trust	35%	53%	41%
State of Oregon/DOE	11%	0%	7%
Utility, or Utility plus State of Oregon	10%	0%	7%
Program PMC, ATAC or Contractor	2%	12%	6%
Non-Program Contractor	1%	2%	1%
Don't Know	41%	33%	38%
Total	**100%**	**100%**	**100%**

Responses of those reporting the program sponsor was something other than the Energy Trust were also recorded, categorized and included in Table 5.7. A few participants (7%) believed the program was sponsored by the State of Oregon or by their utility (7%). Some individuals giving answers other than Energy Trust described the Trust accurately, though not by name: e.g., that it was set up by the Oregon legislature or that the source of the money is public purpose funds (both of these responses were categorized as State of Oregon/DOE).

If participants were not able to correctly name the Energy Trust as the program sponsor, interviewers asked them if, before today, they had ever heard of the Energy Trust of Oregon. Participants who reported they had heard of the Energy Trust in response to this question were summed with those who had correctly recalled the Energy Trust in the previous question to reveal the level of awareness of the Energy Trust.

Awareness of the Energy Trust was very high, at 90% overall; 87% counting only participants with lighting projects and 96% for participants with mechanical projects. This contrasts favorably with the results of a survey of lighting participants conducted in June 2003 (mid-way the program's first year), which found a 52% awareness of the Energy Trust. Participants who did mechanical projects tended to be more aware of the Energy Trust (χ^2, $p < 0.10$, this finding approached significance) and were significantly more likely to know the Trust is the sponsor of the program (χ^2, $p < 0.05$).

Four-fifths (80%) of participants are also aware of the Business Energy Tax Credit (BETC) offered by the State of Oregon, while only two-fifths (40%) are aware of the Small-scale Energy Loan Program (SELP), also offered by the State (Table 5.8). Both programs had a higher awareness among participants who did mechanical projects, though this difference was not significant.

Table 5.8

AWARENESS OF AND PARTICIPATION IN BETC AND SELP BY PROJECT TYPE

PROJECT TYPE	AWARE	CONTRACTOR MENTIONED	APPLIED FOR	RECEIVED
BUSINESS ENERGY TAX CREDIT (BETC)				
Lighting (n=91)	77%	55%	51%	34%
Mechanical (n=51)	84%	29%	45%	29%
Total (n=142)	**80%**	**46%**	**49%**	**32%**
SMALL-SCALE ENERGY LOAN PROGRAM (SELP)				
Lighting (n=90)	37%	18%	0%	0%
Mechanical (n=51)	45%	6%	2%	2%
Total (n=141)	**40%**	**13%**	**1%**	**1%**

Most (55%) lighting participants say their contractor mentioned BETC to them, but less than one-third (29%) of mechanical participants say so. The remaining participants who knew of BETC learned about it from sources other than their contractors. One-fifth (18%) of lighting participants say their contractor mentioned SELP to them, while only 6% of mechanical participants said so.

While about half (49%) of participants applied for BETC and about one-third (32%) had received that tax credit, only 1% applied for SELP. Open-ended comments suggest the relative unpopularity of SELP is due to a disinclination to borrow money to undertake these types of projects.

INITIATING A PROJECT

The majority (60%) of lighting participants and half (49%) of mechanical participants had already begun to think about installing new equipment when they learned of the program (Table 5.9; note the table shows the converse of these percentages—the 40% and 51% who learned of the program before beginning to consider installing equipment). All participants reported they had learned of the incentives before installing the equipment and all but two participants (mechanical) reported learning about the incentives before ordering the equipment.

Table 5.9

WHEN PARTICIPANTS FOUND OUT ABOUT PROGRAM INCENTIVES*

PARTICIPANTS FOUND OUT ABOUT PROGRAM INCENTIVES…	LIGHTING N=92	MECHANICAL N=51	TOTAL N=143
…Before Beginning to Think About Installing New Equipment	40%	51%	44%
…Before Beginning to Consider Equipment Choices	71%	73%	72%
…Before Deciding On Equipment Specifications	85%	79%	83%
…Before Ordering Equipment	100%	96%	99%
…Before Installing Equipment	100%	100%	100%

* *Reported percentages are cumulative. For example, of the 72% who found out about program incentives before they began to consider equipment choices, 44% of these had found out about the program even before beginning to think about installing new equipment.*

Two-thirds of participants heard of the program from their contractor or equipment vendor (Table 5.10). About 20% of participants reported calling their utility or just generally knowing that the Energy Trust was now offering efficiency programs similar to programs they had participated in with their utility. Ten percent of participants reported through open-ended comments that they had learned of the program through personal or business connections with the program management contractor, program technical analysis contractors (ATACs), the Oregon Department of Energy (ODE) or through presentations made by the Energy Trust.

Table 5.10

HOW PARTICIPANTS LEARNED OF THE PROGRAM

PARTICIPANT LEARNED OF PROGRAM FROM:	LIGHTING N=94	MECHANICAL N=51	TOTAL N=145
Equipment Vendor or Contractor	70%	59%	66%
Utility or Prior Utility Program Experience	13%	29%	19%
PMC, ATAC, ODE, or Energy Trust Activities	10%	10%	10%
Colleague or Associate	7%	2%	5%
Total	**100%**	**100%**	**100%**

In the case of nearly half (48%) of participants, project work was done by a contractor with whom the participant had worked in the past or had some other basis for an ongoing relationship (Table 5.11). Nearly one in five lighting projects came about because the contractor approached the respondent.

Table 5.11

HOW PARTICIPANTS SELECTED CONTRACTOR

HOW CONTRACTOR WAS SELECTED	LIGHTING N=94	MECHANICAL N=51	TOTAL N=145
Participant Had Ongoing Relationship with Contractor	45%	55%	48%
Contractor Approached Participant	17%	2%	12%
Referred by Associate	21%	12%	18%
From Search (competitive bid, Yellow Pages, etc.)	9%	12%	10%

Referred by Energy Trust of Utility	4%	2%	3%
Did the Work Themselves	4%	17%	9%
Total	**100%**	**100%**	**100%**

That two-thirds (66%) of participants report learning of the program from their contractor (see Table 5.10) suggests that contractors are proactively marketing the program. To explore more deeply the steps leading to the Building Efficiency projects, we jointly analyzed the responses described in Table 5.9, Table 5.10 and Table 5.11.

Cases indicative of proactive contractor marketing of the program include:

- Twelve percent of participants who worked with a contractor who had newly approached them and told them about the opportunity.
- Eleven percent where contractors with whom participants had worked in the past contacted them about the program opportunity before the facility staff began thinking of a project.
- Five percent of participants who learned of the program from a contractor before they were considering a project (these either worked with a contractor someone recommended to them—4%—or did the work themselves—1%).

Collectively, these 28% of cases appear to have come into the program as a result of proactive marketing by contractors.

The single most common method whereby firms were brought into the program was learning about BE from their existing contractor as they discussed choices of equipment for a planned project (23%). We cannot infer the degree of proactive marketing that occurred in these cases; the contractor may have been actively advocating energy-efficient solutions (and program involvement) or more passively responding to customers' inquiries.

Participants were asked what reasons their contractors cited in persuading them to install energy-efficient equipment. The most commonly mentioned reason contractors gave was saving energy and money, at 71% (Table 5.12). Most lighting participants (59%) and almost a third (30%) of mechanical participants reported their contractor mentioned incentives, rebates or tax credits for installing energy-efficient equipment. Half of lighting participants (but only 16% of mechanical participants) reported their contractor cited better equipment performance as a reason. Almost one-third (30%) of mechanical participants indicated the contractor did not need to give them any reasons; perhaps these participants had worked with engineering consultants or decided on energy-efficient equipment prior to involvement with the contractor.

Table 5.12

REASONS CONTRACTORS CITED FOR INSTALLING ENERGY-EFFICIENT EQUIPMENT (MULTIPLE RESPONSES ALLOWED)

REASON FOR INSTALLING ENERGY-EFFICIENT EQUIPMENT	LIGHTING N=88*	MECHANICAL N=43*	TOTAL N=136*
Saving Energy, Saving Money	83%	53%	71%
Incentives, Rebates, Tax Credits	59%	30%	48%
Higher-Quality Equipment, Better Performance	50%	16%	38%
Decreased Maintenance Cost/Effort	19%	7%	15%
Contractor Did Not/Did Not Need To Offer Reasons	8%	30%	15%
Environmental Benefits	6%	0%	4%
Quick Payback	3%	2%	3%

* *Participants who did not employ a contractor for the project were excluded.*

About 13% of lighting participants and 2% of mechanical participants reported that they did not install all of the energy-efficient items their contractor recommended.

PROJECT FINANCING AND INFLUENCE OF INCENTIVES

Nearly one-third (31%) of participants reported that they did not conduct any type of formal financial analysis when considering whether to implement the project (Table 5.13). More than half of those who did conduct a formal analysis (equal to 40% of the total sample) described their analytical approach as that of determining project payback. About 13% of the sample described their approach as calculating a return on investment, while 16% were unable to describe their process, or described it without using one of the more common financial terms. No one used the term "break-even analysis."

Table 5.13

FINANCIAL ANALYSIS CONDUCTED

FINANCIAL ANALYSIS	LIGHTING N=86	MECHANICAL N=48	TOTAL N=134
None	31%	31%	31%
Payback	40%	42%	40%
Return on Investment (ROI)	14%	10%	13%
Break-Even Analysis	0%	0%	0%
Unspecified	15%	17%	16%
Total	**100%**	**100%**	**100%**

About one-half (52%) of lighting projects were funded from the participating organization's operating budget; another quarter were funded out of the short-term capital budget (Table 5.14). Mechanical projects were equally likely to be funded from the operating budget, the short-term capital budget, the long-term capital budget or from nonstandard methods (such as tapping a combination of funding sources).

Table 5.14

SOURCE OF FUNDS FOR PROJECT

SOURCE OF FUNDS	LIGHTING N=92	MECHANICAL N=46	TOTAL N=138
Operating Budget	52%	24%	43%
Short-Term Capital Budget/Plan	26%	20%	24%
Long-Term Capital Budget/Plan	5%	26%	12%

Other	17%	30%	21%
Total	**100%**	**100%**	**100%**

All participants used an eleven-point scale ("0" to "10") to indicate how much influence the incentives had on their decision to install the equipment. About three-fourths of both types of participants said the program had a strong influence ("7" to "10"; Table 5.15).

Table 5.15

INFLUENCE OF INCENTIVES ON DECISION TO INSTALL

PROJECT TYPE	"0" TO "3"	"4" TO "6"	"7" TO "10"
REPORTED INFLUENCE OF PROGRAM ON DECISION TO INSTALL EQUIPMENT			
Lighting (94)	10%	10%	80%
Mechanical (n=51)	11%	14%	75%
Total (n=145)	**10%**	**12%**	**78%**
REPORTED LIKELIHOOD EXACT SAME EQUIPMENT WOULD HAVE BEEN INSTALLED WITHOUT INCENTIVE			
Lighting (n=92)	49%	29%	22%
Mechanical (n=50)	36%	30%	34%
Total (n=142)	**44%**	**30%**	**26%**

Participants used the same scale to describe the likelihood their organization would have installed exactly the same type of equipment, even if there had been no incentive. Almost half (49%) of lighting participants said that they would have been unlikely ("0" to "3") to install the exact same type of equipment without an incentive. However, only about one-third (36%) of mechanical participants said they would have been unlikely to install the exact same type of without the incentives, with a similar number saying they would have been likely to do so. Analysis revealed that mechanical participants tended to more often say they would have installed the exact same type of equipment without the incentive (this finding approached significance, χ^2, $p < 0.10$).

With participants who reported they would likely have installed the exact same equipment without the incentive, we explored whether the incentive helped them install the equipment more quickly than they might otherwise have been able to do. If participants believed the project would have been postponed, interviewers explored how much of the project probably would have been postponed and how long the project would have been postponed. Most of these participants reported that, in the absence of the incentive, they would have installed the energy-efficient equipment within six months of the date the equipment was actually installed (Table 5.16). However, 45% of lighting participants indicated they probably would have postponed the project for at least one year.

Table 5.16

INFLUENCE OF PROGRAM ON PROJECT TIMING

WITHOUT THE INCENTIVE, THE SAME EQUIPMENT WOULD PROBABLY HAVE BEEN…	LIGHTING N=27	MECHANICAL N=20	TOTAL N=47
…Installed within 6 Months	47%	70%	57%
…Postponed 6 to 12 Months	8%	10%	9%
…Postponed One to Two Years	19%	15%	17%
…Postponed Three to Five Years	18%	5%	13%
…Postponed More Than Five Years	8%	0%	4%
Total	**100%**	**100%**	**100%**

Over three-fourths (76%) of lighting participants had no prior experience participating in utility energy efficiency programs, while a majority (54%) of mechanical participants did have such experience. This difference was statistically significant (χ^2, $p < 0.05$). Of those who indicated having participated in past utility programs, we asked whether they would say their experience with those programs lead them to look into options for energy-efficient equipment. A majority of participants indicated that yes, those experiences likely influenced their decision to consider efficient options. This line of questioning provides a broad indication of program spillover effects occurring over many years.

Just over half (51%) of mechanical participants reported having installed at least some energy-efficient equipment—without getting any incentives—before participating in the program, while 40% of lighting participants said they had done so (Table 5.17). Fewer participants of both types (lighting 21%, mechanical 30%) reported having installed energy-efficient equipment without incentives after their Building Efficiency project.

Table 5.17

EFFICIENT EQUIPMENT INSTALLED WITHOUT INCENTIVES

INSTALLED ENERGY EFFICIENT EQUIPMENT WITHOUT INCENTIVE...	LIGHTING	MECHANICAL	TOTAL
...Before this Project (n=88, 47, 135)	40%	51%	44%
...After this Project (n=92, 50, 142)	21%	30%	24%

Participants who reported that after participating in the program, they installed additional energy-efficient equipment without getting an incentive were asked to say how much influence the program had on their decision to install this additional equipment. Forty-five percent of participants said the program's influence was large ("7" to "10"; Table 5.18).

Table 5.18

INFLUENCE OF PROGRAM ON ADDITIONAL INSTALLATIONS

PROJECT TYPE	"0" TO "3"	"4" TO "6"	"7" TO "10"
Lighting (n=17)	29%	24%	47%
Mechanical (n=14)	36%	21%	43%
Total (n=31)	**32%**	**23%**	**45%**

Most participating organizations do not have a policy, formal or informal, about purchasing energy-efficient equipment (Table 5.19). However, a substantial number (38%) of mechanical participants do have such a policy, which was significantly more than the number of lighting participants with this type of policy (χ^2, $p < 0.05$).

Table 5.19

POLICIES ABOUT PURCHASING ENERGY EFFICIENT EQUIPMENT

PROJECT TYPE	HAVE POLICY
Lighting (n=91)	11%
Mechanical (n=50)	38%
Total (n=141)	**21%**

Six individuals reported that their organization's policy about purchasing energy-efficient equipment was put in place after participating in Building Efficiency. These individuals used an eleven-point scale to gauge the program's influence on the adoption of the policy. Three of the six reported that their experience in the program strongly influenced the adoption of the policy (ratings of "7" to "10" on the scale).

PARTICIPATION EXPERIENCES

When asked whether any step of their projects had been delayed or took longer than expected, few (15%) participants reported any delays (Table 5.20). Delays were more common for lighting projects than for mechanical projects (this finding approached significance, χ^2, $p < 0.10$).

Table 5.20

OCCURRENCE OF DELAYS AT ANY STEP OF PROJECT

PROJECT TYPE	EXPERIENCED DELAY
Lighting (n=92)	18%
Mechanical (n=51)	8%
Total (n=143)	**15%**

Those who reported their project had been delayed were asked to describe what had been delayed and the length of the delay. Table 5.21 shows the themes that emerged from their responses. Among the four participants with mechanical projects that experienced delays, the most common issue was problems getting program paperwork or forms properly completed. Among participants with lighting projects, the most common issue reported was delays receiving incentive checks. Not all participants could specify the length of delays, but among the eight participants reporting late incentive checks, three said the payment took more than four months, three said it took several months, and one simply said it was "ridiculous." One individual reported having to resubmit paperwork.

Table 5.21

DESCRIPTION OF PROJECT DELAYS (MULTIPLE RESPONSES ALLOWED)

DESCRIPTION	LIGHTING N=17	MECHANICAL N=4
Delay In Receiving Incentive Payment	7	1
Problems Preparing Application Forms	1	3
Delays In Equipment Delivery, Broken Equipment	3	0
Follow-Up Inspection	1	0
Contractor Slow Doing Work	1	0
General Unspecified Delays	5	0

Participants used a five-point scale to report how satisfied they were with various aspects of the program. Most (78% to 98%) participants expressed satisfaction ("4" or "5") with all aspects of the program we asked about (Table 5.22). While none of the differences between mechanical and lighting participants were significant, it is notable that a greater portion (96%) of mechanical participants were satisfied with the savings they had seen on energy bills than were lighting participants (78%). Many participants of both types (40% of the sample) could not say how satisfied they were with the savings (they were excluded from the table).

Table 5.22

PARTICIPANT SATISFACTION WITH ASPECTS OF PROGRAM

PARTICIPANT SATISFACTION WITH…	PERCENT EXPRESSING SATISFACTION ("4" OR "5")		
	LIGHTING	MECHANICAL	TOTAL
…Performance of Equipment Installed (n=91, 50, 141)	92%	90%	91%
…Monthly Energy Savings (n=59, 26, 85)	78%	96%	84%
…the Rebate Amount (n=90, 50, 140)	89%	84%	87%
…the Application Process (n=89, 51, 140)	90%	86%	89%
…the Quality of Contractor's Work (n=90, 44, 134)	98%	95%	97%
…the Program, Overall (n=92, 51, 143)	99%	96%	98%

About one-fourth (24%) of lighting participants and a majority (54%) of mechanical participants reported having participated in energy efficiency programs offered by utilities in years past. These participants used an eleven-point ("0" to "10") scale of favorability to compare their current experience with BE to their experience with past programs. Overall, two-thirds (67%) of participants—three-fourths (76%) of lighting participants and a majority (59%) of mechanical participants—reported that BE compares favorably ("7" to "10"; Table 5.24). No participants reported that BE compares unfavorably ("0" to "3").

Table 5.23

SATISFACTION WITH BUILDING EFFICIENCY COMPARED TO UTILITY PROGRAMS

PROJECT TYPE	"0" TO "3" (LOW)	"4" TO "6"	"7" TO "10" (HIGH)
Lighting (n=21)	0%	24%	76%
Mechanical (n=22)	0%	41%	59%
Total (n=43)	**0%**	**33%**	**67%**

Most (56%) lighting participants and two-thirds (68%) of mechanical participants reported that at some point in the process they had a phone conversation with someone at the Energy Trust or at the PMC. These participants used a five-point scale to indicate how satisfied they were with various aspects of their interaction with the Trust or the program administrator. Most (61% to 91%) expressed high satisfaction ("5") with their interactions (Table 5.24). While most participants (64% of lighting, 78% of mechanical) reported they had experienced no issues that needed resolution, more than two-thirds (70%) of those who had experienced issues reported high satisfaction ("5") with the resolution ultimately achieved.

Table 5.24

SATISFACTION WITH ENERGY TRUST/PMC INTERACTIONS

PARTICIPANT SATISFACTION WITH…	PROJECT TYPE	SATISFACTION RATING				
		"1"	"2"	"3"	"4"	"5"
…the Energy Trust/PMC's Courtesy on the Phone	Lighting (n=44)	—	—	—	18%	82%
	Mechanical (n=32)	—	—	—	3%	97%
	Total (n=76)	—	—	—	12%	88%
…the Energy Trust/PMC's Knowledge of Program Services	Lighting (n=37)	—	—	—	14%	87%
	Mechanical (n=32)	—	—	—	9%	91%
	Total (n=69)	—	—	—	12%	88%
…the Energy Trust/PMC's Helpfulness on the Phone	Lighting (n=43)	—	2%	—	21%	77%
	Mechanical (n=28)	—	4%	4%	14%	79%
	Total (n=71)	—	3%	1%	18%	78%
…the Ease of Transactions (paperwork/payments)	Lighting (n=44)	2%	2%	5%	25%	66%
	Mechanical (n=32)	3%	3%	13%	28%	53%
	Total (n=76)	3%	3%	8%	26%	61%
…the Resolution of Any Issues You Had (among only those who had issues)	Lighting (n=16)	6%	6%	13%	6%	69%
	Mechanical (n=7)	14%	—	14%	—	71%
	Total (n=23)	9%	4%	13%	4%	70%

SUMMARY

Retail facilities conducted about one-quarter of lighting projects (24%), while office facilities comprise about the same portion of mechanical participants (27%). Manufacturing facilities comprise a little less than one-quarter of both lighting and mechanical projects (18% and 24%, respectively) Facilities with lighting projects are typically smaller than those with mechanical projects.

Awareness of the Energy Trust was high (90%), a finding that contrasts favorably with the roughly 50% awareness found among lighting participants six months after program launch.

Four-fifths (80%) of participants were aware of BETC tax credits; half that many were aware of the state's loan program, SELP. Participants frequently learned of BETC and SELP from their contractors, but among participants aware of these state programs, about 30% of lighting participants and 70% of mechanical participants learned about the programs from sources other than their contractors. Some of the mechanical participants may have learned of the programs from consulting engineers, although the survey did not explore this.

The team jointly analyzed the responses to a series of questions as one means of assessing the reasonableness of a program design hypothesis, namely that market actors can be the principal means of delivering the program. The team estimates that contractors for about 25% to 50% of participants actively sought customers to participate in the program. Remaining participants either learned of the program from sources other than their contractors or learned through conversations they initiated with their contractors.

About 80% of participants reported the incentives strongly influenced their decision to install the efficient equipment at this time.

Eight percent of lighting participants reported delays in receiving their incentive checks and 7% of mechanical participants reported delays owing to documentation needed by the program. About 30% of participants experienced some problem with their project that needed resolution; 13% of these participants (4% of total participants) expressed dissatisfaction with the problem's final resolution.

Nearly all participants (98%) rated themselves as satisfied or highly satisfied (a "4" or "5" on a five-point scale) with the program overall. Two-thirds of those participants who had previously participated in an efficiency program favorably compared their experiences with the Building Efficiency program to their other experiences. Just under 90% of participants expressed satisfaction or high satisfaction with the application process and the program paperwork.

6. ENERGY IMPACT ANALYSIS METHODS

The analysis of program impacts was begun in April 2004, about nine months prior to the analysis of program processes. Impact analyses were based on information and program data available as of March 31, 2004. At that time, there were a total of 265 completed lighting projects and 88 completed mechanical projects (Table 6.1). For comparison, the table also provides data as of the end of 2004, the period covered by the evaluation of program processes and consistent with the program status summarized in Chapter 2.

Table 6.1

PROJECTS COMPLETED AS OF MARCH 31, 3004, BY PROJECT TYPE*

STATUS	LIGHTING			MECHANICAL		
	CUSTOM	PRESCRIPTIVE	TOTAL	CUSTOM	PRESCRIPTIVE	TOTAL
Projects Completed as of 3/31/04	109	156	265	38	50	88
Projects Completed as of 12/31/04	229	294	523	115	158	273

* *The table reflects the following conventions: if a project included both lighting and mechanical equipment, it was tallied as a mechanical project; if a project included both custom and prescriptive measures, it was tallied as a custom project; if a project's description in the program database did not indicate custom or prescriptive, the project was tallied as prescriptive.*

Roughly one-half of the total completed lighting projects were finished by March 31, 2004, compared with roughly one-third of the total mechanical projects. During the last nine months of 2004, the average number of lighting projects completed monthly was about 50% higher than the monthly average for the program's first 15 months. For mechanical projects, the monthly average during the last nine months of 2004 was more than three times the monthly average for the preceding 15 months.

The Building Efficiency program's project files and tracking database contain electricity or therm savings for each project underway or completed. The values are estimates of the *expected* savings, based on the best engineering data available. The expected savings estimates are used in the cost-effectiveness analysis of each proposed measure to determine which will qualify for program incentives.

Two types of adjustments to the expected savings estimates data are needed for them to conform to program evaluation standards. The first adjustment moves the data from an estimate of expected savings to an estimate of *realized* savings—savings estimated on the basis of project operating conditions investigated after installation. The first adjustment yields an estimate of the *gross program impact* (also referred to, in percentage terms, as the *gross realization rate*).

The second adjustment moves data from the estimate of realized gross program impacts to an estimate of realized *net impacts*, or an estimate of total program-induced savings. Net impacts expressed as a proportion of gross impacts is termed the *net-to-gross ratio*. This adjustment accounts for *free-ridership* and *spillover*. Free-ridership is the effect where the participant would have installed the exact same quantity and type of equipment at the same time in the absence of the energy efficiency program. If any of these three parameters change—the quantity, timing and/or type (albeit still efficient), the effect is known as *partial free-ridership*. Spillover is the effect where the participant installs additional energy-efficiency measures as a result of program experiences, but without requesting or receiving an incentive.

This chapter on energy impact analysis methods is organized into four sections:

- *Sample Design*
- *Gross Impact and Realization Rate Estimation*
- *Net-to-Gross Ratio Estimation*
- *Lighting, Mechanical and Total Program Net Impact Estimation*

SAMPLE DESIGN

In this section, we discuss the sampling plans to support the estimation of end-use and program gross impact realization rates and the net-to-gross ratios. The estimation of gross impact realization rates was based on onsite audits; the sample for the audits was comprised of the lighting and mechanical *projects* (as opposed to facilities) constituting the top 80% of the program's expected savings for these two end-uses.[34] The estimation of net-to-gross ratios was based on telephone interviews with the person responsible for the project at their facility; the sample for these interviews was comprised of the participating *facilities*. We also conducted onsite investigations of nonparticipating facilities that reported having purchased lighting or mechanical equipment during the previous 15 months.

Table 6.2 presents the population of projects and unique firms within the program period under investigation (projects completed from program inception through March 31, 2004). The table shows the overall number of projects and firms and the number of each within the top 80% of the expected energy savings. The projects in the top 80% were used to calculate the realized gross impacts. The gross realization rates from the top 80% were applied to the bottom 20% of projects. All firms were used to calculate the realized net impacts.

Table 6.2

POPULATION OF TOTAL PROJECTS AND UNIQUE FIRMS, BOTH OVERALL AND IN THE TOP 80% OF EXPECTED ENERGY IMPACTS

POPULATION	LIGHTING	MECHANICAL CUSTOM	MECHANICAL PRESCRIPTIVE	TOTAL
Total Projects Overall	265	38	50	353
Unique Firms Overall*	178	34	31	243
Projects in Top 80%	242	21	28	290
Unique Firms in Top 80%	172	20	11	203

* *A unique firm can have projects at multiple locations. The unique firms constitute the population for telephone surveys, whereas projects constitute the population for onsite audits.*

As shown in Table 6.2, 28 prescriptive mechanical projects comprise the top 80% of savings. All 28 of these projects were provided incentives for efficient motors.

34 As shown below, roughly one-half of the projects generate 80% of the expected energy savings. We investigate this group in order to make the best use of evaluation resources.

Participant Telephone Interviews

With respect to participant telephone interviews, we attempted a census including:

- The 178 unique firms associated with lighting projects;
- The 34 unique firms associated with mechanical custom projects; and
- The 31 unique firms associated with mechanical prescriptive projects.

Participant Onsite Audits

The sampling strategies for onsite audits used in estimating the gross impacts and realization rates were:

- For lighting projects, a random sample, stratified by savings, was drawn with the goal of completing 50 onsite audits. Table 6.3 presents the population and sample size by stratum for the lighting projects. (We sampled only CFLs, T8s, and T5s; not shown in the table are other lighting measures totaling 2,008,231 kWh, for a program total as of March 31, 2004 of 13,968,644 kWh.) Details on the sampling plan for lighting participant onsite audits are provided in Appendix A.

Table 6.3

POPULATION AND SAMPLE LIGHTING PROJECTS, STRATIFIED BY EXPECTED SAVINGS

STRATUM BOUNDARIES (KWH)	TOTAL KWH USED BY CFL, T8, AND T5 IN STRATUM	POPULATION	QUOTA
1 Less than 45,000 kWh	2,498,821	174	20
2 45,000 to 140,000 kWh	4,557,403	58	20
3 140,000 or Greater kWh	4,884,189	10	10
Total	**11,960,413**	**242**	**50**

- For mechanical custom projects, we attempted a census of all 21 projects comprising the top 80% of the expected savings.

- For mechanical prescriptive projects, we attempted a census of all 28 projects comprising the top 80% of the expected savings.

Nonparticipant Onsite Investigations

The sampling strategy for nonparticipant onsite audits was based on a telephone screening survey. To receive an onsite visit, firms had to meet two conditions:

- They had invested more than $200 in the last 15 months in lighting *and/or* had installed any mechanical equipment including HVAC, refrigeration, compressor, motor or drive equipment; *and*

- They agreed to an onsite visit.

Of the 5,043 firms interviewed, 80 firms (1.59%) met the first condition; 43 (0.85%) firms met both conditions. These 43 firms comprised the sample for the onsite investigation of nonparticipants.

GROSS IMPACT AND REALIZATION RATE ESTIMATION

In the year prior to initiating the impact evaluation, we assessed the suitability of several methods to estimate the gross program impact and realization rate. These methods included spot metering, short- and long-term metering, pre-installation (baseline) metering and monitoring of equipment, regression analysis of participant monthly energy use and the ratio estimator approach. We chose the ratio estimator approach because we judged the other approaches to be either unreliable for a variety of reasons, or too costly and yielding only marginal improvements to the estimates of gross impacts.

We believe the significant expense of the metering and monitoring methods for estimating realized savings were not justified for two reasons. One, most savings were generated from prescriptive measures for which the most reliable expected savings data are in use, derived from manufacturer-provided information and algorithms. Two, custom measures were preceded by engineering studies, which increased our confidence in these estimates.

Another approach—a statistical analysis of a participant's billing data—was not used for two reasons, both of which were related to the statistical power of this approach.[35] First, there was the concern that for small commercial lighting participants, the monthly savings were expected to be less than 10% of the pre-installation monthly energy use (i.e., the signal-to-noise ratio was expected to be low[36]). Such a small effect reduces the statistical power of the analysis.

The other concern with a billing data approach was with the small number of participants with completed projects as of March 31, 2004, that were available to participate in a regression model. There were 178 unique lighting participants and 65 unique mechanical participants. In a recent evaluation of participants in Oregon's Transitional C/I program,[37] approximately 45% were not suitable for inclusion in a regression analyses for a variety of reasons, including insufficient pre- and/or post-kWh consumption data and a post-program consumption change of more than 50%—an implausibly large reduction. Assuming an exploration of billing data for Building Efficiency participants would result in a similar proportion of unusable records, we anticipate approximately 100 lighting participants and 35 mechanical participants would have data suitable for inclusion in a regression model.

Thus, we rejected the billing analysis approach because of the relatively small expected effects, combined with an expected small number of participants available for analysis.[38]

Based on discussions with the Energy Trust in the year preceding the impact evaluation concerning the limitations of other analytical methods, we made adjustments to the program estimates of expected gross energy and demand impacts using the ratio estimator approach (Cochran 1977; see Appendix A).[39]

The equation given in Figure 6.1 provides the ratio estimator algorithm we used to adjust the savings for the population of projects, based on the onsite inspections and

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35 Statistical power is the probability that statistical significance will be attained, given that there really is a treatment effect. (Lipsey, Mark W. *Design Sensitivity: Statistical Power for Experimental Research*. Newbury Park, CA: SAGE Publications, 1990.)

36 This threshold of 10% or more has been established by *The California Evaluation Framework*, prepared for the California Public Utilities Commission and the Project Advisory Group, June 2004, by TecMarket Works in association with Megdal & Associates, Architectural Energy Corporation, RLW Analytics, Resource Insight, B & B Resources, Ken Keating and Associates, Ed Vine and Associates, American Council for an Energy Efficient Economy, Ralph Prahl and Associates, and Innovologie.

37 Quantec (2004). *Evaluation of the Transition C&I Program* prepared for the Energy Trust of Oregon.

38 See Cohen, Jacob. (1988). *Statistical Power Analysis for the Behavioral Sciences*. Hillsdale, N.J.: Lawrence Erlbaum Associates, Publishers.

39 Cochran, William G. 1977. *Sampling Techniques*. New York, N.Y.: John Wiley & Sons.

engineering reviews of randomly-sampled projects. From Figure 6.1, we can see that the total kWh, therm and kW impacts for the population of Building Efficiency projects—***X***—is adjusted, using the ratio of the mean kWh, therm and kW impacts estimated by the evaluation team for the sampled units, to the mean kWh, therm and kW impacts as reported in project files. (Due to missing kW values in the project records, we adjust kW savings for lighting equipment only.)

Figure 6.1

RAITO ESTIMATOR ALGORITHM

$$\hat{Y}_R = \frac{\bar{y}}{\bar{x}} X$$

Where:

$\hat{Y}_R$ = Ratio estimate of total kWh, therm, and kW in the population of sites

X = Total kWh, therm, and kW impacts for population of projects as reported in project files

$\bar{x}$ = Sample mean kWh, therm, and kW impacts as reported in project files

$\bar{y}$ = Sample mean kWh, therm, and kW impacts estimated by the evaluation team based on inspections and engineering reviews.

Gross savings for a program can differ from those reported during the course of program implementation for many reasons. The expected number of lighting fixtures may not be installed, a different size motor may have inadvertently been installed, or a custom site may have made last minute changes that are not reflected in the original estimate of savings. With the ratio estimator approach, these types of factors that commonly affect savings were investigated through onsite inspection of the installed equipment at a sample of sites.

The choice of measures to include in the onsite inspections was determined based on the expected kWh savings. The sample was selected to investigate the measures that account for at least 80% of the lighting savings and at least 80% of the mechanical savings. Using the results from the top 80%, the ratio of realized to expected savings for the audited measures was applied *by measure* to those in the top 80%. For those measures in the bottom 20% by end-use, the average ratio for that end-use was applied. The realized gross impact estimate is expressed as a proportion of the expected gross estimate to produce a "gross realization rate" for the program.

The ratio estimator approach used in the evaluation required measure-specific data. However, at the time of the evaluation, the program database consisted of impact values at the site level, with the measure-specific data available from the Program Management Contractor (PMC) through project-specific *Excel* files or hard copies. We requested all of the measure-specific data for those projects under investigation and entered them into an *Access* database.

There were slight differences (0.4% overall) between the program level impacts found in the program database and the impacts seen from the measure-specific data; some of these differences could be accounted for in reviewing the measure-specific and project level documents, but not all. The evaluation team did not undertake a large effort to track down why there were discrepancies because the overall difference was so small. In addition, conversations with the PMC indicated that the estimates in the program-tracking database were often—but not always—updated, based on changes that occurred at the time of installation.

The Building Efficiency program covered two end-uses—lighting and mechanical. The next two sections provide more detail about how the specific expected and realized savings estimates were calculated for each end-use.

Lighting End-Use Impact Details

The measure-specific lighting information from program records included the number of fixtures (both before and after the retrofit), a connected load for the fixtures and their operating hours. Calculation of the gross impact for the lighting end-use followed this process:

1. Expected electrical energy (kWh) and demand (kW) was calculated using the measure-specific values from the program records. These records included an estimate of hours of operation.

2. The realized demand (kW) impact was calculated based on the number of fixtures found during the audit (see Figure 6.2).

Figure 6.2

LIGHTING KW IMPACT ALGORITHM (SITE LEVEL)

$$\text{kW Impact}_{m,s} = \sum_{m=1}^{n}\left[\left(\text{PreN}_m * \text{PreWatts}_m\right) - \left(\text{PostN}_m * \text{PostWatts}_m\right)\right]$$

Where:

Pre = Data from program records

Post = Data from onsite audits

N = Number of units of efficiency measures of a given type

m = Measure type at site (audited)

s = Site

3. The hours of operation of the audited site for all measures at that site was calculated based on the data gathered during the audit (see Figure 6.3).

Figure 6.3

LIGHTING HOURS OF OPERATION ALGORITHM (SITE LEVEL)

$$HoursOfOperation_s = HoursOpen * PercentOfLightsOnWhenOpen + HoursClosed * PercentOfLightsOnWhenClosed$$

Where:

s = Site

4. The realized energy (kWh) impact was calculated as shown in Figure 6.4, using the demand (kW) impact (from Figure 6.1) and hours of operation (from Figure 6.2). HVAC energy impacts that result from lighting efficiency measures (termed lighting/ HVAC interactive effects) are included in the impact estimate. The method used to estimate the interactive effects is explained in Appendix B.

Figure 6.4

LIGHTING KWH IMPACT ALGORITHM (SITE LEVEL)

$$\text{kWh Impact}_s = \sum_{m=1}^{n} \text{kW Impact}_{m,s} * \text{Hours Of Operation}_s + \text{HVAC Interactive Effects}_s$$

Where:

m = Measure type at site (audited)

s = Site

5. For each measure type, for all sites in a stratum (see Table 6.3 for strata definitions), the realized impact estimates for sampled sites were summed to provide a realized value for the stratum. This was divided by the expected impact estimate for the sample sites in the stratum to obtain a stratum ratio. Different stratum ratios are calculated for the energy and the demand impacts. The stratum ratio specific to each measure was applied to the total expected population impact for that measure, as shown in Figure 6.5.

Figure 6.5

AUDITED MEASURE LIGHTING POPULATION IMPACT ALGORITHM

$$\text{Ex Post kWh Impact}_m = \sum_{s=1}^{n} \text{Ex Ante kWh Impact}_{m,s} * \text{Strata\_Ratio}_{st,kWh}$$

$$\text{Ex Post kW Impact}_m = \sum_{s=1}^{n} \text{Ex Ante kW Impact}_{m,s} * \text{Strata\_Ratio}_{st,kW}$$

Where:

m = Measure type at site (audited)

s = Site

st = Stratum for that site

kWh = Ratio specific to the stratum based on energy impacts of the sample

kW = Ratio specific to the stratum based on demand impacts of the sample

6. The expected and realized impact for the measures in the top 80% by expected kWh impact were summed and a ratio of realized to expected was calculated.

7. The impact for those measures in the bottom 20% by expected kWh impact—which were not audited onsite—were multiplied by the ratio calculated in Step 6, as shown in Figure 6.6.

Figure 6.6

NON-AUDITED MEASURE LIGHTING POPULATION IMPACT ALGORITHM

$$\text{Ex Post kWh Impact}_n = \frac{\sum_{m=1}^{3} \text{Ex Post kWh Impact}_m}{\sum_{m=1}^{3} \text{Ex Ante kWh Impact}_m} * \text{Ex Ante kWh Impact}_n$$

Where:

m = Measure type at site (audited)

n = Non-audited measure type

8. Lastly, the total realized impacts are computed as the sum of the estimated realized impacts for the audited and non-audited measures.

Mechanical End-Use Impact Details

As mentioned in the discussion of Table 6.2, the mechanical end-use investigated consisted of custom applications and prescriptive motor measures.

For custom measures, site visits corroborated additional factors affecting savings that had been identified by the project's technical analysis study or supporting algorithms. For each site visited, we either left unchanged the expected assumptions reported in the project files, or adjusted them downward or upward. These adjusted figures generated the realized savings for each project in the sample. Appendix C provides a discussion of the findings for each project.

For the prescriptive motor sites in the sample, we verified that the specified motor was in place and operating. The realized kWh impact was the sum of those motors found to meet these criteria. The realized kWh impact estimates were divided by the expected kWh impact estimates to obtain a prescriptive motor measure realization rate for kWh.

As mentioned in the discussion of Figure 6.4 and elaborated in Appendix B, electrical energy and demand savings from lighting/ HVAC interactions are incorporated into the lighting impacts. Therm savings from lighting/ HVAC interactions are applied as a line item in the overall therm savings reported for the program in Chapter 7.

This concludes our discussion of the methods we used to calculate gross impacts. The next section discusses the method we used to calculate the net-to-gross ratio, which we applied to the gross impacts to obtain net impacts.

NET-TO-GROSS RATIO ESTIMATION

The term *free-riders* has been coined by impact evaluators to refer to participants who receive rebates for implementing an efficiency measure they would have installed anyway, even without the rebate; hence, they are getting a "free ride" on the incentive program. To determine the savings for Oregon that resulted from the program's operation, one needs to subtract from gross program savings the savings accruing to free-riders—savings that very likely would have occurred in the absence of the program.

Conversely, spillover savings are the energy savings of firms who were influenced by BE to install program-qualifying equipment without getting incentives provided by the program. The current evaluation estimates spillover savings among program participants (i.e., participant spillover).

Net program savings refers to gross program savings minus the savings attributable to free-riders, plus savings attributable to spillover. The net-to-gross ratio represents the portion of gross savings attributable to the program and is defined as one minus the rate of free-ridership plus the rate of spillover effects. The net-to-gross ratio is used to adjust the gross kWh and therm impacts.

In some cases, the program motivates firms to replace equipment prior to the end of its useful life. This is referred to as an "early replacement" action. Situations in which early replacement potentially confounds the estimation of free-ridership were carefully examined. In other cases, the program motivated a firm to select more efficient equipment when replacing equipment that has reached the end of its useful life. This is referred to as a "normal replacement" action.

We estimated program net impacts from an analysis of participant survey data that explored project decision-making and timing. This method is known as the self-report approach. Our initial research plan called for the results from the nonparticipant onsite surveys to play a more prominent role—to be, in fact, on equal footing with the self-report approach. Our plans called for using a discrete choice approach, which involves comparing the energy-efficiency actions of participants with those of nonparticipants.[40] However because the period under investigation (2003 through mid-2004) was a period of economic recession and jobless recovery in the state, we found a very low incidence of firms (1.59%) had purchased any lighting or mechanical equipment *at all* during the period. Thus, we were unable to generate an adequate sample of nonparticipating purchasers of equipment to perform a full discrete choice analysis.[41]

To check the reasonableness of the self-report net-to-gross ratio, we compared it to net-to-gross ratios that were estimated using two other somewhat less rigorous approaches, based on information we gathered through nonparticipant onsite surveys and from program files.[42]

From nonparticipant onsite surveys, we obtained information about the percent of installations that would have qualified for the Building Efficiency program, which allowed a simple comparison with participants, yielding a net-to-gross ratio

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40 Discrete choice analysis represents an alternative to more traditional methods of estimating net-to-gross ratios. For the program, each potential participant has a choice among three options regarding an eligible measure: 1) implement the measure within the program; 2) implement the measure outside the program; or 3) do not implement the measure. The potential participant chooses the option that provides it with the greatest "utility." The utility the potential participant obtains from each option depends on the investment cost, energy savings and other factors associated with the option. Participants are those who choose option 1, while nonparticipants are those who choose either option 2 or 3. To estimate the net-to-gross ratio, a discrete choice model is estimated that describes potential participants' choices among these options, using data on the actual choices that participants and nonparticipants made during the program period (see Train, 1994). The gross energy and demand impacts (adjusted by the realizations rate) are then multiplied by the net-to-gross ratio to produce the net impacts.

41 Even had the sample size been adequate, such an approach may have encountered other obstacles. Quantec, in its study, *Evaluation of the Transition C&I Program,* prepared for the Energy Trust of Oregon, found that "attempts to calibrate a choice model in this study were unsuccessful, and statistically reliable estimates could not be obtained. In our judgment, the limited variation in measure installations and incentive amounts were perhaps the main confounding factors."

42 This effort to crosscheck through different modes of inquiry is referred to as triangulation. If all sources of information agree, the evaluator gains confidence in the accuracy of the information. (Weiss, Carol. 1998. Evaluation: Methods for Studying Programs and Policies. New Jersey. Prentice Hall. Scriven, Michael. 1991. Evaluation Thesaurus. Newbury Park, CA: Sage Publications.)

calculated simply as: one minus the percent of nonparticipants installing program-qualifying equipment. A second approach involved an examination of simple project paybacks calculated by the PMC. These paybacks without the incentive were translated into net-to-gross ratios. (We explain our method below, in the text relating to Table 6.5.)

These two alternative estimate methods were used to *crosscheck*, not adjust, the self-report net-to-gross ratio, since they were based on less reliable methods. If these alternative estimates of net-to-gross ratios had been as reliable as the self-report estimates, we would have averaged them to produce a single, most reliable estimate.

In summary, our analysis estimates three net-to-gross ratios that are based on:

1. Participant self-reports collected via a telephone,
2. Nonparticipant onsite audits, and
3. Participant paybacks contained in the program database.

Each is described in greater detail below.

Participant Survey Data

The surveys of participants queried the individual involved in the decision-making process at each participating site. The survey obtained highly structured responses concerning the probability that the firm would have installed the same measure in the absence of the program. The survey also included open-ended questions that focused on the firm's motivation for installing the efficiency measure, as well as the context of the decision—including information considered, the role of financing and any alternatives that were considered.

When participants are asked simply, "Would you have installed the same equipment without an incentive," they frequently say, "yes." Such a response pattern has been shown to overestimate the free-ridership effect and therefore underestimate the influence of efficiency programs.[43] There are at least two

[43] See Ridge, Richard. *Improving the Standard Performance Contracting Program: An Examination of the Historical Evidence and Directions for the Future*. Submitted to the Southern California Edison, November 2001. In this report, five studies are reviewed that estimate net-to-gross ratios based on three approaches: 1) billing analyses with a comparison groups; 2) discrete choice analysis; and 3) self-report. The self-report approach consistently had lower net-to-gross ratios (i.e., higher free-ridership estimates).

plausible reasons for this. First, it is human nature for people to recall the events leading up to an action in a manner congruent with the action taken, even if the events were not congruent. Thus, those who purchase an efficient unit are likely to say they had always planned to do so regardless of the incentive. Second, people are unaware of all the influences on them. For example, they may not recall program marketing that they or their associates were exposed to that made energy efficiency an attractive objective.

Because of the inadequacy of a single question asking about the influence of the program, we investigated the events, information flows and decision-making that led up to program participation. From this detailed questioning, we ascertained whether or not the program influenced the participant's decision to install the efficient equipment, as well as whether it influenced the timing of the installation (i.e., whether the measure was installed sooner than it would have been without the program).

For all sites, the self-report net-to-gross ratio was calculated from the closed-ended survey responses given by the person involved in the decision to install the efficient equipment. The calculation of the net-to-gross ratio differed slightly, depending on whether the end-use was lighting or mechanical. The number of questions varied slightly between the two end-uses, as did the question numbering. We will first describe the net-to-gross ratio calculation for *lighting* measures and then the slight difference in the calculation for *mechanical* measures.

The central inputs to the calculation of the *lighting* self-report net-to-gross ratio come from seven questions asked of participants. For convenience, the questions are given in abbreviated form in Figure 6.7. (Refer to the participant survey in Appendix D for the exact line of questioning.)

Based on previous experience using this set of questions, the evaluators knew Question 12 is subject to misunderstanding because of its necessarily negative phrasing, and can generate responses indicating the opposite of what the respondent meant to communicate. This potential for error was handled by incorporating automatic checks into the survey form that detected clear contradictions between Questions 11 and 12, since this is where such a misunderstanding would become evident. When the interviewer received responses indicating a contradiction between these two answers, they used suggested phrasing provided for presenting the apparent conflict to the respondent and requesting resolution. However, if the inconsistency could not be resolved within the interview and the response was clearly inconsistent with the responses to Questions 20, 21 and 22, and a net-to-gross ratio implied by the payback

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information, then the inconsistency was considered to result from measurement error and the observation was set to missing in the estimation of free-ridership.

Figure 6.7

QUESTIONS USED TO DETERMINE LIGHTING SELF-REPORT NET-TO-GROSS RATIO

Q9 When did you first hear about the Building Efficiency Program incentives? Was it before you ordered the equipment, or after?

Q10 Was it before you installed the lighting equipment, or after?

{Questions 11 and 12 use a scale from 0 to 10, with 0 being no influence at all and 10 being a lot of influence.}

Q11 How much influence did the incentive have on your decision to install the efficient lighting?

Q12 Without the incentive, how likely is it that you would have installed **exactly** the same type and efficiency of lighting equipment?

{Questions 20 and 21 use a scale from 0 to 10, with 0 being not at all agree and 10 being strongly agree}

Q20 The incentive made this lighting project an "easier sell" to management

Q21 The incentive helped the lighting project meet our investment criteria

Q22 The savings estimated for this lighting project helped convince me to install the measures.

As an *initial* estimate of the self-report net-to-gross ratio, we calculated the simple average of five items (Questions 11, 12, 20, 21 and 22). To determine the appropriateness of all five items to calculate the final self-report net-to-gross ratio, we conducted a statistical analysis of question reliability, which we discuss in a later section of this chapter.

If the respondent indicated that they had already ordered or installed the equipment before hearing about the program (based on their response to Questions 9 or 10), then a sixth factor was assigned a score of zero and averaged in with the other five items (Questions 11, 12, 20, 21 and 22) to adjust the self-report net-to-gross ratio.

Deferred Free-Riders

Next, we considered the deferred free-riders, for whom the program *accelerated* the installation of the equipment. These are participants who, in the absence of the program, would have eventually installed exactly the same equipment that was installed through the program. Question 17 asks the participate whether the same equipment might have been installed at a later date without the rebate. When accelerated installations are claimed, the respondent was asked why the equipment installation was accelerated by the time period mentioned.

We included information from the timing question only when two conditions were met: 1) the respondent indicated in Question 12 that without the incentive they would have installed exactly the same type and number of efficient lighting equipment; and 2) that before the contact with the program they were planning on adding or replacing lighting equipment. When these conditions were met, the net-to-gross ratio was based ***solely*** on the timing forecast. Table 6.4 shows the relationship between forecast and net-to-gross ratio.[44]

Table 6.4

FORECAST CONVERSION TABLE

FORECASTED INSTALLATION OF SAME EQUIPMENT	IMPLIED NET-TO-GROSS RATIO
Less than 6 Months	0.00
6 to 12 Months	0.25
1 to 2 Years	0.50
3 to 5 Years	0.75
Greater than 5 Years	1.00

44 Spanner, G, and Riewer, S, 1990. "The Energy Savings Plan: Incentives for Efficiency Improvements in the Industrial Sector" *Proceedings of the ACEEE Summer Study*. Washington DC. Pp. 7.251 to 7.260. Spanner, G., Dixon, D. and Fishbaugher, M, 1990. *Impact Evaluation of an Energy Savings Plan Project at Bellingham Cold Storage*. Bonneville Power Administration, Portland OR. Pp. 2.8-2.9.

Reliability of Self-Report Net-to-Gross Ratio

The decision regarding which items should be used in estimating the net-to-gross ratio were made using a statistical method call Cronbach's alpha, which measures how well a set of items (or variables) measures a single unidimensional latent construct, such as the program's influence on participants' decisions.[45] If the inter-item correlations are high, then there is evidence that the items are measuring the same underlying construct (in this case, the influence of the program on participant decisions). This convergence on a construct to be estimated is what evaluators mean when they speak of have "high" or "good" reliability. A reliability coefficient of 0.80 or higher is considered "acceptable" in most social science applications. The reliability coefficient of all five questions (Questions 11, 12, 20, 21 and 22) met the minimum criterion of 0.80 and thus we used all five questions to calculate the net-to-gross ratio.[46]

Spillover

After adjusting the initial net-to-gross ratio for deferred free-riders, we assessed the issue of spillover to determine whether any other information in the survey or program database suggested that the self-report net-to-gross ratio was underestimated. Spillover is defined as:

> Reductions in energy consumption and/or demand in a utility's service area caused by the presence of the DSM [efficiency] program, beyond program-related gross savings of participants. These effects could result from: (a) additional energy efficiency actions that program participants take outside the program as a result of having participated; (b) changes in the array of energy-using equipment that manufacturers, dealers, and contractors offer all customers as a result of program availability; and (c) changes in the energy use of non-participants as a result of utility programs, whether direct (e.g., utility

45 Cronbach's alpha can be written as a function of the number of test items and the average inter-correlation among the items. Below, for expository purposes, we show the formula for the standardized Cronbach's alpha:

$$\partial = \frac{N \times \bar{r}}{1 + (N-1) \times \bar{r}}$$

Here N is equal to the number of items and r-bar is the average inter-item correlation among the items.

46 As a test, the net-to-gross ratio based on the payback was explored for possible inclusion in the calculation of the self-report net-to-gross ratio. Adding this variable *reduced* the reliability of the construct as measured by Cronbach's alpha. As a result, payback was not included in the calculation of the self-report net-to-gross ratio. Consequently, the payback-based net-to-gross ratio was used as originally intended, as an additional point of comparison.

program advertising) or indirect (e.g., stocking practices such as (b) above, or changes in consumer buying habits).[47]

Part "a" of the above definition is referred to as *participant spillover,* which we estimated in this study.

For example, consider a participant that received financial assistance from Building Efficiency to install T-8 fluorescent fixtures. After experiencing and documenting to his own satisfaction the energy efficiency benefits of the retrofit, this participant proceeds to retrofit the remainder of the facility at his own expense. These additional installations are considered benefits that *spilled over* from the original program experience. When taken into account, such spillover increases the net-to-gross ratio.[48] Energy and demand spillovers were estimated using responses to Questions 26, 26a and 26b (shown in Figure 6.8).

Figure 6.8

QUESTIONS USED TO DETERMINE SPILLOVER

Q26 Since participating in the program, have you installed any *additional* energy efficient equipment without any incentives from the Energy Trust's Building Efficiency Program?

{If yes:}

Q26a Please describe the type and quantity of the efficient equipment or measures?

Q26b Overall, how influential would you say the program was in your decision to install additional efficient equipment? (0 to 10 scale, with a 0 indicating not at all influential and a 10 indicating very influential.)

Here, we note several concerns about the reliability of estimated spillover based on the self-reports of respondents. First, while program participants can accurately

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[47] Protocols and Procedures for the Verification of Costs, Benefits, and Shareholder Earnings from Demand-Side Management Programs, page A-9.

[48] Cambridge Systematics, Inc. (1994). *DSM Program Spillover Effects: Review of Empirical Studies and Recommendations for Measurement Methods*. Prepared for the Southern California Edison Company and the California DSM Measurement Advisory Committee (CADMAC).

report some behaviors, such as whether the equipment is still in place,[49] they are notoriously error-prone when it comes to reporting on whether they have purchased *energy efficient* equipment, such as air conditioners and refrigerators.[50] One study concluded that: "...most respondents are unclear (or unaware) of the criteria used to define energy efficiency for various measures. This can lead to both under- and over-estimation of actual market penetration..."[51]

Second, it is important to remember that evaluations that include savings from spillover measures must estimate the gross savings using the same level of methodological rigor that was used for program-induced measures and practices. The level of rigor that could be achieved by using the information collected by telephone did not always meet this standard. Only in some cases did the descriptions of the equipment and their quantity yielded reasonably sound estimates of gross kWh spillover impacts.

Finally, there are extra hurdles that evaluators must address if a persuasive case is to be made for program influence on these installations. These hurdles stem from the fact that the identification of appropriate installations and their causal connection to an efficiency program is necessarily more vague (less concrete) than was the case for equipment specifically recommended or rebated by a program. The reason is obvious. In traditional program evaluations, specific equipment is detailed in program records, serving both the identification and the program connection functions. The issue is only in assessing the *level* of program impact on the installation decision, at some point between 0% and 100% percent. For spillover measures, simply identifying the equipment and/or practices is at issue, as well as making any causal connection at all with a utility program.

With these caveats in mind, we provide in Chapter 7 an estimate of spillover in terms of kWh for only those participants who provided enough specific data to estimate energy savings. Because there were so few participants with specific data, we did not generalize the possible spillover to all participants who indicated some sort of installation of measures but provided no details. While we recognize that the quality of these estimates is rough at best, we also recognize that these systematic,

49 Richardson, Valerie and Skumatz, Lisa A. "Measure retention in residential new construction." A paper presented at the *American Council for and Energy Efficient Economy Conference* in August 2000.

50 Hagler Bailly Consulting. *CBEE Baseline Study on Public Awareness and Attitudes Toward Energy Efficiency: Volume 1*. Prepared for Pacific Gas & Electric Company and the California Board for Energy Efficiency, 1999.

51 The vast majority of the errors result in over-reporting the adoption of efficient measures.

but imprecise methods provide a high level of confidence that the spillover is not zero.

In addition to energy spillover, we also estimated the impact of the program on *policies* that govern selection or specification of energy-efficient equipment. While the kWh impacts of such policies are impossible to estimate in this study, Questions 27, 27a and 27b (see Figure 6.9) attempted to determine the existence of such policies and the influence of the program on the development of these policies. To the extent that the program influenced such policies suggests that the net-to-gross ratio adjusted only for free-riders is an underestimation of the true program influence.

Figure 6.9

QUESTIONS USED TO DETERMINE SPILLOVER

Q27 Has your organization developed any policies to govern the selection or specification of energy-efficient equipment?

{If yes:}

Q27a And were these policies put in place BEFORE or AFTER you began participating in the Energy Trust's Building Efficiency program?

{If After}

Q27b To what extent were these policies influenced by your participation in the Energy Trust's Building Efficiency Program? (0 to 10 scale, with a 0 indicating not at all influential and a 10 indicating very influential.)

Nonparticipant Onsite Data

As discussed above in the *Sample Design* section, we attempted to conduct onsite inspections with all nonparticipants who had installed lighting or mechanical equipment between January 2003 and March 2004, and who agreed to a site visit. A telephone screening survey of 5,043 establishments identified only 43 such firms. Subsequently, nine of these nonparticipants either refused the onsite visit or were not reachable through numerous attempts; another five either had not actually installed equipment during the period of interest or had subsequently removed the equipment. Consequently, we completed onsite inspections for 29 nonparticipants with recently installed equipment. At these sites, we inspected 62 lighting measures and 10 HVAC measures that were installed to determine whether they would have qualified for Building Efficiency incentives. The percent of these purchases that were considered as qualifying for incentives is a rough indication of Building Efficiency free-ridership. That is, the net-to-gross ratio is roughly equal to one minus the percent who installed a measure that qualified for an incentive.

It is considered to be a rough estimate for two reasons. First, the sample sizes are very small. Second, such a comparison does not control for self-selection bias.[52] For these reasons, this information was not incorporated into the calculation of the self-report net-to-gross ratio. Rather, the nonparticipant information served as another point of comparison to judge the accuracy of the self-report net-to-gross ratio.

Program Files

The program maintains data on each participant in electronic or hardcopy form. These contained various pieces of information that were relevant to the analysis of free-ridership, such as the payback with the incentive and the payback without the incentive. We were able to convert the payback estimates without the incentive into estimates of net-to-gross ratios, as discussed below. In addition, we compared these project paybacks with the investment criteria reported by participants in the telephone survey. These analyses provided a second check on the self-report net-to-gross ratio.

The first point of comparison involved net-to-gross ratios that were based on the simple payback information, both *with* and *without* the incentive, provided by the PMC for each measure under consideration for installation. This information was obtained from Building Efficiency files for each of the 94 respondents to the lighting survey. Where that information was included in the program file, we converted

52 In many evaluations, program-induced effects have been estimated by comparing the observed savings of program participants and nonparticipants. This comparison is appropriate only if participants and nonparticipants are identical in all respects except program participation. However, participants and nonparticipants usually differ in observed economic and demographic/firmographic characteristics, which in turn induce differences in unobserved preferences for energy consumption and program participation. Attribution of the observed difference in energy savings to the program alone ignores these other differences. The result can be an upwardly-biased estimate of program effectiveness because the demographic/firmographic and economic characteristics of the program participants would have induced some conservation in the absence of the programs. This bias can been called a self-selection bias because the simple comparison ignores how individuals self-select into the voluntary programs. The self-report approach, in effect, relies on the participant to adjust for this self-selection bias, whereas a strict comparison approach cannot account for self-selection at all.

these simple project paybacks *without* the incentive into estimates of the net-to-gross ratio using the payback-to-net-to-gross ratio conversions in Table 6.5.[53]

Table 6.5

PAYBACK CONVERSION TO NET-TO-GROSS RATIO

PAYBACK PERIOD	IMPLIED NET-TO-GROSS RATIO
6 Months or Less	0.40
More than 6 Months and Less than 2 Years	0.75
2 Years or More	1.00

Derivation of the Mechanical Net-to-Gross Ratio

While the question numbers were somewhat different, the same kinds of information used for lighting measures were also used in estimating the net-to-gross ratios for mechanical measures.[54] The main difference was that the payback information was not used because it was rarely available.

Before calculating the net-to-gross ratio, an assessment of the internal consistency (an indicator of reliability) was performed using Questions 12, 13b, 18, 19 and 20 from the mechanical participant survey. The Cronbach's alpha for these five items was very high at 0.88, indicating a very reliable index supporting the use of these five items to calculate the self-report net-to-gross ratio.

LIGHTING, MECHANICAL, AND TOTAL PROGRAM NET IMPACT ESTIMATION

In this section, we describe the methods we used to produce end-use and program-level net impact estimates from the data available.

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53 These conversion rates (shown in the table) are contained in the *California Measurement and Evaluation (M&E) Protocols,*

54 See Appendix C for all surveys.

The quantitative and qualitative data from the participant survey and the program files were used to produce estimates of the final net-to-gross ratios for each measure. The engineering analysis produced estimates of the realized gross impacts for each measure. Given these inputs, the program-level net kWh and therm impacts were calculated in four steps:

1. For each measure in the population within each end-use, the expected gross kWh and therm impact estimates were adjusted by the associated gross savings realization rates (determined from the onsite investigations) to produce adjusted program-level gross energy impacts (referred to as AG_Energy).[55]

2. For each measure in the population within each end-use, these products were multiplied by the final net-to-gross ratio to produce measure-level net impacts.

3. The measure-level net impacts were summed within each end-use to produce net end-use-level impacts.

4. The net end-use-level impacts were summed to produce total program-level net impacts.

Equation 2 is provided as another way of looking at these calculations:

$$\text{NetEnergy} = \sum_{e=1}^{2} \sum_{i=1}^{N} \left[NTGR_e \times \text{AG\_Energy}_{e,i} \right] \qquad (1.)$$

where:

net-to-gross ratio$_e$ =	The final net-to-gross ratio for the eth end use (lighting or mechanical).
AG_Energy$_{e,i}$ =	The total program-level gross kWh or therm impacts for the ith measure-specific item in the eth end use adjusted by the realization rate.

55 Note that in the case of lighting, these calculations were done within each stratum and then summed to obtain the gross per measure impacts.

Confidence intervals were calculated for realization rates and net-to-gross ratio at the 80% and 90% confidence level.

7. ENERGY IMPACT RESULTS

This chapter provides results of the analysis used to produce adjustments to the estimates of expected program savings and to generate estimates of realized program impacts.

To recap our method (presented in detail in Chapter 6), the analysis of realized savings estimates began with onsite audits for a sample of lighting and mechanical projects. The aim of the participant audits was to determine whether program-installed equipment was still in-place and functional, and whether operating conditions and contextual factors with significant energy-use consequences were at all different from expected. The aim of nonparticipant audits was to discover whether recent lighting or mechanical projects might have qualified for program incentives. Findings from the participant onsite audits were used to adjust the expected savings estimates for the sampled participating projects and to create the estimates of realized project impacts. Prior to conducting the onsite audits, we reviewed all available project data, including any reports written by a technical analysis contractor (ATAC) for custom mechanical sites.

This chapter briefly discusses the onsite audits and the review of project documents, and then provides details on the adjustments to the lighting and mechanical end-uses. The estimation of gross impacts is followed by the results of the net-to-gross ratio analysis and the estimation of net impacts. The chapter is organized into the following sections:

- *Onsite Audits*
- *Project Document Review*
- *Gross Impact Results (Lighting, Mechanical)*
- *Net-to-Gross Ratio Results (Lighting, Mechanical, Program Total and Spillover Adjustment)*
- *Net Energy Impacts*
- *Estimated Impact of the Building Efficiency Program on Efficient Installations in Oregon*
- *Summary*

ONSITE AUDITS

The participant onsite audits followed the sample design given in Chapter 6; Table 7.1 gives the number of completed audits.

Table 7.1

PARTICIPANT ONSITE AUDITS COMPLETED

AUDIT TYPE	PLANNED	COMPLETED
Lighting	50	50
Mechanical – Prescriptive	28	27
Mechanical – Custom	21	21
Nonparticipants	43	29
Total	**142**	**127**

There was one refusal among the lighting participants for the sites originally chosen for audit. This refusal was brought to our attention during the telephone net-to-gross surveys; we deleted the site from our sample prior to calling the participant for the audit and replaced it with a site randomly selected. With one exception, all the mechanical sites (both prescriptive and custom audits) were audited as planned. The exception was a prescriptive motor site that was inadvertently left out during a custom site audit. We also audited nonparticipant sites, with an audit disposition as shown in Table 7.2.

We used the nonparticipant data in the net-to-gross analysis as a small comparison group. These nonparticipants had been screened for the audit through a telephone survey in which they indicated they had installed equipment recently. As shown in the dispositions, it was interesting to find out that 9% indicated they had installed equipment during the screening survey, yet the onsite audit found that nothing had been done. It is unknown why this occurred, although one nonparticipant did state that they had "lied to the interviewer."

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Table 7.2

NONPARTICIPANT ONSITE AUDIT DISPOSITION

AUDIT DISPOSITION	PERCENT
Completed (N=29)	67%
No Equipment Installed (N=4)	9%
Refused (N=2)	5%
Efficient Equipment Moved During Remodel (N=1)	2%
Unable to Contact (N=7)	16%
Total (N=43)	**100%**

For the completed nonparticipant audits, the onsite investigation assessed whether the recently installed equipment could be eligible for a Building Efficiency incentive. The measures that met the program criteria were labeled as "efficient" (Table 7.3). If it was known that the measure did not meet the program criteria, then it was labeled as "not efficient." For some measures, including those at four mechanical sites, we were unable to determine the efficiency level. The evaluator did not have access to the roof to look at rooftop units for one site and the other three sites had equipment that was not typically rebated by the program, so we were unable to assess whether the installations met program criteria. These measures were labeled as "maybe efficient." Sufficient data was collected to estimate the connected load of the nonparticipant lighting installations. The grouping by efficiency was done by connected load for the lighting end-use category. We were unable to collect sufficient information for the mechanical end-use to perform a similar grouping, so the site—not the equipment—was used as the unit of measure.

Table 7.3

NONPARTICIPANT EFFICIENT INSTALLATIONS

END USE	EFFICIENT	NOT EFFICIENT	MAYBE EFFICIENT
Lighting (by kW, kW=102.7)	23%	75%	2%
Mechanical (by site, n=15)	27%	47%	27%

PROJECT DOCUMENT REVIEW

To prepare for the site visits of the custom mechanical projects, we reviewed all available project documentation to ascertain the exact quantities and specifications of installed equipment and equipment removed from service, operating hours and other parameters affecting project savings. We attempted to match the estimated savings found in the paperwork to that in the project database. For some projects, this review was facilitated by organized, well documented packets of information. For other projects, it was difficult to determine the expected savings and the assumptions used to estimate those savings.

Table 7.4 summarizes our assessment of the quality of the custom project paperwork as documented in the files (i.e., could we find what was implemented, could we follow the analysis performed). Not reflected in the table is the fact that eight of 21 custom project files lacked demand (kW) savings estimates, as did 66% of lighting project files, a finding discussed more in the subsections that address lighting and mechanical demand savings.

Table 7.4

EVALUATOR ASSESSMENT OF QUALITY OF PROJECT PAPERWORK

REPORT PREPARED BY:	NUMBER OF PROJECTS	ASSESSMENT		
		THOROUGH	ADEQUATE	DIFFICULTIES
Vendor	10	5 50%	2 20%	3 30%
ATAC	9	6 67%	1 11%	2 22%
Other	2	1 50%	0 0%	1 50%
Total	**21**	**12** **57%**	**3** **14%**	**6** **29%**

The table distinguishes between analyses of custom projects conducted by vendors and those by ATACs. The evaluation team found difficulties in nearly one-third of the projects. Because of the small number of projects reviewed, firm conclusions cannot be drawn comparing vendors and ATACs; the findings suggest ATAC studies are of somewhat higher quality than vendor studies.

For the most part, the analyses found in the project files were reasonable. However, three projects had errors that were evident in the paperwork, prior to the field investigation. Two of these projects had errors in the spreadsheets, such that the total expected savings did not add up correctly from the components. A third project reported four motors, yet gave the operating schedule for only one of them, with the implicit assumption that all four had the same operating schedule. The assumption was possibly true—and thus the error could be undetected from a review of the savings analysis documentation—however, it was found by the onsite investigation to be false. The motors had different operating schedules.

While Table 7.4 gives a sense of the adequacy of the documentation in the files, it does not indicate the level of work required at times of the evaluator to find the necessary data elements. It was not always straightforward to find specific information that matched the program tracking database, even for projects we assessed as having "thorough documentation." Sometimes the evaluation team spent as much as 15 to 20 minutes looking through the paperwork to find the expected values matching those in the database.

Some participants had been offered multiple efficiency options (sometimes from multiple vendors). In these cases, it often was hard for the evaluators to identify the specific measure installed and awarded an incentive, such as when none of the alternative values matched the estimated savings recorded in the database. (This specific difficulty of lack of match between data in the files and the database occurred for several projects.)

The project documentation lacks a summary of the critical information relating to the estimation of project savings. For the most part, the needed documentation was present, yet it was difficult to find.

Table 7.5 presents for each of the 21 custom projects investigated onsite, a brief description of the project, a comment on the adequacy of the project documentation, the realization rate determined for the project's impact and reasons supporting the realization rate. (Appendix C provides a detailed discussion of the onsite findings.) The subsequent section discusses the realized gross energy savings for the lighting and mechanical end-uses, and for the program overall.

Table 7.5

ASSESSMENT OF DOCUMENTATION AND REALIZATION RATES FOR CUSTOM MECHANICAL PROJECTS

ID	MEASURE	COMMENT ON DOCUMENTATION	PROJECT KWH GROSS IMPACT REALIZATION RATE	REASONS FOR REALIZATION RATE
AERATOR PUMPS				
BE0095	Aerator Pumps	Thorough documentation.	84%	Spreadsheet error in expected savings estimates.
CHILLER REPLACEMENT				
BE0113	Chiller Replacement	Fair documentation.	100%	Run hours and scheduling as expected.
BE0363	Chiller Replacement	Thorough documentation.	100%	Run hours and scheduling as expected.
BE0672	Chiller Replacement	Well documented, reasonable assumptions.	100%	Run hours and scheduling as expected.
CONTROLS				
BE0059	Controls	Well documented, reasonable assumptions.	0%	Measure not implemented
BE0114	Controls	Well documented, reasonable assumptions; extraneous data in packet made it difficult to find specific information needed.	100%	Complex site, scheduling as expected.
BE0415	Controls	Well documented, reasonable assumptions.	100%	EMS found at site and appeared to be working as expected.
BE0468	Controls	Well documented, reasonable assumptions.	100%	EMS found at site and appeared to be working as expected.

Continued

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ID	MEASURE	COMMENT ON DOCUMENTATION	PROJECT KWH GROSS IMPACT REALIZATION RATE	REASONS FOR REALIZATION RATE
RETRO-COMMISSIONING				
BE0218	Retro-Commissioning	Well documented, reasonable assumptions, although it was difficult to determine which equipment should be audited.	100%	Retro-commissioning occurred according to plan.
BE0396	Retro-Commissioning	Two bids in hard copy data; it was difficult to determine which equipment should be audited.	100%	Run hours and scheduling as expected.
BE0350	Retro-Commissioning	Difficult to determine what which equipment should be audited.	121%	Increased chiller run hours found during audit based on tenant operational change.
VARIABLE FREQUENCY DRIVES (VFD)				
BE0347	VFD on 3 Chilled Water Pumps / 2 HE* Motors	Difficult to follow what was done exactly; chiller included in paperwork, but not in incentive; multiple copies of motor savings.	6%	Onsite indicated no VFDs.
BE0151	VFD on AHU*	Thorough documentation.	43%	Analysis had not taken into account actual schedule of each of the four AHUs.
BE0085	VFD; Change Condenser Temperature	Multiple copies of ATAC report in packet; difficult to determine which to use; otherwise thorough documentation.	85%	Fewer run hours found during audit.
BE0320	VFD on AHU	Well documented, reasonable assumptions.	100%	Run hours and scheduling as expected.
BE0546	VFD on AHU	Thorough documentation, but difficult to find exact savings for which incentive was given.	100%	Run hours and scheduling as expected.
BE0416	VFD on Pump	Documentation adequate.	100%	Run hours and scheduling as expected.
				Continued

ID	MEASURE	COMMENT ON DOCUMENTATION	PROJECT KWH GROSS IMPACT REALIZATION RATE	REASONS FOR REALIZATION RATE
BE0129	VFD on Chilled Water Pumps	Thorough documentation.	105%	Incorrect motor installed that was found during audit and rectified afterwards by contractor.
BE0420	VFD on 4 AHUs and 2 Chilled Water Pumps	Paperwork not useful; went to ATAC to obtain original spreadsheet on calculations.	106%	Spreadsheet error in analysis.
BE0164	VFD on AHU	Thorough documentation.	100%	Run hours and scheduling as expected.
BE0115	VFD on AHU	Documentation adequate.	155%	Baseline run hours too low and motor efficiencies too high.

* *HE=high efficiency; AHU = air handling unit.*

GROSS IMPACT RESULTS

Lighting Measures

Analysis of the lighting sites followed the method described in Chapter 6.

Gross Energy Impacts—Lighting

Because the analysis of realized energy savings included information regarding the number of installed fixtures and the operating hours at the site, both of these variables have the potential to be different from the assumptions driving expected savings. When differences in hours of operation were found, we relied on the hours of operation we gathered systematically onsite using a set procedure. In our discussion of each measure below, we attempt to tease out the influence of changing numbers of fixtures and changing hours of operation on the realization rate.

The results for the three lighting measures audited are shown in Table 7.6. A discussion of each measure follows the table.

Table 7.6

AUDITED LIGHTING SITES—ENERGY REALIZATION RATE

AUDITED LIGHTING SAMPLE	GROSS KWH IMPACT		REALIZATION RATE
	EXPECTED	REALIZED	
CFL	850,897	719,414	85%
T8	4,092,552	4,169,234	102%
T5	1,404,423	1,328,679	95%
Total	**6,347,872**	**6,217,326**	**98%**

CFL

The analysis of compact fluorescent lighting (CFL) measures was based on the one-to-one change-out of an incandescent bulb for a CFL. If the auditor did not find the CFL in place, both the baseline fixture number and the found fixture number were reduced. Similarly, if more CFLs were found than expected, it was assumed that the CFL replaced more incandescent bulbs, and the baseline fixture number was increased to match the found fixture number. Of the CFLs expected, 94% were found; the hours of operation tended to be less than expected, yielding a sample realization rate of 85%. For example, a restaurant chain accounted for about 25% of the CFL impacts. These sites, while open 24 hours, stated that less than 100% of their lights are on at all times. This decreased the operating hours for all fixtures at the site.

T8

T8 fixtures were not necessarily analyzed on a one-to-one change-out expectation. Some sites may have reduced fixtures at the time of the retrofit. We assessed the T8 fixtures on a site-by-site basis to determine whether to adjust the baseline or not. The audits found 95% of the expected fixtures and higher hours of operation than expected. This led to a gross realization rate for the sample higher than 100%.

T5

T5 fixtures were analyzed similarly to the T8 fixtures. There were only five sites that installed T5 fixtures. One site installed 20 more fixtures than planned and one site returned ten fixtures, giving an overall increase of ten fixtures across all sites (1% of the expected fixtures). However, the realized hours of operation were somewhat less than assumed in the estimation of expected savings.

Gross Demand Impacts—Lighting

The expected demand (kW) savings presented in this report were calculated for the evaluation from the measure-specific information in the project files. These values differ from the total demand savings obtained by summing the project data reported in the program database. We calculated expected demand savings from the project files because the program database did not frequently or reliably capture project demand reductions. As mentioned, 66% of the lighting records lacked demand savings estimates or listed demand savings as 0 kW. This erratic treatment of demand savings in the database may owe to the fact that project incentives are not affected by demand savings and thus program staff may not have addressed them.

For the audited sites, Table 7.7 shows the demand realization rate of the three measures comprising more than 80% of lighting savings. These estimates are derived from the manufacturer-reported kW demand for the equipment. Thus, the demand values shown in the table are not peak demand, as at system peak all installed lighting measures are not simultaneously in use.

Table 7.7

AUDITED LIGHTING SITES—EQUIPMENT DEMAND REALIZATION RATE

AUDITED LIGHTING SAMPLE	GROSS KW IMPACT*		REALIZATION RATE
	EXPECTED	REALIZED	
CFL	278	265	95%
T8	772	748	97%
T5	188	179	95%
Total	**1,238**	**1,192**	**96%**

**Equipment kW impact, not system peak impact.*

Realized Gross Energy Impacts—Lighting

The expected and realized average impacts from the sampled sites were segregated into their respective stratum and used to calculate a stratum ratio, as shown in Table 7.8. The realized energy values in the table incorporate savings from lighting/HVAC interactive effects, as discussed in Appendix B.

Table 7.8

LIGHTING STRATA RATIOS, INCLUSIVE OF HVAC INTERACTIVE EFFECTS

STRATUM*	ENERGY (KWH)		
	SAMPLE EXPECTED MEAN	SAMPLE REALIZED MEAN	STRATUM RATIO
1	11,302	7,901	0.70
2	78,081	69,705	0.89
3	464,960	505,617	1.09

**Due to irregularities pertaining to two sites, strata 1 and 2 each have 19 observations, rather than the 20 observations investigated on-site.*

We applied the stratum ratios according to the methods shown in Figure 6.5 and Figure 6.6 of the preceding chapter and generated gross impacts for the lighting end-use, shown in Table 7.9. Note that the first three measures in the table are shaded. These measures account for more than 80% of the energy savings for lighting, were investigated through onsite audits, and thus have unique realization rates. The other measures were not investigated onsite and so we have used the average realization rate of the three audited measures.

Table 7.9

LIGHTING REALIZED GROSS IMPACTS

MEASURE TYPE	GROSS ENERGY (KWH) IMPACT		
	EXPECTED	REALIZED	REALIZATION RATE
T8	7,618,286	7,120,527	93.5%
CFL	2,176,262	1,902,849	87.4%
T5	2,165,865	2,121,101	97.9%
Delamping	537,158	500,513	93.2%
Controls	376,024	350,372	93.2%
Metal Halide	255,408	237,984	93.2%
Quartz Lamp	237,291	221,103	93.2%
LED Exit Sign	196,588	183,177	93.2%
Metal Halide Pulse Start	187,817	175,004	93.2%
High Pressure Sodium	113,581	105,833	93.2%
Occupancy Sensor	80,863	75,347	93.2%
Cold Cathode	11,259	10,491	93.2%
Photo Cell	6,899	6,428	93.2%
Other Fluorescent	5,238	4,881	93.2%
Exit Other	105	98	93.2%
Total	**13,968,644**	**13,015,708**	**93.2%**

Mechanical Measures

This section provides a summary of the findings for the mechanical projects.

Gross Energy Impacts—Mechanical

Comprehensive findings from each of the custom mechanical audits are provided in detail in Appendix C.

The audits of the prescriptive motor sites found most motors (89%, or 75 of 84 motors) had been installed, while 11% were held as replacement stock on the shelf at their respective sites (see Table 7.10). When asked, facility operators indicated that the motors were purchased with the intent of installing them when the existing operational motor failed. With the audits being performed in October 2004, the length of time on the shelf for the motors varied from 11 months to 15 months. Because this was an impact evaluation of the first year of installations and it was not known when these motors would be put into service (and the energy impacts seen by the system), we did not include those motors in the analysis. The realization rate of 77% (obtained from the installed audited motors' realized kWh savings divided by the expected kWh savings) was applied to all motors in the population to get realized kWh gross impact.

Table 7.10

AUDITED MOTORS RESULTS

AUDITED MOTORS	EXPECTED	REALIZED	
		INSTALLED	ON SHELF
Number	84	75	9
KWh	359,661	278,226	81,435

The kWh results for the audited sample are shown in Table 7.11.

Table 7.11

AUDITED MECHANICAL SITES—ELECTRICITY (KWH) REALIZATION RATE

AUDITED MECHANICAL SAMPLE	GROSS KWH IMPACT		REALIZATION RATE
	EXPECTED	REALIZED	
Controls	1,205,338	1,181,585	98.0%
Variable Frequency Drive	918,629	695,017	75.7%
Aeration System	546,884	458,154	83.8%
Chiller	388,248	388,248	100.0%
Motor	359,661	278,226	77.4%
Retro-Commissioning	388,493	420,423	108.2%
Total	**3,807,253**	**3,463,968**	**91.0%**

The therm results for the audited sample are shown in Table 7.12

Table 7.12

AUDITED MECHANICAL SITES—THERM REALIZATION RATE

AUDITED MECHANICAL SAMPLE	GROSS THERM IMPACT		REALIZATION RATE
	EXPECTED	REALIZED	
Controls	2,284	2,284	100%
Retro-Commissioning	17,313	17,313	100%
Total	**19,597**	**19,597**	**100%**

Gross Demand Impacts—Mechanical

The expected demand (kW) savings reported in the program database for many of the mechanical projects was zero and files for these projects contained no demand savings estimates, a finding similar to that for many of the lighting projects. However, unlike lighting, the measure-specific information in the project files did not provide sufficient data to recreate an expected demand impact for mechanical projects, as we were able to do in the lighting analysis.

Realized Gross Energy Impacts—Mechanical

The information in Table 7.13 is provided on the project site level to get a better indication of the site variation for the custom sites. (Please refer to Appendix C for a detailed discussion of why the realization rates differed from 100%.)

Table 7.13

PROJECT SPECIFIC RESULTS FOR AUDITED CUSTOM SITES

PROJECT	EXPECTED		REALIZED		GROSS REALIZATION RATE	
	KWH	THERM	KWH	THERM	KWH	THERM
BE0059	23,753	0	0	0	0%	—
BE0085	139,310	0	119,106	0	85%	—
BE0095	546,884	0	458,154	0	84%	—
BE0113	92,485	0	92,485	0	100%	—
BE0114	264,744	0	264,744	0	100%	—
BE0115	71,642	0	111,201	0	155%	—
BE0129	41,200	0	43,432	0	105%	—
BE0151	279,864	0	120,095	0	43%	—
BE0164	54,850	0	54,850	0	100%	—
BE0218	204,640	0	204,640	0	100%	—
BE0320	221,118	0	221,118	0	100%	—
BE0347	91,018	0	5,588	0	6%	—
BE0350	149,040	0	180,970	0	121%	—
BE0363	295,763	0	295,763	0	100%	—
BE0396	34,813	7,100	34,813	7,100	100%	100%
BE0415	19,296	1,440	19,296	1,440	100%	100%
BE0416	10,877	0	10,877	0	100%	—
BE0420	751,700	0	794,015	0	106%	—
BE0468	13,678	1,130	13,678	1,130	100%	100%
BE0546	8,750	0	8,750	0	100%	—
BE0672	132,167	0	132,167	0	100%	—
Total	**3,447,592**	**9,670**	**3,185,742**	**9,670**	**91%**	**100%**

The kWh impact and realization rates for the mechanical end-use are shown in Table 7.14 and the therm impacts and realization rates are shown in Table 7.15. (Please refer to Appendix B for the method by which therm savings were adjusted to account for lighting/ HVAC interactive effects to show a heating penalty.) Note that the first six measures in Table 7.14 and the first three measures in Table 7.15 are shaded. These measures account for more than 80% of the kWh savings for mechanical projects, were investigated through onsite audits and thus have unique realization rates. The other measures were not investigated onsite and so we have used the average realization rate of the six audited measures for kWh. A realization rate of 100% was used for the therm measures in the bottom 20% of energy savings.

Table 7.14

MECHANICAL REALIZED GROSS IMPACT RESULTS

MEASURE TYPE	GROSS KWH IMPACT		
	EXPECTED	REALIZED	REALIZATION RATE
Controls	1,203,292	1,221,823	102%
VFD	918,629	695017	76%
Aeration System	546,884	458,154	84%
Chiller	388,248	388,248	100%
Motor	377,267	291,846	77%
Retro-Commissioning	378,716	420,423	111%
Refrigeration Upgrade and Controls	352,052	320,309	91%
Restaurant EMS	240,000	218,360	91%
Arc Welder	149,472	135,995	91%
Air Conditioning	87,047	79,198	91%
Economizers	21,596	19,649	91%
Custom Heat Pump	17,360	15,795	91%
Compressor	5,869	5,340	91%
Boiler	5,112	4,651	91%
Ductwork	1,210	1,101	91%
Total	**4,692,753**	**4,275,907**	**91%**

Table 7.15

GROSS THERM IMPACTS BY MEASURE

MEASURE TYPE	GROSS THERM IMPACT		
	EXPECTED	REALIZED	GROSS REALIZATION RATE
Controls	2,284	2,284	100%
Retro-Commissioning	17,313	17,313	100%
Restaurant EMS	3,750	3,750	100%
Boiler	11,375	11,375	100%
Ductwork	2,284	2,284	100%
Water Heating	2,284	2,284	100%
Swimming Pool Insulation	7,363	7,363	100%
Air Conditioning	11,420	11,420	100%
HVAC Heating Penalty	0	-11,458	Negative
Program Total	**58,073**	**46,615**	**80%**

Note: Shaded measures were in the top 80% by expected kWh impact.

NET-TO-GROSS RATIO RESULTS

In this section, we present the net-to-gross ratios for lighting and mechanical measures. We first derive the net-to-gross ratios by considering only the free-ridership effects and then further adjust the ratios to account for spillover effects. Our discussion of the net-to-gross ratios accounting for free-ridership only includes a presentation of the confidence intervals associated with the ratios. We cross-check the ratios—based as they are on participants' responses to a series of questions assessing free-ridership—with ratios suggested by the nonparticipant onsite findings and by payback calculations obtained from the program files. We then discuss the findings concerning spillover, the measurable effects of which are much smaller than those of free-ridership.

Through the remainder of this report, net-to-gross ratios are reported as decimal numbers with a 0.0 indicating 100% percent free-ridership and a 1.0 indicating 0% free-ridership.

Lighting Net-to-Gross Ratio (Free-Ridership Adjustment Only)

The initial lighting net-to-gross ratio—adjusted for free-ridership, but not for spillover—was calculated for the 94 surveyed lighting participants. This initial ratio was based solely on the responses to the five net-to-gross ratio questions (Questions 11, 12, 20, 21 and 22; see Chapter 6) on the participant survey and, when relevant, to the question regarding acceleration of the installation (deferred free-ridership). Table 7.16 presents the average net-to-gross ratio, both unweighted (that is, a simple average across participants) and weighted by expected kWh savings.

Table 7.16

NET-TO-GROSS RATIO FOR LIGHTING MEASURES (FREE-RIDERSHIP ADJUSTMENT ONLY; N=94)

WEIGHTING	NET-TO-GROSS RATIO	STANDARD ERROR	95% CONFIDENCE INTERVAL	
			LOWER BOUND	UPPER BOUND
Unweighted (Simple Average of Projects)	0.800	0.018	0.765	0.835
Weighted (by Project Expected Savings)	0.831	0.016	0.800	0.862

Nonparticipant Comparison Group—Lighting

We conducted onsite audits of 29 nonparticipants who reported installing equipment during the evaluation period. These 29 nonparticipants installed 62 lighting measures; the onsite investigations determined whether the equipment installed would have qualified for a rebate through the Building Efficiency program. Of the 62 measures, 14 (23%) were determined to be program-qualifying. Applying this finding to the participant population suggests that, in the absence of the program, roughly 23% of participants likely would have installed efficient equipment without an incentive and thus would have been program free-riders.

The finding from nonparticipants suggest a net-to-gross ratio (defined as 1 – free-ridership) of 0.77. This finding is very consistent with the unweighted self-report net-to-gross ratio of 0.80 and the difference between the estimates (0.03) is not statistically significant (z = 0.43).

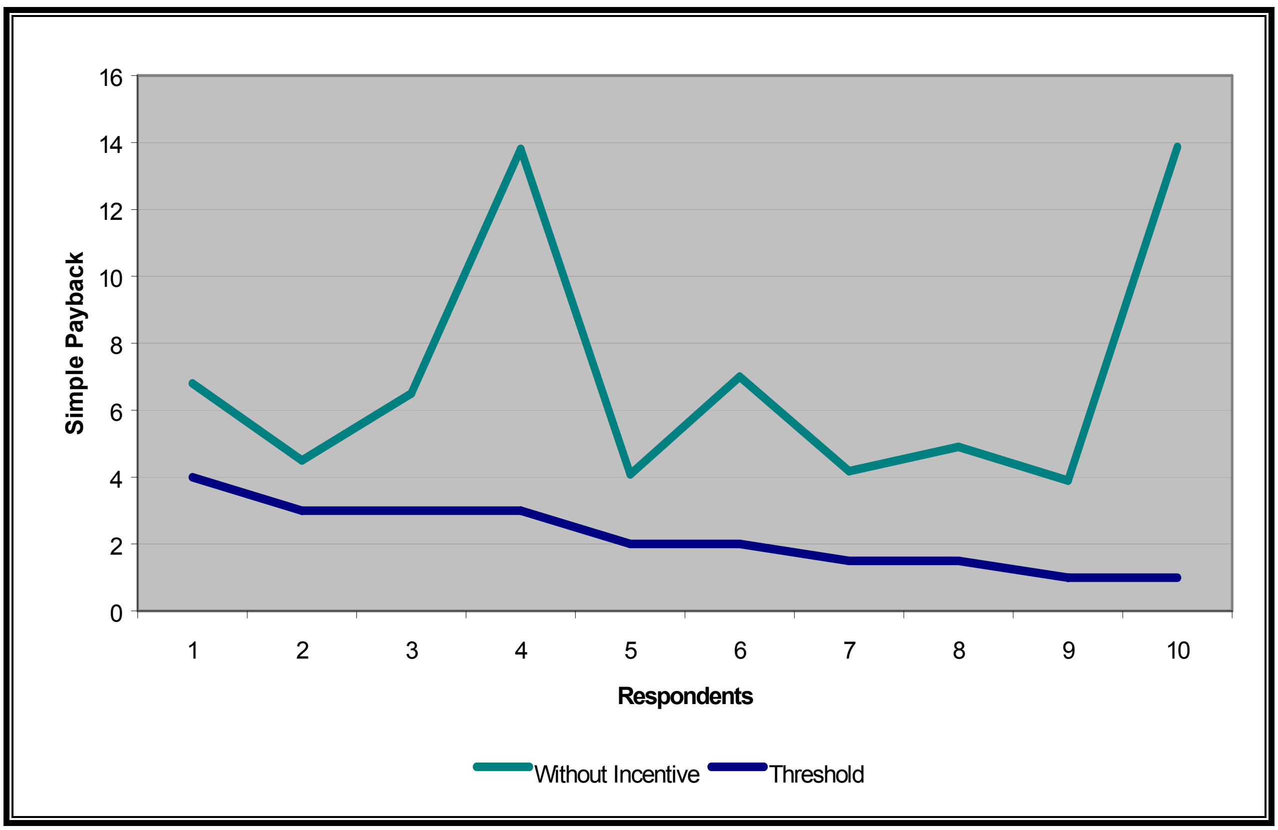
Payback Criteria—Lighting

All but 10 of the 94 lighting project files include a statement of the payback for the package of recommended measures with and without the incentive.

Our survey of participants asked them to report the payback threshold that must be met before they make capital investments in efficient equipment. Only 10 participants were able to provide this information. Figure 7.1 presents the payback without the incentive and the threshold for these respondents.

Figure 7.1

LIGHTING PAYBACKS WITHOUT INCENTIVE AND THRESHOLD



If the payback without the incentive is lower than the threshold, then this would imply a very high free-ridership rate and very low net-to-gross ratio, as the lighting projects would have been attractive to the organizations even without an incentive. As one can see from Figure 7.1, there are no cases where this occurs.[56]

For the 84 projects whose files included statements of project paybacks with and without the incentives, we calculated a weighted average of the two payback periods, using weights based on the projects' expected kWh savings. The projects have a mean payback of 7.01 years without the incentive and 5.42 years with it. Thus, project incentives lowered paybacks an average of 1.59 years.[57]

For these 84 projects, the paybacks *without* the incentive were then translated into a project-specific implied net-to-gross ratio using the payback conversions shown in Chapter 6 and repeated below in Table 7.17. Eighty-two of the projects had paybacks without incentives of two years or more; two projects had paybacks of six months or less. The net-to-gross ratio implied by this method is therefore quite high, at 0.986, with a very small standard error of 0.065. From this perspective, the weighted net-to-gross ratio estimated from participant self-reports of 0.831 (see Table 7.15) is conservative. The payback analyses support a net-to-gross ratio that is ***at least*** 0.831, and possibly much higher.

Table 7.17

PAYBACK CONVERSION TO NET-TO-GROSS RATIO

PAYBACK PERIOD	IMPLIED NET-TO-GROSS RATIO
Six Months or Less	0.40
More than 6 Months and Less than 2 Years	0.75
Two Years or More	1.00

56 The payback threshold indicates that potential projects exceeding the threshold will not be pursued by an organization (allowing for exceptions to the rule). The converse does not hold: organizations do not pursue all potential projects whose paybacks are less than the threshold due to limitations of capital, labor, etc.

57 The 95% confidence interval bounds for the effect of the incentive on project paybacks are 1.37 to 1.81 years.

Mechanical Net-to-Gross Ratio (Free-Ridership Adjustment Only)

The net-to-gross ratio was calculated for the 51 surveyed participants with mechanical projects. This initial ratio was based solely on the responses to the five net-to-gross ratio questions on the participant survey and, when relevant, the question regarding acceleration of the installation (deferred free-ridership). Table 7.18 presents the mechanical net-to-gross ratio, both unweighted (a simple average of respondents) and weighted by expected kWh savings.

Table 7.18

NET-TO-GROSS RATIO FOR MECHANICAL MEASURES (FREE-RIDERSHIP ADJUSTMENT ONLY; N=51)

WEIGHTING	NET-TO-GROSS RATIO	STANDARD ERROR	95% CONFIDENCE INTERVAL	
			LOWER BOUND	UPPER BOUND
Unweighted (Simple Average of Projects)	0.710	0.044	0.624	0.796
Weighted (by Project Expected Savings)	0.800	0.038	0.726	0.874

Nonparticipant Comparison Group—Mechanical

Of the 29 nonparticipant sites that were visited by the evaluation team, 15 had installed mechanical equipment. The investigator was able to verify the efficiency of 11 of these 15 installations; of the eleven installations (all HVAC), four (36%) were determined to qualify for the program. Assuming that a roughly comparable proportion of the participants would have installed efficient mechanical equipment in the absence of the program suggests a free-ridership rate of 36%, equivalent to a net-to-gross proportion of 64% and ratio of 0.64. This estimate is roughly comparable to the unweighted self-report net-to-gross ratio of 0.71. Due to the small sample size, the difference (0.07) is not statistically significant (z = 0.48).

Payback Criteria—Mechanical

We were unable to analyze payback criteria to cross-check the mechanical net-to-gross ratio results as we did for lighting. Whereas the lighting project application forms specified the project payback with and without the incentive, the mechanical project application forms lacked this information.

Program Net-to-Gross Ratio (Free-Ridership Adjustment Only)

Table 7.19 provides the net-to-gross ratios across all 94 lighting participants and 51 mechanical participants, adjusted for free-ridership, but not for spillover. (The spillover adjustment is given in the next section.)

Table 7.19

NET-TO-GROSS RATIO FOR ALL MEASURES (FREE-RIDERSHIP ADJUSTMENT ONLY; N=145)

WEIGHTING	NET-TO-GROSS RATIO	STANDARD ERROR	95% CONFIDENCE INTERVAL	
			LOWER BOUND	UPPER BOUND
Unweighted (Simple Average of Projects)	0.768	0.020	0.729	0.807
Weighted (by Project Expected Savings)	0.817	0.018	0.782	0.852

Spillover Adjustment to the Initial Net-to-Gross Ratios

The participant self-report method used in this evaluation is unable to provide robust estimates of spillover. Below, we derive a small spillover adjustment to the lighting net-to-gross ratio and a somewhat larger adjustment to the mechanical net-to-gross ratio. In spite of our limited ability to quantify spillover effects, program spillover is occurring. As a consequence, it is very likely the final net-to-gross ratios are conservative and underestimate total program-induced savings.

Through the telephone survey, participants were asked a series of spillover questions regarding equipment installed outside of the program and purchasing policies.

As shown in Table 7.20, 20% of lighting participants and 27% of mechanical participants indicated that, subsequent to participation, they had installed additional energy-efficient equipment or measures without receiving any incentives from the program. The evaluation team examined the descriptions survey respondents provided of the equipment they installed and judged whether the equipment or action described qualified as spillover. Finally, the evaluation team assessed whether the descriptions of installed spillover equipment contained sufficient detail to support an estimation of spillover impacts.

Table 7.20

INDICATIONS OF EFFICIENCY SPILLOVER

PARTICIPANT SURVEY	REPORTED INSTALLING EFFICIENT EQUIPMENT WITHOUT AN INCENTIVE*	EQUIPMENT JUDGED TO QUALIFY FOR INCENTIVES		REPORTED DATA SUFFICIENT TO SUPPORT IMPACT ESTIMATION	
		LIGHTING	MECHANICAL	LIGHTING	MECHANICAL
Lighting (N=94)	19 (20%)	8 (9%)	4 (4%)	2	0
Mechanical (N=51)	14 (27%)	6 (12%)	10 (20%)	1	3
Total (N=145)	**33 (23%)**	**14 (10%)**	**14 (10%)**	**3 (2%)**	**3 (2%)**

The 33 lighting and mechanical participants reporting spillover were asked to use a rating scale to indicate the degree of influence the program had on their decision to install efficient equipment and not seek a rebate. On a scale of 0 to 10, with a "0" indicating *no influence* and a "10" indicating *very influential*, the mean influence of the program was moderate at 5.1 for lighting participants and 0.49 for mechanical participants.[58]

As indicated in Table 7.20, only three participants with lighting spillover provided a sufficiently detailed description of the installed equipment to support the derivation

58 The mean ratings of program influence had standard errors of 0.84 and 0.93, respectively.

of energy impact estimates. We estimate the installed lighting fixtures (T8s and CFLs) provided an additional 6% to 7% of energy savings.[59]

Similarly, only three participants reporting mechanical spillover provided enough information to estimate a possible kWh impact:

- One participant indicated having installed a 2.5-ton and a 3-ton heat pump. Because the program does not offer incentives for a 2.5-ton unit, only the deemed savings from the 3-ton unit were used as the spillover energy savings.
- One participant installed a 250-hp motor for which they intended to obtain an incentive, but failed to do so. There was no deemed savings value for this size motor, so the deemed value for a 200-hp motor was applied as the spillover energy savings.
- One participant installed an additional chiller. This site was audited and the second chiller was found to be of identical efficiency to the chiller for which they received an incentive. It is unknown why the company did not choose to attempt to obtain an incentive for this second unit. Regardless, the savings for the first unit was used as the same value for the spillover impact of this second unit. This may be somewhat conservative, as the first was a 350-ton unit and the second (for which no incentive was requested) was a 400-ton unit that replaced an old one of similar size.

The estimated spillover savings for these three sites were 106% of the sites' expected gross savings.

We added the savings from these spillover installations to the lighting and mechanical project savings to calculate lighting and mechanical net-to-gross ratios that included spillover. We did *not* assume that all participants reporting lighting spillover saved an additional 6% to 7% of savings, nor did we assume all participants reporting mechanical spillover saved an additional 106% of savings, as it would be imprudent to make such an adjustment on the basis of only three sites for each end-use.

59 One site installed CFLs in a multi-family type setting; we used a conservative assumption regarding the hours of operation for a hotel room to calculate the kWh for this site. For the other two sites, we used the participants' reported hours of operation.

As part of our spillover analysis, we also sought to determine the extent to which the program caused participants to develop policies to govern the selection or specification of energy-efficient equipment. Nearly 11% of lighting participants and 37% of mechanical participants indicated they had such policies. Of these, only one lighting participant (1%) and two mechanical participants (4%) indicated that these policies were established after participation in the program. The one lighting participant was unable to assess the influence of the program on adoption of the policy. For the three mechanical participants, the average influence of the program on these policies, on the same 11-point scale as used to describe spillover installations, was moderately strong at 7.6, with a standard error of 0.75. While rigorous estimates of the savings associated with these policy changes were not made, to the extent that there is such spillover, the net-to-gross ratio is underestimated.

Table 7.21 provides the kWh-weighted net-to-gross ratios by end-use and program. Mechanical participants included somewhat more free-riders than did lighting participants, yet mechanical participants had higher spillover savings. These offsetting adjustments resulted in identical net-to-gross ratios for lighting and mechanical when the influence of both free-rider and spillover effects are included. Program net savings impacts, discussed in the subsequent section, are calculated by multiplying the realized gross savings estimates by the realized net-to-gross ratio adjusted for both free-riders and spillovers (given in the far right column of the table.)

Table 7.21

NET-TO-GROSS RATIO WITH SPILLOVER ADJUSTMENTS

END USE	EXPECTED NET-TO-GROSS RATIO	REALIZED NET-TO-GROSS RATIO		
		FREE-RIDER ADJUSTMENT*	SPILLOVER ADJUSTMENT	FREE-RIDER + SPILLOVER ADJUSTMENT
Lighting	1.0	0.83	0.0004	0.83
Mechanical	1.0	0.80	0.03	0.83
Program	1.0	0.82	0.01	0.83

* *Free-Rider adjustment = (1 – FR), where FR = Free rider estimate.*

NET ENERGY IMPACTS

Using the method described in Chapter 6 and the net-to-gross ratios adjusted for free-rider and spillover effects, we calculated the Building Efficiency net energy impacts.

The net impact is 83% of gross. The net proportion was estimated independently for lighting and mechanical measures and coincidentally has the same value for both end uses. Table 7.22 reports the net electrical energy (kWh) impact estimates by end-use and for the program overall. Table 7.23 presents net therm impacts by end-use and for the program overall. The tables include several shaded rows. The measures in these rows comprise 80% of the end-use savings and were investigated onsite.

Table 7.22

NET ELECTRICAL ENERGY IMPACTS BY MEASURE

MEASURE TYPE	GROSS KWH IMPACT			NET KWH IMPACT		
	EXPECTED	REALIZED	GROSS REALIZATION RATE	NET-TO-GROSS RATIO	REALIZED	NET REALIZATION RATE
T8	7,618,286	7,120,527	93.5%	0.83	5,919,927	77.7%
CFL	2,176,262	1,902,849	87.4%	0.83	1,582,007	72.7%
T5	2,165,865	2,121,101	97.9%	0.83	1,763,460	81.4%
Delamping	537,158	500,513	93.2%	0.83	416,121	77.5%
Controls	376,024	350,372	93.2%	0.83	291,295	77.5%
Metal Halide	255,408	237,984	93.2%	0.83	197,857	77.5%
Quartz Lamp	237,291	221,103	93.2%	0.83	183,823	77.5%
LED Exit Sign	196,588	183,177	93.2%	0.83	152,291	77.5%
Metal Halide Pulse Start	187,817	175,004	93.2%	0.83	145,497	77.5%
High Pressure Sodium	113,581	105,833	93.2%	0.83	87,988	77.5%

Continued

MEASURE TYPE	GROSS KWH IMPACT			NET KWH IMPACT		
	EXPECTED	REALIZED	GROSS REALIZATION RATE	NET-TO-GROSS RATIO	REALIZED	NET REALIZATION RATE
Occupancy Sensor	80,863	75,347	93.2%	0.83	62,642	77.5%
Cold Cathode	11,259	10,491	93.2%	0.83	8,722	77.5%
Photo Cell	6,899	6,428	93.2%	0.83	5,344	77.5%
Other Fluorescent	5,238	4,881	93.2%	0.83	4,058	77.5%
Exit Other	105	98	93.2%	0.83	81	77.5%
Sub-Total Lighting	***13,968,644***	***13,015,707***	***93.2%***	***0.83***	***10,821,114***	***77.5%***
Controls	1,203,292	1,221,823	101.5%	0.83	1,019,999	84.8%
VFD	918,629	695,017	75.5%	0.83	580,212	63.2%
Aeration System	546,884	458,154	83.8%	0.83	382,475	69.9%
Chiller	388,248	388,248	100.0%	0.83	324,116	83.5%
Motor	377,267	291,846	77.4%	0.83	243,638	64.6%
Retro-Commissioning	378,716	420,423	111.0%	0.83	350,976	92.7%
Refrigeration Upgrade and Controls	352,052	320,309	91.0%	0.83	267,399	76.0%
Retaurant EMS	240,000	218,360	91.0%	0.83	182,291	76.0%
Arc Welder	149,472	135,995	91.0%	0.83	113,531	76.0%
Air Conditioning	87,047	79,198	91.0%	0.83	66,116	76.0%
Economizers	21,596	19,649	91.0%	0.83	16,403	76.0%
Custom HE Heat Pump	17,360	15,795	91.0%	0.83	13,186	76.0%
Compressor	5,869	5,340	91.0%	0.83	4,458	76.0%
Boiler	5,112	4,651	91.0%	0.83	3,883	76.0%
Ductwork	1,210	1,101	91.0%	0.83	919	76.0%
Sub-Total Mechanical	***4,692,753***	***4,275,907***	***91.1%***	***0.83***	***3,569,602***	***76.1%***
Grand Total	**18,661,397**	**17,291,614**	**92.7%**	**0.83**	**14,391,273**	**77.1%**

Note: Shaded measures were in the top 80% by expected kWh impact.

Table 7.23

NET THERM IMPACTS BY MEASURE

MEASURE TYPE	GROSS THERM IMPACT			NET THERM IMPACT		
	EXPECTED	REALIZED	GROSS REALIZATION RATE	NET-TO-GROSS RATIO	REALIZED	NET REALIZATION RATE
Controls	2,284	2,284	100%	0.83	1,907	83%
Retro-Commissioning	17,313	17,313	100%	0.83	14,453	83%
Restaurant EMS	3,750	3,750	100%	0.83	3,131	83%
Boiler	11,375	11,375	100%	0.83	9,496	83%
Ductwork	2,284	2,284	100%	0.83	1,907	83%
Water Heating	2,284	2,284	100%	0.83	1,907	83%
Swimming Pool Insulation	7,363	7,363	100%	0.83	6,147	83%
Air Conditioning	11,420	11,420	100%	0.83	9,534	83%
HVAC Heating Penalty	0	(11,458)	Negative	0.83	-9,565	Negative
Program Total	**58,073**	**46,615**	**80%**	**0.83**	**38,915**	**67%**

Note: Shaded measures were in the top 80% by expected kWh impact.

ESTIMATED IMPACT OF THE BUILDING EFFICIENCY PROGRAM ON EFFICIENT INSTALLATIONS IN OREGON

Another way of looking at the accomplishments of the Building Efficiency program in Oregon is to consider its effect on the total number of efficient lighting and mechanical projects in the state.[60]

As shown in Table 7.24, we estimate the net-to-gross ratio for both lighting and mechanical measures to be 0.83. Conversely, we estimate that 17% (1 - 0.83) of the

60 For simplicity, this discussion refers to the entire state of Oregon; more precisely, it concerns the territory served by the Energy Trust of Oregon.

savings acquired through the program would have occurred even had the program not been offered, and thus the program does not deserve credit for these savings.

Table 7.24

SUMMARY OF PROGRAM IMPACTS
PROJECTS COMPLETED BETWEEN 1/1/03 AND 3/31/04

CATEGORY	GROSS EXPECTED SAVINGS	GROSS REALIZATION RATE	NET-TO-GROSS RATIO	NET REALIZATION RATE	NET REALIZED SAVINGS
ELECTRICITY IMPACTS					
Sub-Total Lighting	13,968,644	93.2%	0.83	77.5%	10,821,114
Sub-Total Mechanical	4,692,753	91.1%	0.83	76.1%	3,569,602
Program kWh	18,661,397	92.7%	0.83	77.1%	14,390,716
THERM IMPACTS					
Program Therms	58,073	80.3%	0.83	67%	38,915

Stated differently, we estimate that 17% of all lighting and mechanical projects installed in the state are efficient in the absence of a program.[61] When the program is operating, the total energy-efficient installations statewide equals these installations plus the net installations attained through the program. It is of interest to consider the relative sizes of these two groups: efficient installations occurring absent the program and those occurring as a result of the program. Such a comparison illustrates the effect of the Building Efficiency program on the total number of efficient lighting and mechanical projects in the Energy Trust's service territory.

We contacted 2% of the state's nonresidential facilities by telephone in an extensive screening of nonparticipants to identify those that had installed lighting or

61 Seventeen percent of projects weighted by energy consumption. For the remainder of this section, the terms "proportion" and "number" of projects and installations should be understood to mean weighted tallies, weighted by the energy consumption of the installed equipment.

mechanical equipment during the program period.[62] Based on this screening, we are able to estimate the total numbers of lighting and mechanical equipment installed in Oregon during the period of interest:

- Just over 1% of facilities indicated having purchased lighting equipment during the period under investigation; similarly, just over 1% indicated having purchased mechanical equipment; some facilities may have purchased both types of equipment.
- Based on these findings, we estimate that 1,432 facilities purchased lighting equipment between January 1, 2003, and March 31, 2004. Of these:
    - 1,254 facilities did not participate in the program, yet 17% (213) installed energy-efficient equipment anyway.
    - 178 facilities participated; yet 17% (30) *would have* installed energy efficient equipment anyway.
- Thus, out of an estimated1,432 facilities that purchased lighting equipment during the investigation period, in the absence of the program 243 (=213 + 30; 17%) would have purchased efficient equipment. With the program, 391 (=213 + 178; 27%) installed efficient equipment. Thus, we estimate the program increased the proportion of efficient lighting installations by 61% (=391/243).
- Following a similar line of reasoning, we estimate the program increased the proportion of efficient mechanical installations by 22%, from 249 to 303, out of an estimated 1,467 mechanical installations during the period.

Oregon's economy was depressed during much of the investigation period, yet was rebounding during latter part of 2004. Given that the lighting network was well established by mid-2003, the growth in monthly BE lighting projects during the last nine months of 2004 can serve as a proxy for the growth in lighting and mechanical installations overall during that period. Yet the growth in monthly BE mechanical projects outstripped that of BE lighting projects, as the program increased its penetration into the mechanical sector. Following the same line of reasoning, and using the growth factor seen in BE lighting projects to proxy the growth in total

[62] We determined that we contacted 2% of facilities based on a count of total facilities in the Energy Trust's service territory as provided by InfoUSA, a vendor of commercial establishment data.

mechanical installations statewide, we estimate that during the last nine months of 2004, the program increased the proportion of efficient mechanical installations by over 40%, from 255 to 370 out of an estimated 1,500 mechanical installations during the period.

SUMMARY

Table 7.24 summarizes the Building Efficiency program's electricity (kWh) and therm impacts from inception in January 2003 through March 31, 2004, as found from the impact evaluation.

In addition to these findings, the evaluation team's review of the documentation for mechanical custom projects found almost one-third of the 21 project files reviewed to be unsatisfactory. The files for 8 of 21 custom mechanical projects, as well as 66% of lighting project files, lacked estimates of project demand impacts. Further, the documentation supporting two custom mechanical projects contained errors that were evident from the paper review, prior to the field investigation; documentation supporting a third custom mechanical project contained an error that arguably could have been discovered during the project review phase (the operating schedule for one motor was incorrectly assumed to apply to all four proposed motors).

The organization of the information in the custom mechanical files made finding the data needed for impacts estimation to be difficult and time consuming. The files lacked a summary statement describing the equipment to be installed and removed, the current and expected energy consumption and demand, the expected energy and demand savings, and the equipment operating characteristics used to estimate the savings.

Based on our survey of over 5,000 nonparticipating commercial establishments, we are able to estimate the total market for lighting and mechanical installations during the evaluation period and the increased share of efficient projects that resulted from program activities. We estimate the Building Efficiency program increased the penetration of efficient lighting projects in the Energy Trust service territory in 2003-2004 by about 60% more than the penetration would have been in the absence of the program (from 17% to 27% of total installations weighted by project size in kWh). It increased the penetration of efficient mechanical projects by about 20% (from 17% to 21%) from January 2003 through March 2004. In addition, between April and December 2004, BE mechanical projects increased at a much faster rate than BE lighting projects, as shown in Table 6.1 of the preceding chapter. Using a proxy to estimate the growth in the overall mechanical market, we estimate that during the last nine months of 2004, the Building Efficiency program increased the penetration of efficient mechanical projects by about 40% (from 17% to 25% of total installations weighted by project size).

8. CONCLUSIONS AND RECOMMENDATIONS

According to the program tracking database, by the end of December 2004, the Building Efficiency program had installed 796 projects saving 51,253,725 kWh (about 5.9 aMW) and 135,500 therms. The delivered savings exceed the terms of the PMC's 2003-2004 contract with the Energy Trust, which calls for electricity savings of 5.5 aMW. On an annual basis, the 2004 electricity savings are twice the 2004 goal. Considering all projects regardless of their stage of completion, BE projects in the pipeline as of the end of 2004 totaled about 12.0 aMW and 322,567 therms.

Energy Trust staff are pleased and PMC staff justifiably proud of these accomplishments. The 2004 achievements result from the activities of the PMC to engage large institutional customers and, more importantly, the trade ally community in energy efficiency solutions. Because the trade ally community was engaged, as Oregon's economy improved throughout 2004, the rate of Building Efficiency projects increased as well. The rate of incoming mechanical projects outstripped that of lighting projects in the latter half of 2004 as the program increased its outreach to mechanical contractors.

Participating customers, mechanical contractors and ATACs expressed high overall satisfaction with the program and with the participation processes. Two-thirds of those participants who had previously participated in an efficiency program favorably compared their experiences with the Building Efficiency program to their prior experiences. Respondents believed the program's overall simplicity is its strength. Many respondents had favorable impressions of the PMC staff, although a few ATACs reported experiencing some problematic aspects in their relationship with the PMC. Contractors appreciated the PMC's efforts to reduce the burden of paperwork and hoped the PMC would continue to streamline the process. When ATACs expressed concerns, they tended to focus on larger issues: program marketing, the viability of the Energy Trust and the prospect of a different PMC being selected in the fall of 2005.

The current evaluation has three primary objectives:

- To provide a process evaluation update for the program after two years of operation;
- To develop adjusted savings estimates for completed projects and the associated program gross realization rate; and

- To estimate the extent of free-ridership and spillover effects, and the associated net realization rate.

We organize our conclusions into program processes (addressing the first objective), and program impacts (addressing the second and third objectives).

Our recommendations follow our conclusions.

CONCLUSIONS

Process Evaluation Update

The following discussion addresses a number of program research issues Energy Trust staff discussed with the team concerning the evaluation, namely:

1. Have there been any changes in the program in response to the findings and recommendations of the first process evaluation?
2. Are vendors informing their customers of the state tax credits available for energy efficiency?
3. How well is the program reaching the mechanical market?
4. How well is the model working of using a PMC for program delivery?
5. How well is the model working of relying primarily on market actors (vendors) for program delivery and secondarily on program staff (PMC)?

1. Have there been any changes in the program in response to the findings and recommendations of the first process evaluation?

Changes have occurred in response to the first process evaluation findings; further changes are warranted. Chapter 1 of this report lists the recommendations from the first process evaluation and summarizes the responses to these recommendations given by Energy Trust staff to the Board of Directors on December 11, 2003. Our conclusions regarding the status of these recommendations and remaining challenges follow:

> *Prior Recommendation: Develop a sales plan to be funded by additional resources*. The steps reported by Energy Trust staff to the Board have occurred. The PMC has hired a network coordinator for the mechanical sector and, on an ongoing basis, has been working with Energy Trust staff to

develop strategies to cost-effectively penetrate the equipment replacement market. The acquired savings—in excess of the goal—testify to the success of these activities. According to mechanical vendors and Energy Trust and PMC staff, the mechanical network coordinator is very active and effective in building the network and inducing program participation.

Successful program marketing creates its own challenges. Current program challenges include the following:

a. The Technical Manager, who is responsible for approving custom mechanical projects, reports a backlog of about 200 projects. Although he did not express a need for additional staffing assistance, he stated he advises participants to "be a squeaky wheel" to get his more rapid attention. The most common concern expressed by ATACs and participating mechanical contractors was their perception that the Technical Manager role is understaffed; they reported particularly slow project turn-around times at the end of 2004, as the VFD "sale" (higher promotional incentive) was set to expire.

b. The lighting network coordinator envisions additional support the program could provide to lighting vendors were it not constrained by staffing limitations.

c. PMC staff fear running out of incentive money, as the program entered 2005 with 80% of its unspent incentive money already committed. Energy Trust staff are aware of the need to increase the incentive budget.

Prior Recommendation: Direct the activities of, and change the "culture" of, Energy Trust administrative staff to provide fast, customer-focused response to Energy Trust staff responsible for programs. The steps reported by Energy Trust staff to the Board have occurred in part. One major set of policy issues—risk management—is described by staff as having been resolved. The current evaluation has no findings bearing on this issue, as no major contracting activities have occurred in the interim. The contracting scheduled to occur in the latter half of 2005 to implement the program for the next several years will be a test of how satisfactorily these issues have been resolved.

The Energy Trust staff also reported to the Board that "legal resources specializing in energy efficiency-related contracts and forms are now being utilized." Consistent with this response, Energy Trust program staff report high satisfaction with the support they now receive from the legal department. The PMC noted some improvement, yet also noted the negotiations for its contract extension spanned September through December.

All contacts who have interacted with the newly hired Energy Trust Program Manager expressed praise for his responsiveness and understanding of issues facing the Building Efficiency program.

PMC staff continued to identify areas in which the support of the Energy Trust has lagged behind program needs:

a. Although the program began offering gas efficiency incentives in mid-2003, the Energy Trust has approved what PMC staff characterize as a limited number of prescriptive gas measures, including only two measures targeting the restaurant sector. PMC staff believe a shortage of prescriptive measures has hampered program penetration into the gas-fired equipment market.

b. PMC staff also expressed feeling disappointed by lack of Energy Trust response to a PMC-proposed software tool intended to assist vendors and participants develop incentive applications for efficient motors.

c. A need for better coordination between the Energy Trust and the PMC is evidenced by the Energy Trust rewarding high-performing vendors of packaged AC equipment with bonus checks without having first notified the PMC.

d. Regarding program policy, the objectives of reducing the cost of delivered savings and increasing the program's reach, while both admirable, have conflicting implications for PMC-directed activities. The Energy Trust has encouraged the PMC to meet both objectives, yet has not worked with the PMC to address aspects of the program—such as the inclusion of non-energy benefits in the cost-effectiveness screening and a single contract performance indicator—that complicate the attainment of these conflicting objectives.

Prior Recommendation: Clarify technical analysis contractor confusion about the Building Efficiency program and about their role in program delivery. The steps reported by Energy Trust staff to the Board have occurred in large part, and ATACs do not report continued confusion. Meetings have been held with ATACs, although individual interviews have not occurred, nor has a program operations guide been compiled. A majority of ATACs report their participation in the program has met their expectations.

The program's design called for ATACs to actively market their program services—an implementation approach ATACs were not experienced with and did not understand at the time of their initial program involvement, when the first evaluation was conducted. The current evaluation found that ATACs actively market their services and are responsible for generating a majority of the work they conduct for the program.

ATACs are satisfied with the direction they have received from the PMC regarding their studies and the usefulness of project forms. They do not report a need for additional guidance, such as a written guide. The impact evaluation team, however, found the evaluation task was made more difficult and delayed by the disorganization of a portion of custom mechanical project documents (including those prepared by ATACs) and all custom mechanical files' lack of a project summary identifying key assumptions.

Prior Recommendation: Follow up with customers who contacted the Energy Trust about efficiency programs prior to the launch of Building Efficiency. The response of Energy Trust staff to the Board fully addressed this issue and no problems remain.

2. *Are vendors informing their customers of the state tax credits available for energy efficiency?*

Vendors are informing their customers about the energy efficiency tax credits. Four-fifths (80%) of participants were aware of BETC tax credits; half that many were aware of the state's loan program, SELP. Participants frequently learned of BETC and SELP from their contractors, but also became informed through other channels. Participating firms described little interest in the loan program. PMC staff describe having a good working relationship with State of Oregon staff that administer the tax credit and loan programs, a marked improvement from the program's early days. Some participating contractors expressed a desire for a single set of forms that would satisfy the needs of both the Building Efficiency and the BETC programs, or for greater consistency between forms.

3. How well is the program reaching the mechanical market?

The program is reaching the mechanical market and is on target to achieve desired mechanical savings, although some program issues continue to affect market penetration. Mechanical projects accounted for 46% of the savings completed in 2004, up from 32% of the savings completed in 2003, and are expected by PMC staff to account for about 60% of savings in 2005, the target that Energy Trust program design staff had hoped the program might achieve.

Issues identified in preceding subsections continue to impact the penetration of the mechanical market: 1) a limited number of prescriptive gas-fired efficiency measures, especially for restaurants; 2) the need for an Energy Trust-approved software tool vendors' use in developing motor applications; 3) the likelihood of delays in custom project approval if the rate of applications exceeds the capacity of the staff; and 4) the prospect of a shortfall in incentive funds.

4. How well is the model working of using a PMC for program delivery?

The current PMC model has served the program well. The use of a PMC for program delivery has, as the Energy Trust anticipated when it created the role, enabled the program to launch quickly and effectively, without adding to Energy Trust staff. Regarding the specific firm serving as program PMC, it has, by all accounts, hired good staff and program contractors (ATACs). The program achievements after 18 months of implementation speak to the success of program delivery by the PMC.

Even so, there are areas where improvement could be made. The PMC had a less than satisfactory performance regarding the documentation of custom mechanical projects, as judged by the evaluation team. The evaluation team considered almost one-third of the 21 custom mechanical project files reviewed to be unsatisfactory. Further, the documentation supporting two custom mechanical projects, and arguably that for a third project, contained errors that were evident from the paper review, prior to the field investigation. Finally, the efforts of the impact evaluation team were hindered and protracted because the project files lack a summary statement describing the equipment to be installed and to be replaced, current and expected energy consumption and electricity demand and expected savings in both, and key assumptions supporting the savings estimates, such as operating hours and motor loadings.

The condition of the files reflects tradeoffs the PMC makes to administer the program within its budget and deliver the savings specified in its contract.

5. How well is the model working of relying primarily on market actors (vendors) for program delivery and secondarily on program staff (PMC)?

The program's primary reliance on market actors (consultants, contractors and vendors) to promote energy-efficient, program-qualifying equipment appears to be successful.

The program's use of lighting and mechanical contractor networks appears to be succeeding in drawing contractors into the program, educating them about efficient equipment, continuing to motivate their participation and keeping them informed of program developments. Currently, the PMC has assigned one FTE (full-time equivalent) staff to coordinate each network. In addition, the PMC has assigned one FTE to work with large commercial establishments (primarily institutions) and large vendors to promote and coordinate complex projects.

The lighting network built on a network previously established by PacifiCorp and was generating contractor involvement early in the program. The mechanical network had no pre-existing network to build on and did not become an effective tool for bringing commercial projects to the program until the latter half of 2004.

ATACs constitute both program staff and market actors. They conduct technical analysis studies of potential projects, paid for by the PMC and thus conducted in their role as program staff. Yet the firms hired to serve as ATACs are consulting engineering firms or energy professionals. The majority of the studies conducted by the ATACs are, by their own assessment, for projects they have brought to the program. Thus, the ATACs comprise another route by which projects are brought to the program and the program is successfully delivered through market actors.

The evaluation team jointly analyzed the responses to a series of questions posed to program participants as one means of assessing the reasonableness of the design hypothesis that market actors can be the principal means of delivering the program. The evaluation team estimated that contractors for about 25% to 50% of participants actively marketed the program to these firms. Remaining participants either learned of the program from sources other than their contractors or learned through conversations they initiated with their contractors.

The evaluation team found indications that some contractors do not understand the scope and flexibility of custom incentives. In addition, five of the seventeen interviewed contractors mentioned problems caused by lack of availability of qualifying equipment. They indicated the supply of qualifying equipment was limited due to low inventory levels at distributors and low manufacturing levels, creating what was described as a "constant problem." Of the five contractors describing a lack of equipment availability, two were firms offering engineering services and installation of chillers and cooling towers, two were distributors, and one sold packaged HVAC systems.

ATACs report instances where participants have reduced the project scope from addressing several building systems to addressing a single system, to avoid being reassigned to the New Building Efficiency program, which offers lower incentives.

The program pays custom mechanical projects 35% of total cost. PMC staff believe that a portion (35% or higher, perhaps) of *incremental* cost would be sufficient to motivate the market and would reduce the cost of energy savings. Staff would want the definition of "incremental" to include the replacement of an entire system as an alternative to replacing a key malfunctioning component (e.g., a burned out compressor in a seven-year-old chiller), where incremental cost would be defined as the entire system cost minus the cost of the replacement component. Projects that pass cost-effectiveness criteria using such a definition of incremental cost should be eligible for incentives. If the program were to maintain incentives calculated on total project cost, PMC staff believe a 30% incentive likely would continue to motivate the market.

Impact Evaluation Conclusions

Table 8.1 summarizes the Building Efficiency program's electricity (kWh) and therm impacts from its inception in January 2003 through March 31, 2004, as found from the impact portion of the evaluation. The program tracking database gives expected savings for these projects of 18,661,397 kWh and 58,073 therms. Based on our on-site investigations of the projects comprising 80% of these savings, we estimate that the program's gross realized energy savings equal 93% of estimated kWh and 80% of estimated therms. These estimates account for interactive effects from lighting efficiency measures: decreased cooling loads and increased heating loads.

We estimated free-rider and spillover effects from participants' self-report of their actions and intentions. We cross-checked the free-rider estimates based on self-report with information available from other sources, including the actions of nonparticipants and an investigation of project paybacks. Based on these analyses, we determined a net-to-gross ratio of 83%. This single value was calculated independently for lighting and mechanical measures (electric and gas); it is a coincidence that the net-to-gross ratio for the two end uses is identical.

Table 8.1

SUMMARY OF PROGRAM IMPACTS OF PROJECTS COMPLETED BETWEEN 1/1/03 AND 3/31/04

CATEGORY	GROSS EXPECTED SAVINGS	GROSS REALIZATION RATE	NET-TO-GROSS RATIO	NET REALIZATION RATE	NET REALIZED SAVINGS
ELECTRICITY (KWH) IMPACTS					
Sub-Total Lighting	13,968,644	93.2%	0.83	77.5%	10,821,114
Sub-Total Mechanical	4,692,753	91.1%	0.83	76.1%	3,569,602
Program Energy	18,661,397	92.7%	0.83	77.1%	14,390,716
THERM IMPACTS					
Program Therms	58,073	80%	0.83	67.0%	38,915

Given the gross realization adjustment and the adjustment for free-riders and spillover, the program's energy net realization rate are 77% for kWh and 67% for therms. We estimate program net savings to be 14,390,716 kWh (1.65 aMW) and 38,915 therms. Applying these energy net realization rates (calculated for projects completed through March 2004) to the savings of all completed projects as reported by the program tracking database through 2004 yields program net energy savings of 4.6 aMW and nearly 91,000 therms for the 2003-2004 period.

The program tracking database reported demand savings for one-third of the completed lighting projects and 13 of the 21 completed custom mechanical projects. The evaluators were able to estimate expected demand savings for the lighting projects without data, but not for the custom mechanical projects that lacked demand savings estimates. Thus, the study produced no estimate of program demand savings.

We estimate the Building Efficiency program increased the penetration of efficient lighting projects in the Energy Trust service territory in 2003-2004 by about 60% more than the penetration would have been in the absence of the program (from 17% to 27% of total installations weighted by size in kWh). The penetration of efficient mechanical projects by about 20% (from 17% to 21%) during the period January 1, 2003, to March 31, 2004. Between April 1 and December 31, 2004, BE mechanical projects increased at a much faster rate than BE lighting projects. We estimate that during the last nine months of 2004, the Building Efficiency program increased the penetration of efficient mechanical projects in the Energy Trust service territory by about 40% more than the penetration would have been in the absence of the program (from 17% to 25% of total installations weighted by size in kWh).

RECOMMENDATIONS

1. The Energy Trust should ensure the Building Efficiency incentive budget is sufficient to support qualified applications.

From the program's outset, Energy Trust staff have recognized the importance of an uninterrupted stream of incentive money to support qualified applications. Now that the Building Efficiency program has succeeded in involving market actors (consultants, contractors and vendors) as its key delivery agents, the Energy Trust must ensure it funds the projects these market actors generate. An interruption in incentives likely would greatly undermine the contractor networks and have repercussions for years to come.

2. The PMC should develop a summary sheet for each custom mechanical project describing: the equipment to be changed out, its consumption, demand and operating parameters; the equipment to be installed, its consumption, demand and operating parameters; and the expected energy and demand savings.

The impact portion of the evaluation was slowed and potentially compromised by the lack of such a summary sheet for each custom project. In some cases, the evaluation team was unable to identify the equipment actually installed prior to talking onsite with the participant, as the project files contained multiple options, the characteristics of which (e.g., expected savings) matched none of the project information in the program tracking database.

3. The Energy Trust and PMC should continue efforts to streamline program application forms and provide tools to assist in project and application development.

Notwithstanding the praise offered by many contractors, vendors and participants regarding program processes and forms, respondents identified room for continued improvement. Requests were made for spreadsheet tools for additional prescriptive incentives and for forms to be made available on the program website that can be filled out and submitted electronically for mechanical projects, similar to the forms the PMC created in 2004 for lighting projects. PMC staff noted that the Energy

Trust has let one proposed tool for motor vendors remain unapproved for over a year.

4. The Energy Trust should investigate the savings from custom mechanical projects completed between March 31, 2004, and December 31, 2005.

The evaluation team had concerns with the documentation of nearly one-third of 21 projects completed before March 31 and investigated for the impact portion of the evaluation. In addition, the documents for two, and arguably three, projects contained errors that were evident from a file review, prior to a field visit. The Energy Trust should undertake a review of a much larger number projects and determine whether change is warranted in any of the program implementation procedures. The assessment should consider whether the quality of project documentation differs systematically throughout that prepared by ATACs, by vendors and by customers.

5. The Energy Trust should review indicators relating to whether the PMC Technical Manager role is understaffed and should consider how the structure of the PMC's contract affects project quality control.

Energy Trust staff should conduct an ongoing review of data (such as frequency distributions) indicating the elapsed time from the submission of a custom mechanical application to the award of incentives. The PMC should track the information necessary to support such a review. In addition, Energy Trust staff should seek the opinion of PMC staff as to the adequacy of the staffing level, as well as seek feedback on this and other program issues from occasional direct interactions with ATACs, vendors and participants.

The Energy Trust should also give thought to the PMC's current contract terms and the tension they create for the PMC in its efforts to minimize administrative costs while maintaining project quality control. The PMC's contract with the Energy Trust sets program savings as the PMC's performance goal, and the upcoming contract to be let in 2005 will contain an incentive for reducing the levelized cost of savings. In addition, the Energy Trust asks the PMC to broaden the scope of participants by reaching traditionally underserved customers. Because the main driver of levelized savings cost—the measure cost-effectiveness screen—is outside of the PMC's control, the PMC will be able to meet these objectives only by devoting its staffing resources to developing new marketing approaches and implementation tools. As the Technical Manager has expertise directly relevant to these areas, he will no doubt be pulled in additional directions. Were this to occur, its likely consequences include reduced project scrutiny and longer average time to approve mechanical projects.

Thus, it is imperative that the Energy Trust carefully consider the methods the PMC might be expected to use to accomplish what the Trust asks of it, the structure of the PMC's financial rewards and the controls in place to ensure project quality.

6. The Energy Trust should consistently enter the utility account number (electricity or gas, as relevant to the project) of each Building Efficiency participant into its program tracking system and should develop a mapping of service territory zip codes to NOAA weather stations.

The current impact evaluation was unable to examine participants' energy use for the 12 months prior to participation. Such an examination enables the evaluators to conduct a consistency check on the estimated annual savings by considering whether savings as a percent of total annual energy use is a reasonable number. We understand this problem the Energy Trust is currently working to enter the needed data.

A mapping of service territory zip codes to NOAA weather stations would enable evaluators to match the most appropriate heating and cooling-degree days to each participant. NOAA weather station data would be useful in interpreting estimates of HVAC-related savings from the project engineering algorithms, as well as from any regression models used in an impact evaluation. Such data can also be incorporated into energy use simulation models, such as DOE-2. We recommend that the Trust subscribe to the data for each of the relevant NOAA weather stations so that these data can be downloaded monthly.

APPENDICES

APPENDIX A

Sampling Plan for Lighting Participant On-Site Investigations

Appendix A: Sampling Plan for Lighting Participant On-Site Investigations

SAMPLING PLAN FOR LIGHTING PARTICIPANT ON-SITE INVESTIGATIONS

We begin by reminding the reader of the approach to estimating the realization rate. Based on the engineering reviews and site visits, any necessary adjustments were made to our estimates of kWh and kW impacts. The equation below illustrates how the ratio approach (Cochran 1977) was used to adjust the savings for the population of projects based on the on-site inspections and engineering reviews of randomly sampled projects.

$$\hat{Y}_R = \frac{\bar{y}}{\bar{x}} X \qquad (1)$$

where

$\hat{Y}_R$ = Ratio estimate of total kWh and kW in the population of sites

X = Total kWh and kW impacts for population of projects as reported in program files

$\bar{x}$ = Sample mean kWh and kW impacts as reported in project files

$\bar{y}$ = Sample mean kWh and kW impacts estimated by the evaluation team

From Equation 1, we can see that the total kWh and kW impacts for the population of Building Efficiency lighting projects, X, was adjusted using the ratio of the mean kWh and kW impacts for the sampled units estimated by the evaluation team to the mean kWh and kW impacts estimated by the program.

Because we expected the ratios to differ by size of the project, we stratified the sample by size of the *ex ante* savings for each site. The sample size for on-site and engineering review is driven both by the size of the evaluation budget and the need for reasonable statistical confidence and precision. The sample size was determined, using the equation below, to meet these two criteria, including the targeted confidence level of 90%, with an allowable relative error of 10% (Levy & Lemeshow 1999).

$$n = \frac{z^2 \times N \times (V_x^2 + V_y^2 - 2\rho_{xy} \times V_x V_y)}{z^2 \times (V_x^2 \times V_y^2 - 2\rho_{xy} \times V_x V_y) + (N-1)\varepsilon^2} \qquad (2)$$

where

- $z =$ The standard normal deviate for the given confidence level, specified as 1.645 for the 90% confidence
- $N =$ The population of projects
- $V_x^2 =$ The square of the coefficient of variation for x defined as $\frac{[(N-1)/N]s_x^2}{\hat{\bar{x}}^2}$ where s_x^2 is the variance of x and $\hat{\bar{x}}^2$ is the square of the estimated mean of x
- $V_y^2 =$ The square of the coefficient of variation for y defined as $\frac{[(N-1)/N]s_y^2}{\hat{\bar{y}}^2}$ where s_y^2 is the variance of y and $\hat{\bar{y}}^2$ is the square of the estimated mean of y
- $\rho_{xy} =$ Assumed simple correlation between x and y (assumed to be 0.80)
- $\varepsilon^2 =$ The square of allowable relative error in the estimate of the ratio (0.15)

We assumed a coefficient of variation of 0.75 for the estimated ratios and a correlation of 0.80 between the *ex ante* and *ex post* estimates of savings. Using these assumptions, a sample size of 47 is required. We chose a slightly larger number of 50 on-sites.

To establish an efficient sample, we developed a sampling strategy for estimating a known surrogate parameter, the *ex ante* savings, which is hypothesized to be related to the ratio. We defined strata boundaries using the Dalenius-Hodges technique (Cochran 1977) and proceeded to draw samples that allowed us to achieve the 90/10 level of precision for estimates of *ex ante* savings.

Determination of Strata Boundaries

The Dalenius and Hodges (1959) method begins with the creation of numerous and narrow strata. Within each stratum, the frequency of coupons, f(y), is calculated. Next, the square root of *f(y)*, $\sqrt{f(y)}$, is calculated and the cumulative of $\sqrt{f(y)}$ is formed. The total of cum $\sqrt{f(y)}$ is then divided by the number of desired strata to determine the division points on the cum $\sqrt{f(y)}$ scale.

The above rule assumes equal widths *d* for the class intervals and it must be modified when the class intervals have variable widths d_y. The approach recommended by Kish (1965) is to multiply the *f(y)* by the width of the interval, take the square root of this value and cumulate the values $\sqrt{d_y f(y)}$. Finally, as in the

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above case, the total of cum $\sqrt{d_y f(y)}$ is then divided by the number of desired strata to determine the division points on the cum $\sqrt{d_y f(y)}$ scale.

Optimal Allocation

Once strata boundaries were determined, an allocation scheme was used which estimated the population mean with the lowest variance for a fixed total sample size *n* under stratified random sampling. Such a scheme is the Neyman allocation, as described in Cochran (1977).

$$n_h = n \frac{N_h s_h}{\sum N_h s_h} \qquad (3)$$

where

N_h = The total number of units in stratum h

n_h = The number of units in the sample of stratum h

n = The total number of units in the sample across all strata

s_h = The variance within stratum h

This formula for optimal allocation may produce an n_h in some stratum that is larger than the corresponding N_h. This problem arises in the BE program sample since the overall sampling fraction is large and some strata are much more variable than others. If the original allocation gives, for example, a n_1 that is greater than N_1 then Equation 4 is revised as follows:

$$n_h = (n - N_1) \frac{N_h s_h}{\sum_{2}^{L} N_h s_h} \qquad (4)$$

The variability of the top strata was sufficiently large that this problem arose. The solution was to take all ten cases in this stratum, which further modified the formula for allocation as follows:

$$n_h = (n - N_1 - N_2) \frac{N_h s_h}{\sum_{3}^{L} N_h s_h} \qquad (5)$$

We reallocated the remaining 40 cases equally across the remaining two strata.

Calculation of Mean

Once the sample is selected, the mean is then calculated as:

$$\bar{y}_{st} = \sum_{h=1}^{L} W_h \bar{y}_h \qquad (6)$$

where

$W_h = \frac{N_h}{N}$ Which is the stratum weight

$\bar{y}_h$ = The mean of y (the ratio) for stratum h

$\bar{y}_{st}$ = The mean resulting from a stratified random sample (*st* for *stratified*)

Confidence Intervals

Both the 80% and 90% confidence intervals for the ratios were calculated for the ratio for the j^{th} measure group *within* each stratum. Since these are the critical ratios, these confidence intervals were calculated in two steps. First, the variance of the ratio was estimated using the following equation:

$$s_h^2 = \frac{(1-f)}{n\bar{x}^2}(s_y^2 + \hat{R}^2 s_x^2 - 2\hat{R} s_{yx}) \qquad (7)$$

where

s_h^2 = Variance of the ratio with stratum h

$\hat{R} = \frac{\bar{y}}{\bar{x}}$, the ratio in stratum h

f = Sampling fraction in stratum h

n = Size of sample in stratum h

$\bar{x}$ = Mean of gross ex *ante* impacts in stratum h

$\bar{y}$ = Mean of gross ex *post* impacts in stratum h

s_x^2 = Variance of the gross ex *ante* impacts in stratum h

s_y^2 = Variance of the gross ex *post* impacts in stratum h

s_{yx} = Covariance of the gross ex *ante* and ex *post* impacts in stratum h

Calculation of Variance of the Mean

The variance of the ratio within each stratum was then substituted in Equation 5 to calculate an unbiased estimate of the variance of $\bar{y}_{st}$:

$$s^2(\bar{y}_{st}) = \sum_{h=1}^{L} \frac{W_h^2 s_h^2}{n_h} - \sum_{h=1}^{L} \frac{W_h s_h^2}{N} \quad (8)$$

Note that the second term in Equation 8 represents the finite population correction.

Calculation of Confidence Intervals

The formula for the confidence intervals is:

$$\bar{y}_{st} \pm ts(\bar{y}_{st}) \quad (9)$$

where

t = The critical value from the t distribution

s = The standard error of $\bar{y}_{st}$ (i.e., $\sqrt{s^2(\bar{y}_{st})}$)

The critical values for the 90% and 95% levels of confidence are 1.64 and 1.96, respectively.

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APPENDIX B

Lighting/HVAC Interactive Effects

Appendix B: Lighting/HVAC Interactive Effects

LIGHTING/HVAC INTERACTIVE EFFECTS

Lighting equipment affects the conditioned space temperature. When the lights are on, they shed heat to the surrounding space. This both increases the cooling load and decreases the heating load on the HVAC (heating, ventilating and air conditioning) system. When a lighting retrofit occurs, there typically is a reduction in heat to the same space. This causes the HVAC to work less in the summer—thereby decreasing the energy use; and work harder in the winter—thereby increasing the energy use. These "interactive" effects and their estimation are discussed in the *American Society of Heating, Refrigeration, and Air Conditioning Engineers* (ASHRAE) *Journal*.[63] This estimation approach was used subsequently to analyze HVAC interactive effects for a large commercial lighting evaluation in California in 1997.[64]

This evaluation used the information from the ASHRAE article to calculate HVAC interactions for the onsite audited lighting sites. Because of an oversight by the evaluation engineer, the information on the HVAC systems at the audited sites was not gathered during the onsite audits. Knowing what type of fuel is used for the heating system and the presence of an air conditioning system is required to properly apply the heating and cooling fractions in the ASHRAE article. Information from *Assessment of the Commercial Building Stock in the Pacific Northwest*[65] was used to apply the percent of sites with cooling and the percent of sites with electric and natural gas fuel use for heating. The percentages were applied based on building type as shown in the table below.

63 *Calculating Lighting and HVAC Interactions*. Rundquist, Robert, Johnson, P, and Aumann, D. ASHRAE Journal November 1993. P. 28-37.

64 *Evaluation of Pacific Gas & Electric Company's 1995 Nonresidential Energy Efficiency Incentives Program for Commercial Lighting Technologies*. Quantum Consulting. March 1, 1997.

65 Northwest Energy Efficiency Alliance. March 8, 2004

BUILDING TYPE	PERCENT OF FLOOR SPACE COOLED	PERCENT OF FLOOR SPACE HEATED BY NATURAL GAS	PERCENT OF FLOOR SPACE HEATED BY ELECTRICITY
Retail	0.79	0.73	0.23
Grocery	0.94	0.50	0.35
Office	0.92	0.43	0.51
Restaurant	0.90	0.66	0.27
Warehouse	0.34	0.87	0.11
Hotel	0.84	0.32	0.63
School	0.41	0.85	0.11
Other	0.57	0.73	0.25

There are Oregon five cities in the ASHRAE article that have a cooling and heating fraction. The actual audited sites were mapped to the nearest city. That and the other applicable variables used in the calculation of the HVAC interactions are shown below.

PROJECT NUMBER	FACILITY TYPE	ACTUAL FACILITY CITY	MAPPED FACILITY CITY	COOLING FRACTION	HEATING FRACTION	PERCENT OF ELECTRIC HEAT	PERCENT OF NATURAL GAS	PERCENT WITH AC
BE0004	Warehouse	Portland	Portland	0.27	0.14	0.11	0.87	0.34
BE0011	Grocery	Klamath Falls	Medford	0.37	0.19	0.35	0.50	0.94
BE0025	Office	Beaverton	Portland	0.27	0.14	0.51	0.43	0.92
BE0038	Grocery	Prineville	Burns	0.3	0.35	0.35	0.50	0.94
BE0049	Retail	Aloha	Portland	0.27	0.14	0.23	0.73	0.79
BE0059	Grocery	Albany	Eugene	0.26	0.14	0.35	0.50	0.94
BE0066	Retail	Redmond	Burns	0.30	0.35	0.23	0.73	0.79
BE0080	Other	Lake Oswego	Portland	0.27	0.14	0.25	0.73	0.57
								Continued

PROJECT NUMBER	FACILITY TYPE	ACTUAL FACILITY CITY	MAPPED FACILITY CITY	COOLING FRACTION	HEATING FRACTION	PERCENT OF ELECTRIC HEAT	PERCENT OF NATURAL GAS	PERCENT WITH AC
BE0084	Retail	Portland	Portland	0.27	0.14	0.23	0.73	0.79
BE0090	Retail	Seaside	Portland	0.27	0.14	0.23	0.73	0.79
BE0094	School	Tualatin	Portland	0.27	0.14	0.11	0.85	0.41
BE0100	Office	Wilsonville	Portland	0.27	0.14	0.51	0.43	0.92
BE0157	Other	Portland	Portland	0.27	0.14	0.25	0.73	0.57
BE0166	Retail	Philomath	Eugene	0.26	0.14	0.23	0.73	0.79
BE0174	Office	Portland	Portland	0.27	0.14	0.51	0.43	0.92
BE0187	Restaurant	Salem	Portland	0.27	0.14	0.27	0.66	0.90
BE0223	Restaurant	Portland	Portland	0.27	0.14	0.27	0.66	0.90
BE0225	Restaurant	Clackamas	Portland	0.27	0.14	0.27	0.66	0.90
BE0234	Retail	Aloha	Portland	0.27	0.14	0.23	0.73	0.79
BE0238	Office	Portland	Portland	0.27	0.14	0.51	0.43	0.92
BE0247	Retail	Salem	Portland	0.27	0.14	0.23	0.73	0.79
BE0269	Restaurant	Medford	Medford	0.37	0.19	0.27	0.66	0.90
BE0272	Restaurant	Medford	Medford	0.37	0.19	0.27	0.66	0.90
BE0273	Restaurant	Medford	Medford	0.37	0.19	0.27	0.66	0.90
BE0306	Hotel	Portland	Portland	0.27	0.14	0.63	0.32	0.84
BE0353	Office	Chiloquin	Medford	0.37	0.19	0.51	0.43	0.92
BE0354	Office	Klamath Falls	Medford	0.37	0.19	0.51	0.43	0.92
BE0360	Office	Portland	Portland	0.27	0.14	0.51	0.43	0.92
BE0384	Office	Roseburg	Medford	0.37	0.19	0.51	0.43	0.92
BE0388	Office	Portland	Portland	0.27	0.14	0.51	0.43	0.92

Continued

PROJECT NUMBER	FACILITY TYPE	ACTUAL FACILITY CITY	MAPPED FACILITY CITY	COOLING FRACTION	HEATING FRACTION	PERCENT OF ELECTRIC HEAT	PERCENT OF NATURAL GAS	PERCENT WITH AC
BE0401	Office	Lake Oswego	Portland	0.27	0.14	0.51	0.43	0.92
BE0406	Office	Tualatin	Portland	0.27	0.14	0.51	0.43	0.92
BE0408	Office	Gresham	Portland	0.27	0.14	0.51	0.43	0.92
BE0456	Office	Portland	Portland	0.27	0.14	0.51	0.43	0.92
BE0482	Retail	Klamath Falls	Medford	0.37	0.19	0.23	0.73	0.79
BE0483	Retail	Klamath Falls	Medford	0.37	0.19	0.23	0.73	0.79
BE0491	Office	Portland	Portland	0.27	0.14	0.51	0.43	0.92
BE0499	Restaurant	Salem	Portland	0.27	0.14	0.27	0.66	0.90
BE0520	Office	Portland	Portland	0.27	0.14	0.51	0.43	0.92
BE0526	Hotel	Lebanon	Eugene	0.26	0.14	0.63	0.32	0.84
BE0530	Grocery	Portland	Portland	0.27	0.14	0.35	0.50	0.94
BE0564	Office	Medford	Medford	0.37	0.19	0.51	0.43	0.92
BE0572	Office	Beaverton	Portland	0.27	0.14	0.51	0.43	0.92
BE0584	Office	Portland	Portland	0.27	0.14	0.51	0.43	0.92
BE0585	School	Portland	Portland	0.27	0.14	0.11	0.85	0.41
BE0654	Office	Hillsboro	Portland	0.27	0.14	0.51	0.43	0.92
BE0686	Office	Medford	Medford	0.37	0.19	0.51	0.43	0.92
BE0705	Office	Beaverton	Portland	0.27	0.14	0.51	0.43	0.92
BE0853	Restaurant	Portland	Portland	0.27	0.14	0.27	0.66	0.90

The energy savings from the HVAC system was calculated as shown below in equation (1) and the therm penalties are shown equation (2).

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*HVAC kWh savings = (Lighting kWh savings * Cooling Fraction / System MCOP * Percent with AC) – (Lighting kWh savings * Heating Fraction * Fraction area on perimeter (default of 0.5 used) * Percent of Electric Heat)* *(1)*

*Increase in HVAC therm use = Lighting kWh savings * Heating Fraction * Fraction area on perimeter (default of 0.5 used) * Percent of Natural Gas * Conversion factor (0.046)* *(2)*

The HVAC energy savings were added to the lighting savings to calculate the strata ratios. The following table shows the lighting strata ratios without HVAC interactions and with HVAC interactions.

STRATA	WITHOUT HVAC INTERACTIONS	WITH HVAC INTERACTIONS
1	0.66	0.70
2	0.85	0.89
3	1.04	1.09

The extra therm usage from the lighting retrofits was applied as a line item in the overall therm savings from the program.

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APPENDIX C

On-Site Findings for Custom Mechanical Projects

Appendix C: On-Site Findings for Custom Mechanical Projects

ON-SITE FINDINGS FOR CUSTOM MECHANICAL PROJECTS

This appendix contains detailed information from the custom onsite audits. While onsite audits were performed for those sites in the top 80% of the total *ex ante* kWh, the custom audits covered the following measures:

- Controls
- Variable Frequency Drives
- Aeration Systems
- Chillers
- Retro-Commissioning

Some of the custom audits included measures outside of the list shown above. While these measures are noted in the write-up, the *ex ante* and *ex post* kWh estimates shown in this appendix reflect only the five "custom" measures.

Details about each project follow.

BE0059

Audit Date: September 25, 2004

Ex-ante kWh Estimate of Mechanical Savings: 23,753

Ex-post kWh Estimate of Mechanical Savings: 0

Site Gross Realization Rate: 0%

This grocery store underwent a complete renovation in 2003. The Energy Trust of Oregon, Inc. (Energy Trust) provided incentives for upgrades of the lighting and refrigeration system. An energy analysis report was completed in February 2003 that highlighted the recommended measures. The *ex ante* kWh savings were based on the following three measures: 1) a lighting retrofit and control addition; 2) night-time shutoff of the main air handling unit; and 3) a refrigeration upgrade with controls. Only the nighttime shutoff control was included in the custom audit analysis. The *ex ante* analysis was thorough and provided detail on the assumptions into the energy savings. Review of this analysis found all assumptions to be well documented and reasonable.

The onsite audit found T8 fixtures (and other efficient lighting types) installed throughout the store, except for four 2-lamp fixtures in the deli that were still T12s. The manager of the store did not know why these few fixtures remained.

The control panel for the HVAC and lights was viewed. This panel showed the runtime for the current and previous day for various systems in the store. The main store lighting was found to have half of the fixtures running 18 hours per day and the other half at 24 hours per day, as expected. However, the main air handing unit ran 24 hours the previous day. Based on this empirical information, it was assumed that the control scheduling for this fan (i.e., shutting off at night) was not implemented. The estimated savings for this measure was subtracted from the total. The refrigeration upgrade with the control panel was visually inspected. As expected, the upgraded system covered the medium temperature refrigeration system, while the low temperature refrigeration continued to use the old compressors. There were no claimed demand impacts for the nighttime shutoff for the main air handling unit—therefore the *ex post* kW savings are identical to the *ex ante* estimate.

BE0085

Audit Date: September 18, 2004

Ex-ante kWh Estimate of Savings: 139,310

Ex-post kWh Estimate of Savings: 119,106

Site Gross Realization Rate: 85%

This site is a community outdoor ice arena with a roof covering. It is a relatively new site that was completed approximately January 2001. The site has been open from the end of October to the end of March each year since construction, although a sign at the site indicates that the hours of operation are October 15th to April 15th. The area is run by volunteers who, based on the conversation with two of them, appear very aware of the energy costs to run the brine cooling system that keeps the ice cold. As the ice is open to the outside, the load on the chilling system varies directly with outdoor air temperature. The volunteers keep a log of the weather, ice conditions and chiller settings to help them track system response and as an "institutional memory." During the onsite audit, a volunteer indicated that one of the reasons the site closes in the end of March rather than mid-April is because it becomes too expensive to keep the ice cold with the warmer weather in April.

A variable frequency drive (VFD) and timer were installed on the brine pumps in August 2003 with the help of an incentive from the Energy Trust. At the time of the technical assessment, besides the VFD measure, it was recommended that the condenser temperature be lowered to 70° and that the heat exchanger be investigated for fouling and cleaned if needed.

The hardcopy of the energy analysis was reviewed and a telephone conversation on September 3, 2004, with the author of the report clarified a few points for the evaluation team prior to the onsite audit. The VFD model number was verified during the audit. During the daytime, the pump is run at 56 cycles (93% of pump speed). A timer was found at the site that decreases the pump cycles during night hours to 30 cycles (50% of pump speed). Night hours are generally sundown to sunup, according to a volunteer, with the nighttime setback hour changed in the timer based on the season. Because of how the time is set up, it can be manually overridden and is, based on the cooling load on the ice. When it is warm outside, whether it is day or night, the speed is kept up on the pumps. However, the volunteers also decrease the speed of the motors when it is cold outside during the day. Because it was indicated that they set the pump speed both up and down based on conditions, it was assumed that there was no bias and that they set up the speed about as often as they decreased the speed. Therefore, the savings from the VFD are considered to be substantiated by the audit, even though there is the ability of the volunteers to override the settings.

The condenser temperature was set at 72°during the onsite audit, with a dead-band temperature of 72°-76°. Conversations with the volunteer dealing with this gave no specific reason why the temperature had not been decreased to 70° as recommended. While the audit found that the temperature was running at a higher setpoint than expected in the *ex ante* analysis, the recommendation calculated the savings from an average entering condenser water temperature of 75°—a probable average based on the dead band of the thermostat.

Because the site has used fewer hours of operation than the *ex ante* estimate of savings calculated—more like five months of use rather than the six months in the *ex ante* analysis—a reduction in baseline and post-retrofit energy use was calculated. The change in run hours caused a reduction in the *ex ante* estimate of energy savings, as shown in the table below. The *ex ante* demand savings were set to equal the *ex ante* estimate.

EQUIPMENT	EX ANTE			EX POST		
	RUN HOURS	BASELINE KWH	EEM KWH	RUN HOURS	BASELINE KWH	EEM KWH
Chiller	3,468	371,456	287,916	2,964	317,444	246,012
Cooling Tower Pump	3,468	27,705	27,705	2,964	23,682	23,682
Cooling Tower Fan	3,468	4,782	9,563	2,964	4,088	8,174
Brine Pumps (run 24/7)	4,380	108,186	47,634	3,744	92,477	40,717
Total		**512,129**	**372,819**		**437,692**	**318,586**
Savings			**139,310**			**119,106**

The heat exchanger had been cleaned the previous year at the recommendation of the technical assessment. It had been found to be quite dirty with a subsequent increase in efficiency once cleaned. At the time of the audit, a volunteer was planning to clean the heat exchanger and indicated that the activity is planned to be annual to help the efficiency of the system. This ongoing operation and maintenance was not given any energy savings within the analysis, but will provide for an efficient system that should continue to provide impacts from the VFD.

BE0095

Audit Date: September 21, 2004

Ex-ante kWh Estimate of Savings: 546,884

Ex-post kWh Estimate of Savings: 458,154

Site Gross Realization Rate: 84%

This site is the wastewater treatment plant for a small town. The retrofit consisted of replacing six 40-hp aerator units (240 hp total) with five 20-hp units and five 15-horsepower units (175 hp total). The new units have upgraded controls as well. The new aerator units were a different technology than the older units, with oxygen being put into the water through a blower motor along with the mixing, rather than simply spraying the water into the air as the previous units had done. The dissolved oxygen (DO) in the water is now determined through a sensor in the lagoon, with the blower runtime set based on this DO value. This site had a commissioning of the work once the new measures were installed. The commissioning provided the kW for each of the mixer and blower motors on the new units.

The run hours for the old aerators were estimated based on the experience of the water treatment plant operators. It was known that one of the older pumps had low run hours due to maintenance problems. The *ex ante* savings estimate assumed that the new units would run for the same amount of time and apportioned the run hours across the ten new aerators. Discussions with the staff at the site indicated that the aerators have different daily run hours based on the season. From mid-spring to early fall, the aerators run 24/7 due to the needs of the plant. There is substantially less need for the aerators during the rainy season, as there is dilution of the biological load on the plant. A new energy management system (EMS) planned for installation relatively soon, but not yet available, will have logging capability. Once the new EMS is in place, it would be interesting to determine the new aerator run hours; however, without the true run hours of the older aerators, an impact cannot be accurately determined. Because the actual number of hours of new aerator run time is unknown, the evaluation team agreed with the *ex ante* decision to use the estimated run hours of the older units.

The motors on the aerators are constant speed motors. The old aerators had a single motor, while the new units have two motors (one for the mixer and one for the blower). The evaluation team had discussions with the manufacturer of the aerator units to ascertain the specific demand of the unit with both motors running. According to the manufacturer, the impeller on the mixer is sized such that the amp draw on the mixer motor is less than the nameplate value. The blower is a much smaller motor. The draw of both motors is approximately equal to the nameplate of the larger mixer motor. This information was backed up empirically through the data collected during the commissioning. The kW values used in the *ex ante* calculations were considered correct for the calculations. The utility bill of September 2004 showed a demand charge that was slightly less than the demand estimated by the *ex ante* calculations. Therefore, the *ex ante* estimate of demand is considered valid, if not conservative.

The energy analysis paperwork was reviewed prior to the audit. Because of discrepancies found through this review, the evaluation team called the firm that produced this original estimate of savings in October 2001 to clarify possible issues with the estimate. It was determined that a spreadsheet error had lead to *ex ante* savings that were higher than they should have been (i.e., the post-retrofit energy and demand use was not properly summed). An updated spreadsheet was sent to the evaluation team. This reduced the *ex ante* estimate of savings from 546,884 kWh and 98.3 kW to 458,154 kWh and 45.4 kW respectively. The *ex post* energy and demand savings, after review of the run hours and kW of the units, was set to equal the updated *ex ante* values.

The evaluation team had extensive discussions with the employees at this site concerning the use of the new aerator units and the changes they have seen with these units. The largest issue with the new aerator units is the increased efficiency they are providing the water treatment plant over the older units.

In water treatment plants, the biochemical oxygen demand (BOD) is: "The rate at which organisms use the oxygen in the water while stabilizing decomposable organic matter under aerobic conditions. In decomposition, organic matter serves as food for the bacteria and energy results from its oxidation. BOD measurements are used as a measure of the organic strength of wastes in water."[66] Pure, clean water has no BOD, while sludge has a great deal of BOD. The new aerators have caused a higher rate of decomposition of organics within the current lagoons and previously non-digestible sludge is being digested. This has decreased the level of sludge (based on measurements by the staff at the site). At some point in the future, the amount of sludge in the lagoons will move to a new lower level based on the efficiency of the new aerators. The City was beginning to look at dredging the lagoon at a high cost. The reduction of sludge in the lagoons has meant that they no longer need to dredge, saving them millions of dollars according to the City Public Works Engineer. This has been a large non-energy benefit seen by the City.

Discussions with the City Engineer indicated that the old aerators were 25 years old. They had replaced motors and impellers over that period of time, but they now needed new units. The current system had been considered fine with them and, until they learned of the new type of aerators through the energy efficiency report in 2001, they were not aware of such a system. He felt that they might have simply replaced the old aerators with new ones of the same type without the information from the report and the available incentive.

BE0113

Audit Date: September 18, 2004

Ex-ante kWh Estimate of Savings: 92,485

Ex-post kWh Estimate of Savings: 92,485

Site Gross Realization Rate: 100%

66 *Water Treatment Plant Operation. Fourth Edition, Volume 1*.California State University, Sacramento Foundation. p.684.

This site is a multi-story residential facility with a large cooling load. The technical assessment took place early in 2003 and recommended removing one large 350-ton chiller and replacing it with two smaller 150-ton chillers, which was done in the spring of 2003.

The technical assessment report was reviewed prior to the onsite audit. The assumptions for the savings were well documented. The two new chillers were indicated to take turns running lead/lag with the old 350-ton chiller being used only when the two smaller chillers could not handle the cooling load. The evaluation team determined that, if the site ran the chillers as expected in the analysis, the *ex ante* savings were very good. Because the relevant personnel would not be available the date of the audit, questions regarding the scheduling of the chillers were asked via email. The site does schedule chillers as expected. The chiller model numbers were verified onsite and the *ex post* savings are considered equal to the *ex ante* savings.

BE0114

Audit Date: September 20, 2004

Ex-ante kWh Estimate of Savings: 264,744

Ex-post kWh Estimate of Savings: 264,744

Site Gross Realization Rate: 100%

This site is a large complex of office and light manufacturing. The incentive for this project helped pay for the DDC control of multiple components on the HVAC system (seven variable air volume air handling units, 70 perimeter electric heaters and one chiller). The onsite audit found the new DDC controls in the older pneumatic boxes with most of the old pneumatic hoses cut away. The schedule indicated in the *ex ante* estimate of savings was verified through visually reviewing the programming of the energy management system. The *ex post* estimate of savings was set to equal the *ex ante* impact, as the assumptions in the *ex ante* energy savings calculations were considered reasonable and possibly somewhat conservative.

BE0115

Audit Date: September 22, 2004

Ex-ante kWh Estimate of Savings: 71,642

Ex-post kWh Estimate of Savings: 111,201

Site Gross Realization Rate: 155%

This site is an office building with a single large rooftop unit that supplies air conditioning to the entire building. Variable frequency drives (VFD) were verified to be installed on the return and supply air fan. According to the mechanical contractor who manages the HVAC for the building, the unit runs 24/7. Although there is a time clock set up to allow for the unit to be turned off, examination indicated that it is not in use (i.e., the unit is set to never turn off). According to the mechanical contractor, this is how the building had been run for the last few years and his conversation with the property managers indicate that this is how they want to continue to run the air conditioning.

The *ex ante* estimate of impact calculated the savings using 6,000 hours of operation and motors of 91% and 93% efficiency. The onsite audit indicated that the motors are older and more likely of 85%-87% efficiency. The mechanical contractor indicated that they have been there for as long as they have been servicing the building (at least six years). The evaluation team recalculated the savings for this site using *FanSave 3.0* software—an *Excel*-based software product. All the *ex ante* assumptions were used except for the run hours and motor efficiency. Because the onsite audit indicated that the fans are run 24/7, the run hours were set to 8,760 hours of operation. The efficiency of the motors was reduced to 87% for each motor.

BE0129

Audit Date: September 20, 2004

Ex-ante kWh Estimate of Savings: 41,200

Ex-post kWh Estimate of Savings: 43,432

Site Gross Realization Rate: 105%

This site is a large office complex that installed two high efficiency motors and variable speed drives (VFD) on the chilled water pumps. The *ex ante* estimate of savings was reviewed and conversation between the evaluation team and the firm that originally calculated the savings occurred to clarify certain points. The audit found that a 25-hp and a 30-hp motor were installed, while it was expected that two 30-hp motors would be present. This surprised the facility manager and the mechanical contractor. After discussions with the evaluation team, the mechanical contractor audited the motor as well and verified that the incorrect motor size had been installed. They had specified and paid for a 30-hp motor, not a 25-hp. As of September 29, 2004, the mechanical contractor is working with their electrical contractor and the owner of the building to resolve this issue. It is expected that the 25-hp motor will be removed and a 30-hp will be installed before the end of the year.

Because of this installation error, the Energy Trust obtained a higher energy savings for a year and five months of 64,831 annual kWh. However, going forward, the *ex post* energy savings will equal the *ex ante* estimate. Using an estimated effective useful life (i.e., the period of time that the energy efficient measure is assumed to be operating) of 15 years, the *ex post* estimated a weighted average energy savings as shown in the table below.

ASSUME 15-YEAR EFFECTIVE USEFUL LIFE ON VFD		
CRITERIA	YEARS	KWH SAVINGS
1 Year, 5 Months	1.4	64,831
13 Years, 7 Months	13.6	41,200
Average kWh Savings Over 15 Years		43,432

Although the estimated demand impact would be larger for the 1.4 years with the smaller motor, the *ex post* demand impact was set as equal to the *ex ante* estimate of impact with the 30-hp motor because that demand impact is not expected for the majority of the years of this measure. As a maximum value, it cannot be averaged, as was done for the kWh savings.

BE0151

Audit Date: September 22, 2004

Ex-ante kWh Estimate of Savings: 279,864

Ex-post kWh Estimate of Savings: 120,095

Site kWh Gross Realization Rate: 43%

This site is an office building that installed four variable frequency drives (VFD) and four new motors on the air-handling fans in the rooftop units of the building. Review of the paperwork prior to the audit indicated that the fans ran 6,231 hours annually. The estimated percent of the year that the VFD would run at various design kW values was considered reasonable by the evaluation team.

The onsite audit verified the installation of the motors and VFD units. The motor model numbers could not safely be determined during the audit due to the running belts near the motor. Therefore, the evaluation team requested the model numbers of the motors be provided to them from the installer, which occurred on September 29, 2004. The efficiency of the motor was verified through finding the motor specifications on the Baldor Motor Internet site.

The rooftop units run off of a timer clock. They are on Monday through Friday, 6:00 a.m. to 6:00 p.m. One unit runs on Saturday and Sunday from noon to midnight; otherwise the units (and therefore the fans), do not run. The schedule indicates that the fan on one unit runs 4,368 annul hours (29% less than expected in the *ex ante* calculation of savings), while the fans on the other three units run for 3,120 hours (50% less than expected). The *ex ante* calculation had determined the kWh savings for one motor and multiplied this by four to obtain the total savings. With the operating hours found during the onsite audit, the *ex ante* calculation overestimated the hours of operation for all four fan motors.

The evaluation team re-calculated the savings estimate using the hours of operation obtained during the onsite audit. The *ex post* VFD calculation applied the identical percent of design kW that was used in the *ex ante* estimate. There was a reduction in the total kWh due to the change in operating hours.

BE0164

Audit Date: September 20, 2004

Ex-ante kWh Estimate of Savings: 54,851

Ex-post kWh Estimate of Savings: 54,851

Site Gross Realization Rate: 100%

This site is an office building that underwent a tenant improvement. During that process, as much of the existing HVAC system was used as was practicable. The Energy Trust incentives were used to install three variable frequency drive (VFD) units on their rooftop air handler units to allow more precise temperature control throughout the site. Additionally, the retrofit eliminated electric reheat modules and installed natural gas units (at 80% efficiency level). The *ex ante* estimate of VFD savings was reviewed and found reasonable and the onsite audit verified installation of the VFD units.

BE0218

Audit Date: September 20, 2004

Ex-ante kWh Estimate of Savings: 204,640

Ex-post kWh Estimate of Savings: 204,640

Site Gross Realization Rate: 100%

This site is a large office building owned by the occupant. The Energy Trust energy audit provided multiple energy efficiency measures that are planned for installation over three phases to stretch the capitol costs. The first and second phase have been completed, consisting of a retro-commissioning of the chiller (phase 1) and control strategy improvements (phase 2). Phase 3 is scheduled for 2005 and will cover an upgrade to the motors on various pumps and fans.

Discussions with the facility manager indicated that the retro-commissioning and control improvements in the building have occurred as indicated in the plan. He noted that the building was having difficulty with stale air and that many of the systems were not running as expected when he was hired a few years ago. He reported that he was able to successfully petition the management to invest in this retro-commissioning project with the help of the incentives from the Energy Trust. According to him, the energy efficiency work now being performed is some of the first and largest ever done in the company. Because of these discussions, the *ex post* estimate of impact was set equal to the *ex ante* estimate. There are two projects for this site in the Energy Trust database. The first project was included in this evaluation and covered only phase 1. Because the second project included phase 2, it was not included in the *ex ante* estimate of savings for this evaluation.

BE0320

Audit Date: September 22, 2004

Ex-ante kWh Estimate of Savings: 221,118

Ex-post kWh Estimate of Savings: 221,118

Site Gross Realization Rate: 100%

This site is large mall with retail, office and parking areas. They have embarked on an energy efficiency crusade and are ambitiously looking at all energy-using equipment that is under their control. For example, they are decreasing the escalators' run hours. Also, the facilities manager is slowly changing out the lighting in the garage and installing variable frequency drives (VFD) in the rooftop air conditioning units as capitol becomes available. Funding from Energy Trust incentives allows this site to upgrade more than they would have been able to afford.

This audit verified the installation of T5 lighting fixtures in the garage and hardwired compact fluorescent lights (CFL) inside the mall. The T5 fixtures have replaced high output T12 fixtures while 42-watt, 2-lamp CFLs replaced 215-watt metal halide fixtures. The CFLs were installed on emergency back-up circuits that are left on 24/7. The T5 fixtures were a phase of a much larger retrofit that has been going on with both the Energy Trust and Pacific Power prior to the creation of the BE program. Not all fixtures are yet upgraded, as they have not had the capitol for that expenditure yet. The T5 fixtures currently are on 24/7, although 80% of the fixtures may be turned off from 1:00 a.m. to 5:00 a.m. once older fixtures are upgraded and a control system is in place. The lighting end-use savings are not included in the *ex ante* savings for this project that are shown above, as they are included in a different end-use and will be accounted for in the evaluation within a different analysis.

The VFD drives were verified onsite. A review of the *ex ante* estimate of impact calculations determined that the hours used met how the site was used, based on the facility manager. The *ex post* estimate of impact for the VFD drives was set equal to the *ex ante* estimate.

BE0347

Audit Date: September 24, 2004

Ex-ante kWh Estimate of Savings: 91,018

Ex-post kWh Estimate of Savings: 5,588

Site Gross Realization Rate: 6%

This site is a large university campus that has been upgrading many HVAC systems. At the building for this project, two lithium bromide absorption chillers were replaced with a single centrifugal chiller with a variable frequency drive (VFD). Although not included in the energy savings by the Energy Trust, the new chiller was noted during the audit. The old HVAC system consisted of eight pumps, while the new system has five.

The Energy Trust incentive for this project covered two new high efficiency motors and installation of three variable frequency drives (VFD) on the other three pumps in the chilled water system. Two pumps (a 15-hp and a 20-hp) were verified at 91% NEMA efficiency. These two pumps are constant speed. The *ex ante* analysis for these two motors indicated that both were 15-hp. It was not known by the staff at the site whether the 20-hp motor replaced a 15-hp from the old system or whether the analysis (that had been performed by a student) had incorrectly indicated the size of this motor originally. However, because the paperwork for the *ex ante* savings had a horsepower that was incorrect for one of the other pumps still existing, it was assumed that the 20-hp motor replaced a 20-hp motor. There were no VFDs on any of the pumps in this system. The savings were recalculated with only the savings from the increase in efficiency from a standard to a high efficiency motor for the two pumps, which greatly decreased the estimated savings.

BE0350

Audit Date: September 23, 2004

Ex-ante kWh Estimate of Savings: 149,040

Ex-post kWh Estimate of Savings: 180,970

Site Gross Realization Rate: 121%

This site is a large office building that performed a retro-commissioning of the building HVAC system. All the work had been completed at the time of the audit. Hard copy information was reviewed prior to the audit and questions regarding some of the assumptions that went into the calculations were discussed during the audit. All outstanding questions were answered and the *ex ante* calculation assumptions were determined to be reasonable, if not conservative.

About the time of the retro-commissioning, a tenant in the building requested that the air conditioning be available for more hours. The building is now open three hours more every weekday and eight hours more each weekend day—a total of 31 more hours per week, or 1,612 more hours per year. The original hours of operation of the chillers was 1,740 hours, based on run times of each chiller. Using this value and an assumed 40-hour workweek, the HVAC system was estimated to run 84% of the time that the building is open. Since the air handling fans and chilled water pumps are on whenever the chiller runs, the increased hours of operation affect the estimated savings for each of these measures. As the building operator would have increased the hours of chiller use regardless of the retro-commissioning, the savings are based on a new baseline with the increased hours of operation. The evaluation team recalculated the savings using the increased hours of operation for both the baseline and the *ex post* estimate of savings. The facility manager noted that even though there have been increased hours of operation, the bills have remained flat, an indication that the efficiency has absorbed the energy use of the additional run hours.

BE0363

Audit Date: September 25, 2004

Ex-ante kWh Estimate of Savings: 295,763

Ex-post kWh Estimate of Savings: 295,763

Site Gross Realization Rate: 100%

This site is a large hospital complex that is in the midst of adding more square footage to the campus. The complex has no doctors' offices, but consists of patient rooms and the ancillary services required for the patients. The management of the hospital has made the decision to try to get an ENERGY STAR® rating for the buildings. As such, the facility manager is looking closely at all energy-using equipment (both electrical and natural gas) within the complex. The Energy Trust provided incentives to install a 325-ton chiller with a variable frequency drive. During the onsite audit, the facility manager indicated that the chiller was a 350-ton chiller. As the specifications from Carrier show either a 300 or 350 nominal ton chiller of this type, it is assumed that the unit is a 350-ton chiller.

The review of the *ex ante* energy analysis showed that it was thorough and complete. The evaluation team agreed with the assumptions made in that analysis. The sequencing of the chillers within the *ex ante* analysis was verified during the onsite audit. Confounding the estimated savings, though, is a retrofit performed outside of the Energy Trust program. The site took out a 150-ton and 400-ton chiller and replaced them with a 400-ton chiller with a VFD. There are now two chillers that run lead every other month. However, because a thorough analysis of the estimated energy savings with the new chiller configuration was out of the scope of this evaluation, the *ex post* was set to equal the *ex ante* savings. It is assumed that there is actually a larger decrease in energy use than estimated.

This was given some empirical evidence in the billing history that showed demand. The *ex ante* estimate of demand savings was 59 kW. During the two-month period of time when the new chiller that was given an incentive was installed and the second new chiller was installed, there was a demand reduction of 147 kW. Although the facility manager indicated that there was no change in building use between these two periods, and a thorough audit of what other changes may have occurred was not done, the demand savings serve to indicate that savings are occurring, but were not used to change the *ex ante* estimate of impact. The *ex post* estimate of savings was set equal to the *ex ante* for both energy and demand.

BE0396

Audit Date: September 20, 2004

Ex-ante kWh Estimate of Savings: 34,813

Ex-post kWh Estimate of Savings: 34,813

Site Gross Realization Rate: 100%

This site is single office building that has recently added to their building, almost doubling the square footage.. The new portion of the building has it's own HVAC system. The Energy Trust incentive paid for a retro-commissioning of the boiler, re-calibration of the controls and a new timer on the air handling unit in the old building.

Discussions with the building owners indicated that they had performed a retrofit of their lighting ballasts about ten years ago with their utility (PGE). When they realized that their natural gas bills were quite high, they remembered that experience and called PGE for help. PGE forwarded them to the Energy Trust for aid in lowering their costs.

This site had two mechanical contractors that bid for the retrofit work. Each had different estimates of kWh and therm savings. Contractor #1 indicated that there would be 34,813 kWh and 7,100 therm savings (the *ex ante* values in the Energy Trust database), while contractor #2 estimated 6,940 kWh and 4,895 therm savings. A review of two of the *EZ Sim* models (EEM 5A for contractor #1 and EEM 5A Modified for contractor #2) matched each estimated savings. The owner chose contractor #1 to perform the modifications. However, the energy analysis report for EEM 5A indicated that the savings were partially from a new variable frequency drive and new high efficiency motors. These measures were not installed by contractor #1. To help clarify what occurred at this site and the relationship to *ex ante* estimates of savings, the table on the next page shows what was supposed to have been modeled in the *EZ Sim* runs and what was installed.

ENERGY EFFICIENT MEASURES	CONTRACTOR #1		CONTRACTOR #2
	INDICATED TO HAVE BEEN MODELED IN *EZ SIM*	IN BID (AND PERFORMED AT SITE)	IN BID
EZ Sim Model	EEM 5A.xls		EEM 5A Modified.xls
Estimated kWh Savings	34,813		6,940
Estimated Therm Savings	7,100		4,895

ENERGY EFFICIENT MEASURES	CONTRACTOR #1		CONTRACTOR #2
	INDICATED TO HAVE BEEN MODELED IN *EZ SIM*	IN BID (AND PERFORMED AT SITE)	IN BID
KWh and Therm Impacts	Re-engineer original system to account for changes in the building configuration		
KWh Impacts	VFD and high efficiency motors on AHU		Install two motor sheaves and fan belts to slow indoor blowers
KWh and Therm Impacts	New boiler and main AHU controls		
KWh and Therm Impacts	Recalibrate HVAC controls in old part of the building		
KWh Impacts	Reset heating water loop to outside air temperature		
kWh and Therm impacts	Recalibrate all pneumatic thermostats		
KWh Impacts	Lower night low limit in building to 55° F		
KWh Impacts	Tune boiler and burner. Provide lockout relay to prevent main boiler from firing when outside air is over 65° F		Provide lockout relay to prevent main boiler from firing when outside air is over 65°F
KWh Impacts	Lower occupied heating temperature setpoint to 70°F		
KWh Impacts			Install new compressor heads with unloading values to provide lower capacity operation of compressors
KWh and Therm Impacts			Insulate 200 feet of hot piping in return air cavity

The work performed by contractor #1 follows the *ex ante* estimated savings measures well, except for the fact that the VFD and high efficiency motors were not installed. However, review of the *EZ Sim* model did not appear to include this measure anyway (as there was no change between the base case and comparison case for the HVAC fan control – both were set to on/off). Because there was no evidence that the model had originally included savings from the VFD, the *ex post* energy estimates were set to equal the *ex ante* estimate.

The natural gas savings were empirically validated through a simple comparison of five months of bills in 2003, and the same five months in 2004. While this comparison does not take weather into account, it does show a decrease of 75% in therm use (4,000 therms over a five-month period), substantially more than weather differences may cause. The *ex post* estimate of natural gas savings was set to equal the *ex ante* estimates of 7,100 therms.

BE0415

Audit Date: September 21, 2004

Ex-ante kWh Estimate of Savings: 19,296

Ex-post kWh Estimate of Savings: 19,296

Site Gross Realization Rate: 100%

This site is an office building with multiple new rooftop units. The new units were installed using prescriptive incentives from the Energy Trust and are not included in the savings shown above, as the prescriptive savings were handled elsewhere in the evaluation. This site had some ducting that had been exposed to the outside, which was moved to the interior of the building; and an energy management system was installed.

The new units were verified. There were two units in which the ducting was moved interior, as indicated by the facility manager. The audit found newer roofing at these sites. The *ex ante* estimated savings accounted for these two duct changes. The control system was viewed at the local building manager's computer. Discussions with the facility manager indicated that the schedule was in place. The *ex post* estimated savings for the control measure (the only measure actually being audited) were set to equal the *ex ante* estimates.

BE0416

Audit Date: September 24, 2004

Ex-ante kWh Estimate of Savings: 10,887

Ex-post kWh Estimate of Savings: 10,887

Site Gross Realization Rate: 100%

This site is a dairy farm that installed a variable frequency drive (VFD) on their vacuum pump. A previous VFD on the pump had burned out about a year ago and they indicated that they might not have replaced it without the incentive from the Energy Trust because they were unhappy with the performance of that unit. The baseline for the *ex ante* analysis assumed a constant speed pump at the site. Based on the discussions with the owner, it is assumed that the replacement would have been a constant speed motor and the *ex ante* baseline equipment is assumed valid.

The newly installed VFD was visually verified at the site. The owner indicated that the pumping system was run four hours in the morning and four in the afternoon, with some variation depending on the number of cows. The *ex ante* estimate of impact assumed a 10-hour pumping period—a value that came from the owner as well. Because of the two different hours of operation and the acknowledged variation based on number of cows to be milked, the *ex ante* estimate of ten hours per day was kept. The *ex post* estimate of savings was set to equal the *ex ante* estimate.

BE0420

Audit Date: September 23, 2004

Ex-ante kWh Estimate of Savings: 751,700

Ex-post kWh Estimate of Savings: 794,629

Site Gross Realization Rate: 106%

This site is a large office building that moved from pneumatic to DDC controls on the HVAC system. They installed variable frequency drives (VFD) on four air handling unit fans and two chilled water pumps. The hard copy information on this site noted a commissioning report may have been done, but it was not completed in time for the evaluation team to review. The building manager noted a decrease in monthly energy costs immediately following the retrofits and provided a running monthly kWh usage from February 2000 to August 2004. From April to August 2004, kWh reductions of 15% to 21% were noted compared to the previous year. These reductions are similar in magnitude to the *ex ante* estimate of savings. There were no changes to the tenants during this time period. While this does not account for differences in weather, there is a clear indication that the savings have occurred.

The spreadsheet that showed how the *ex ante* estimates were determined was obtained and reviewed. In early October, the company that created the *ex ante* values and installed the controls was called to clarify a few points in the *ex ante* assumptions and calculations. During that conversation, it became clear that the controls now shut down the cooling system during unoccupied periods. One of the pieces of equipment in that system, a pump, was inadvertently left out of the *ex* *ante* assumptions. Working with the engineer who originally created the *ex ante* estimates, we updated the values.

Noteworthy for this audit was the unsolicited indication that the building operator was so pleased with the results of this work that he planned to implement something similar in another building the company operates. The company may work with the Energy Trust if they pursue changes in another building, but there is potential for spillover based on this discussion.

BE0468

Audit Date: September 21, 2004

Ex-ante kWh Estimate of Savings: 13,678

Ex-post kWh Estimate of Savings: 13,678

Site Gross Realization Rate: 100%

This site is an office building with multiple rooftop units installed. Eleven 6-ton units were installed under the prescriptive portion of the program. These units were verified. There were no visual indications of any ducting being moved at this building as there had been at BE0415. This was verified by the property manager during the onsite audit, who did not believe that any changes in ducting occurred at this site. However, as the ductwork was not being audited, this was not included in the *ex post* analysis. The control panel for the HVAC is handled by the tenant and was not accessible to be viewed. The *ex post* savings were set to equal the *ex ante* savings for the controls measure.

BE0546

Audit Date: September 24, 2004

Ex-ante kWh Estimate of Savings: 8,750

Ex-post kWh Estimate of Savings: 8,750

Site Gross Realization Rate: 100%

This site is a large hospital complex. The Energy Trust incentive paid for two high efficiency motors and variable frequency drives (VFD) on each motor. The larger air handling unit motor was visually inspected, but the nameplate information could not safely be obtained because the unit was running and could not be turned off (it was supplying air to the operating room). The exhaust fan motor also met the needs of the operating room and could not be turned off. The facilities managers at the site emailed the specifications for the two motors to the evaluation team that verified the high efficient motors. The units run 24/7, as expected. The *ex post* estimate of savings for the VFD (the only measure actually being audited) were set to equal the *ex ante* estimate.

BE0672

Audit Date: September 23, 2004

Ex-ante kWh Estimate of Savings: 132,167

Ex-post kWh Estimate of Savings: 132,167

Site Gross Realization Rate: 100%

This site is a large office building that retrofit their chiller. A new chiller with a variable speed drive and chilled water economizer was installed. The new measures were verified during the onsite audit. Assessment of the *ex ante* estimate of savings from the hardcopy indicated that the calculations were thorough and reasonable. The *ex post* estimate of savings was set to equal the *ex ante* estimate.

APPENDIX D

Survey Instruments and Interview Guides

LIGHTING PARTICIPANT TELEPHONE SURVEY
BUILDING EFFICIENCY PROGRAM – ENERGY TRUST OF OREGON, INC.

Name: ________________________________ **Date:** ______________________________

Organization: ____

Screening

Hi, I am _______________________ with Research Into Action. I'm calling on behalf of the Building Efficiency program that we understand you've participated in during the last year or so. I would like to ask you a few questions about your experience with this program. Is this a convenient time for you?

This is not a solicitation; we are simply trying to gather some information that will help the Energy Trust of Oregon to improve its energy efficiency program planning efforts and services. None of this information will be used to re-calculate incentives or tax credits you've already received. Your answers will be kept confidential by the researchers and the Energy Trust of Oregon.

Confirming Decision Maker

1. Do you recall installing lighting equipment through the Building Efficiency program in __(month, year)__ at __(location of project)__?

    1. Yes
    2. No

        a. If no, identify who, get contact info from:

2. Are you the person at your organization who was most involved in making the decision to install lighting equipment through the program?

    1. Yes
    2. No

        [If no:]

        a. If no, identify who, get contact info from: _________________________

Program Awareness

3. Do you know what organization is sponsoring the Building Efficiency program and providing the incentives?

    1. Yes
    2. No

    [If yes:]

    a. Who?

        1. Energy Trust of Oregon
        2. Their utility
        3. Other: ____________________

4. Before today, had you heard of the Energy Trust of Oregon?

    1. Yes
    2. No
    8 Don't Know
    9 Refused

5. Can you tell me how you first learned about the Building Efficiency program incentives for energy-efficient lighting equipment? [open ended; probe to code]

    1. Lighting vendor or contractor told me
    2. Saw ad from lighting vendor
    3. Saw energy trust ad
    4. Went to energy trust website
    5. Utility or power company rep told me
    6. Friend or colleague told me
    7. Other: Describe: __________________________
    8. Don't Know
    9. Refused

When Heard About program

When did you first hear the Building Efficiency program incentives? Was it...

6. ...before you began to think about getting new lighting equipment, or after?

    1. Before (Skip to Q 11)
    2. After
    8. Don't Know
    9. Refused

7. ..before you began to consider your lighting choices, or after?

    1. Before (Skip to Q 11)
    2. After
    8. Don't Know
    9. Refused

8. ...before you selected or decided on the exact specifications of the equipment, or after?

    1. Before (Skip to Q 11)
    2. After
    8. Don't Know
    9. Refused

9. ...before you ordered the equipment, or after?

    1. Before (Skip to Q 11)
    2. After
    8. Don't Know
    9. Refused

10. ...before you installed the lighting equipment, or after?

    1. Before
    2. After
    8. Don't Know
    9. Refused

Program Influence

According to our records, the total cost for all of the lighting equipment you installed was about ____. The Energy Trust paid about __(%) of the total cost of this equipment, or $____. We are interested in exploring with you two ways this incentive might have influenced your decision to install the energy efficient lighting equipment. First, we'd like to explore the extent to which the incentive influenced ***what*** you installed—the type of equipment or its efficiency. After that, we may ask you about the possible influence of the incentive on the ***timing*** of your lighting project.

11. How much influence did the incentive have on your decision to install the efficient lighting? Please use a scale from 0 to 10, with 0 being no influence at all and 10 being a lot of influence.

    ___Response (**0-10**) **88** Don't Know **99** Refused to Answer

12. Without the incentive, how likely is it that you would have installed **exactly** the same type and efficiency of lighting equipment? Please use a scale from 0 to 10, with 0 being not at all likely and 10 being very likely.

    ___ Response (**0-10**) **88** Don't Know **99** Refused to Answer

    Special Instruction for Contradictory Responses: If [**Q.11 is 0,1,2** *and* **Q12 is 0,1,2**] *or* [**Q.11 is 8,9,10** *and* **Q.12 is 8,9,10**]. **Probe for the reason. However, it is important not to communicate a challenging attitude when posing the question. For example, say,**

    When you answered "8" for the question about the influence of the rebate, I would interpret that to mean that the rebate was quite important to your decision to install; then, when you answered "8" for how likely you would be to install the same equipment *without* the rebate, it sounds like the rebate was *not* very important in your installation decision. I want to check to see if

I am misunderstanding your answers or if the questions may have been unclear.

If they volunteer a helpful answer at this point, respond by changing the appropriate answer. If not, follow up with something like:

Will you explain in your own words, the role the rebate played in your decision to install this efficient equipment?

If possible, translate the answer into a question 11 or 12 response that makes them consistent with each other, and check the response with the respondent for accuracy. If the answer doesn't allow you to decide what answer should be changed, write the answer down and continue the interview.

a. Answer: ____

[If Q12 <=5 ask, else skip to Q14]

13. What type of equipment do you think you might have purchased instead? ____

14. Without the incentive, how likely is it that you would have chosen to install the **same number** of efficient fixtures? Please use a scale from 0 to 10, with 0 being not at all likely and 10 being very likely.

___ Response (**0-10**) **88** Don't Know **99** Refused to Answer

[If Q14<=5), ask, else skip]

15. Compared to the number of efficient fixtures or bulbs you purchased under the program, what percent do you think you might have purchased without an incentive?

___ Percent (0-100) **888** Don't Know **999** Refused to Answer

16. Before your interactions with the Building Efficiency program, was your company planning to replace (or add) lighting equipment?

1. Yes
2. No
8 Don't Know
9 Refused

[If Q16=Yes and Q12 >=5 then continue; Otherwise go to Q18]

17. Now, let's consider the ***timing*** of your purchase. Without the incentive from the Energy Trust program, *when* would you have installed the energy efficient lighting equipment?

    Percent (if they would have installed the equipment in stages, try to obtain the proportion they would have installed in each period. Sum should equal 100%):

    __ Within 6 months of your installation under the program?

    __ Within 6 to 12 months?

    __Within one or two years?

    __Within three to five years?

    __More than five years?

    __Don't know

    __Refused

    a. Why do you think it would have been _______ mos/yrs before you did the project without the incentive?

    ____

18. Did the money for the lighting project come from your organization's . . . (READ)

    1. Operating Budget
    2. Short-Term Capital Budget Or Plan
    3. Long-Term Capital Budget Or Plan
    4. Other: _______________
    8. Don't Know
    9. Refused

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19. Before the project, had your organization previously installed any energy efficient lighting equipment without any incentive?

    1. Yes
    2. No
    8. Don't Know
    9. Refused

Please indicate the extent to which you agree or disagree with the following three statements. A 0 indicates that you **strongly disagree** with the statement, a 10 indicates that you **strongly agree** with the statement.

20. The incentive made this lighting project an "easier sell" to management

    ___ Response (**0-10**) **88** Don't Know **99** Refused to Answer

21. The incentive helped the lighting project meet our investment criteria

    ___ Response (**0-10**) **88** Don't Know **99** Refused to Answer

22. The savings estimated for this lighting project helped convince me to install the measures.

    ___ Response (**0-10**) **88** Don't Know **99** Refused to Answer

23. What financial calculations are made, if any, to help your organization make capital decisions *of this type* such as equipment installations or modifications, e.g., payback, return on investment or break-even analysis?

    1 None {Skip to Q25}
    2 Payback
    3 Return on Investment
    4 Break-even Analysis
    5 Other, specify: ______________________________
    8 Don't Know
    9 Refused

24. What is the cut-off point that your organization uses to decide to go ahead? ________________ (for payback: maximum yrs, for ROI: minimum %)

    88 Don't Know

    99 Refused

PAST PROGRAM INFLUENCE

25. Did your organization participate in any **utility** energy efficiency programs before you installed energy efficient equipment through the Energy Trust's Building Efficiency program?

    1. Yes
    2. No
    8. Don't Know
    9. Refused

    [If No, Don't Know, or Refused, skip to **Q26**; if yes, continue:]

    Please indicate the extent to which you agree or disagree with the following statement. A 0 indicates that you **strongly disagree** with the statement, a 10 indicates that you **strongly agree** with the statement. (Key in 88 for Don't Know or 99 for Refused on the following 4 queries.)

    a. The energy savings performance of equipment installed through the utility program in earlier years was a primary reason why we decided to install energy efficient lighting equipment through the Building Efficiency program.

       0 1 2 3 4 5 6 7 8 9 10

    b. Because of what we learned from our previous participation in the utility energy efficiency program, we asked our contractor to look into energy efficient options for lighting equipment.

       0 1 2 3 4 5 6 7 8 9 10

c. Because of what we learned from our previous participation in the utility energy efficiency program, we took into account the cost-effectiveness of energy efficient lighting equipment when evaluating different options.

0 1 2 3 4 5 6 7 8 9 10

d. Thinking about the other utility incentive program(s) you've participated in, how satisfied are you with the current Building Efficiency program compared to these other programs? Please use a 10 point scale where 0 indicates that you are **very dissatisfied** with the current program and a 10 indicates that your are **very satisfied** with the current program.

0 1 2 3 4 5 6 7 8 9 10

i. Why do you say that? (Probe for specific practices.)

Open:____

ii. *{If less satisfied (answer <= 5), and if not apparent from above comment, Probe},* Do you have any suggestions for how the Energy Trust might make the program more satisfactory for you?

Open: ____

Spillover

26. Since participating in the program, have you installed any ***additional energy efficient*** equipment ***without any incentives*** from the Energy Trust's Building Efficiency program?

1. Yes
2. No
8. Don't Know
9. Refused

[If yes; otherwise, skip to 27:]

a. Please describe the type and quantity of the efficient lighting equipment or measures. (Open-ended)

b. Overall, how influential would you say the program was in your decision to install additional efficient equipment? Please use a 10 point scale where 0 indicates the program was not at all influential in your decision to install additional equipment and a 10 indicates that the program was very influential?

0 1 2 3 4 5 6 7 8 9 10

Energy-Related Decision Making

27. Has your organization developed any policies to govern the selection or specification of energy efficient equipment?

1. Yes
2. No
8. Don't Know
9. Refused

[If yes:]

a. And were these policies put in place BEFORE or AFTER you began participating in the Energy Trust's Building Efficiency program?

1. Yes
2. No
8. Don't Know
9. Refused

[If after:]

i. To what extent were these policies influenced by your participation in the Energy Trust's Building Efficiency program? Please provide your answer on a 10 point scale, with a 0 indicating **not at all influential** and a 10 indicating **very influential**.

0 1 2 3 4 5 6 7 8 9 10

Super T8 Potential

28. Are you aware of a type of T8 lamp that has recently become available that is even more efficient than the previous types of T8 lamps? Some people refer to these as "Super T8s"? Have you heard of these?

    1. Yes
    2. No
    8. Don't Know
    9. Refused

    [If yes:]

    a. Did you install these or consider installing these?

        1. Yes, installed
        2. Considered but did not install
        3. Did not consider

Process Questions

Now I want to ask about your experience in participating in the Building Efficiency program.

29. Do you recall any phone conversations or other interactions with the Energy Trust of Oregon or the program administrator concerning the Building Efficiency program? {If necessary, identify program administrator as Aspen Systems}

    1. Yes
    2. No
    8. Don't Know
    9. Refused

    [If yes:]

a. Do you recall which one? To the best of your knowledge, was it the Energy Trust, the program administrator, or both?

1. The Energy Trust
2. The program administrator (Aspen)
3. Both
8. Don't know

30. Have you experienced any delays in any step of the project or has it taken longer for something to happen than you expected?

1. Yes
2. No
8. Don't Know
9. Refused

[If yes:]

a. Describe (Probe: What was delayed, reason for delay (if known), length of delay): ______________________________

b. What in your view would have been a reasonable turn-around time? [open] ______________________________

31. Can you tell me how you came to be working with the lighting contractor or vendor you worked with? [open]

1. Had worked with contractor in the past
2. Selected contractor from yellow pages, colleagues, etc.
3. Contractor approached respondent
4. Got name from Energy Trust of Oregon
5. Other
8. Don't know

[If other]

a. Describe: ______________________________

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32. What reasons to purchase energy-efficient equipment did your contractor discuss with you? [open; do not read; record all mentions]

    1. Decreased energy use or electricity bill
    2. Incentive, rebate (lowers the first cost of equipment)
    3. Better light/ high quality of light output/ better color
    4. Decreased maintenance costs
    5. Tax credit
    6. Environmental benefits
    7. Other
    8. Don't know

    [If other]

    a. Describe: ____

33. Did you decide to install all of the energy-efficient items that your contractor proposed?

    1. Yes
    2. No
    8. Don't Know
    9. Refused

    [If no:]

    a. What did you decide not to install, and why? [open]: ___________

34. Do you have any plans to install this equipment at a later date? ___________

    [If yes:]

    a. What, when: ____

Satisfaction

We'd like to get a sense of your satisfaction with the program. Please use a scale from 0 to 10, where 0 indicates **not at all satisfied** and 10 indicates **completely satisfied**. Please rate…(For Questions 35-41, key in 88 for Don't Know or 99 for Refused.)

35. …Your overall satisfaction with your program experience _______

    [If <=5]

    a. Why did you say that? [open]: ________________________________

36. …Your satisfaction with the performance of the lighting equipment you installed __________

    [If <=5]

    a. Why did you say that? [open]: ________________________________

37. …Your satisfaction with the savings on your monthly energy bill ____________

    [If <=5]

    a. Why did you say that? [open]: ________________________________

38. …Your satisfaction with the rebate amount ________

    [If <=5]

    a. Why did you say that? [open]: ________________________________

39. …Your satisfaction with the application process __________

    [If <=5]

    a. Why did you say that? [open]: ________________________________

40. …Your satisfaction with the quality of work conducted by your contractor/ vendor ____________

    [If <=5]

a. Why did you say that? [open]: ______________________________

[Ask only if respondent had contact with Energy Trust or program administrator, Q29=yes]

41. …Your satisfaction with your contact with the Energy Trust or the program administrator __________

[If <=5]

a. Why did you say that? [open]: ______________________________

BETC and SELP

42. Are you aware that the State of Oregon offers a tax credit for qualifying energy-efficient investments, called the Business Energy Tax Credit, or BETC?

1. Yes
2. No
8. Don't Know
9. Refused

[If yes:]

a. Did your contractor mention the tax credit program to you?

1. Yes
2. No
8. Don't Know
9. Refused

[If yes:]

i. Did your organization apply to receive a tax credit?

1. Yes
2. No
8. Don't Know
9. Refused

[If yes:]

1. Did your organization receive a tax credit from the State?

    1. Yes
    2. No
    8. Don't Know
    9. Refused

43. Are you aware that the State offers loans for qualifying energy-efficient investments, called the Energy Loan program, or SELP?

    1. Yes
    2. No
    8. Don't Know
    9. Refused

    [If yes:]

    a. Did your contractor mention the loan program to you?

        1. Yes
        2. No
        8. Don't Know
        9. Refused

        [If yes:]

        i. Did your organization apply to receive a loan?

            1. Yes
            2. No
            8. Don't Know
            9. Refused

[If yes:]

1. Did your organization receive a loan from the State?
   1. Yes
   2. No
   8. Don't Know

Firmographics

44. What is the primary activity that occurs at this facility? (DO NOT READ)
   1. Office
   2. Retail
   3. Warehouse/ wholesale
   4. Food service
   5. Hotel
   6. Other: ____

45. Approximately, how many full-time equivalent (FTE) employees work at this facility?

   _____ Number of FTEs

   8. Don't Know

   9 Refused

46. How many other sites does your organization operate?

   _____ Number of Other Sites (Numeric)

   _____ Number of Other Sites (Verbatim)

   8. Don't Know

   9 Refused

47. How many years has your organization been in business at **this** site?

    ____ Number of Years

    8. Don't Know

    9 Refused

48. Approximately how many square feet of lighted area are in your business?

    _____ Square Feet

    8. Don't Know [Skip to Q. 50]

    9. Refused [Skip to Q. 50]

49. Of this square footage, what percent is conditioned?

    _____ Square Feet

    8. Don't Know

    9. Refused

Conclusion

50. **In conclusion**, are there any other comments you would like to make on the incentive program, or any feedback you would like for program manager to hear? [open] ____

51. May we call you another time in the course of this evaluation?

    1. Yes

    2. No

As part of this research, you may be visited sometime this summer or fall so that we might inspect the lighting you installed through the program. An independent contractor hired by the Energy Trust would conduct the inspection. The inspection will not result in any changes to your incentive. You may receive a call to set up a time or the inspector may simply drop by your establishment to count fixtures.

We thank you for your time.

MECHANICAL PARTICIPANT TELEPHONE SURVEY
BUILDING EFFICIENCY PROGRAM – ENERGY TRUST OF OREGON, INC.

Name: ______________________________ **Date:** ____________________________

Organization: ____

Screening

Hi, I am _____________________ with Research Into Action. I'm calling on behalf of the Building Efficiency Program that we understand you've participated in during the last year or so. I would like to ask you a few questions about your experience with this Program. Is this a convenient time for you?

This is not a solicitation; we are simply trying to gather some information that will help the Energy Trust of Oregon to improve its energy efficiency program planning efforts and services. None of this information will be used to re-calculate incentives or tax credits you've already received. Your answers will be kept confidential by the researchers and the Energy Trust of Oregon.

Confirming Decision Maker

1. Do you recall installing mechanical equipment such as a motor, HVAC component, refrigeration equipment, or an energy management system through the Building Efficiency Program in __(month, year)__ at __(location of project)__?

    1. Yes
    2. No
        a. If no, identify who, get contact info from: ______________________

2. Are you the person at your organization who was most involved in making the decision to install this equipment through the Program?

    1. Yes
    2. No

    [If no:]

a. If no, identify who, get contact info from: ________________________

STATEMENT TO PERSON PRIOR TO THE REST OF THE SURVEY: "Although you may have installed other energy efficient measures, such as lighting, we are asking you mainly about the mechanical equipment in this survey."

Program Awareness

3. Do you know what organization is sponsoring the Building Efficiency Program and providing the incentives?

    1. Yes
    2. No

    [If yes:]

    a. Who?

        1. Energy Trust of Oregon [Skip to Q6]
        2. Their utility
        3. Other: __________________

4. Before today, had you heard of the Energy Trust of Oregon?

    1. Yes
    2. No
    8 Don't Know
    9 Refused

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5. Can you tell me how you first learned about the Building Efficiency Program incentives for energy-efficient mechanical equipment project? [DO NOT READ, CHECK ALL THAT APPLY open ended; probe to code]

    1. Mechanical vendor or contractor told me
    2. Saw ad from mechanical vendor
    3. Saw energy trust ad
    4. Went to energy trust website
    5. Utility or power company rep told me
    6. Friend or colleague told me
    7. Other: Describe: ________________________
    8. Don't Know
    9. Refused

When Heard About Program

Now I'm going to ask you a few questions about when you first heard about the Building Efficiency program incentives. Was it...

6. ...before you began to think about getting new mechanical equipment, or after?

    1. Before (Skip to Q 11)
    2. After
    8. Don't Know
    9. Refused

7. ..before you began to consider your choices of mechanical equipment , or after?

    1. Before (Skip to Q 11)
    2. After
    8. Don't Know
    9. Refused

8. ...before you selected or decided on the exact specifications of the mechanical equipment, or after?

    1. Before (Skip to Q 11)
    2. After
    8. Don't Know
    9. Refused

9. ...before you ordered the mechanical equipment, or after?

    1. Before (Skip to Q 11)
    2. After
    8. Don't Know
    9. Refused

10. ...before you installed the mechanical equipment, or after?

    1. Before (Skip to Q 11)
    2. After
    8. Don't Know
    9. Refused

Program Influence

According to our records, the total cost for all of the mechanical equipment you installed was about ____. The Energy Trust paid about a percentage of that cost. We are interested in exploring with you two ways this incentive might have influenced your decision to install the energy efficient mechanical equipment (i.e., the ______measures we show you installed). First, we'd like to explore the extent to which the incentive influenced ***what*** you installed—the type of equipment or its efficiency. After that, we may ask you about the possible influence of the incentive on the ***timing*** of your mechanical project.

11. How much influence did the incentive have on your decision to install the efficient mechanical equipment? Please use a scale from 0 to 10, with 0 being no influence at all and 10 being a lot of influence.

    ___Response (**0-10**) **88** Don't Know **99** Refused to Answer

12. Without the incentive, how likely is it that you would have installed **exactly** the same type and efficiency of mechanical equipment? Please use a scale from 0 to 10, with 0 being not at all likely and 10 being very likely.

    ___Response (**0-10**) **88** Don't Know **99** Refused to Answer

    Special Instruction for Contradictory Responses: If [Q.11 is 0,1,2 *and* Q12 is 0,1,2] *or* [Q.11 is 8,9,10 *and* Q.12 is 8,9,10]. Probe for the reason. However, it is important not to communicate a challenging attitude when posing the question. For example, say,

    When you answered "8" for the question about the influence of the rebate, I would interpret that to mean that the rebate was quite important to your decision to install; then, when you answered "8" for how likely you would be to install the same equipment *without* the rebate, it sounds like the rebate was *not* very important in your installation decision. I want to check to see if I am misunderstanding your answers or if the questions may have been unclear.

    If they volunteer a helpful answer at this point, respond by changing the appropriate answer. If not, follow up with something like:

    Will you explain in your own words, the role the rebate played in your decision to install this efficient equipment?

    If possible, translate the answer into a question 11 or 12 response that makes them consistent with each other, and check the response with the respondent for accuracy. If the answer doesn't allow you to decide what answer should be changed, write the answer down and continue the interview.

    a. Answer: ____________________

[If Q12 <=5 ask, else skip to Q14]

13. What type of equipment do you think you might have purchased instead?

    ____

14. Before your interactions with the Building Efficiency Program, was your company planning to replace (or add) mechanical equipment?

    1. Yes
    2. No
    8 Don't Know
    9 Refused

[If Q14=Yes and Q12<=5), then continue; Otherwise go to Q18]

15. Now, let's consider the ***timing*** of your purchase. Without the incentive from the Energy Trust Program, *when* would you have installed the energy efficient mechanical equipment?

    Percent (if they would have installed the equipment in stages, try to obtain the proportion they would have installed in each period. Sum should equal 100%):

    __ Within 6 months of your installation under the program?

    __ Within 6 to 12 months?

    __Within one or two years?

    __Within three to five years?

    __More than five years?

    __Don't know

    __Refused

    a. Why do you think it would have been _______ mos/yrs before you did the project without the incentive?

    ____

16. Did the money for the lighting project come from your organization's . . . (READ)

    1. Operating Budget
    2. Short-Term Capital Budget Or Plan
    3. Long-Term Capital Budget Or Plan
    4. Other: _______________
    8. Don't Know
    9 Refused

17. Before the project, had your organization previously installed any energy efficient mechanical equipment without any incentive?

    1. Yes
    2. No
    8. Don't Know
    9. Refused

Please indicate the extent to which you agree or disagree with the following three statements. A 0 indicates that you **strongly disagree** with the statement, a 10 indicates that you **strongly agree** with the statement.

18. The incentive for this mechanical equipment made it an "easier sell" to management

    ___ Response (**0-10**) **88** Don't Know **99** Refused to Answer

19. The incentive helped the mechanical equipment meet our investment criteria

    ___ Response (**0-10**) **88** Don't Know **99** Refused to Answer

20. The savings estimated for this mechanical equipment helped convince me to install the measures.

    ___ Response (**0-10**) **88** Don't Know **99** Refused to Answer

21. What financial calculations are made, if any, to help your organization make capital decisions *of this type* such as equipment installations or modifications, e.g., payback, return on investment or break-even analysis?

    1 None {Skip to Q25}

    2 Payback

    3 Return on Investment

    4 Break-even Analysis

    5 Other, specify: ____

    8 Don't Know

    9. Refused

22. What is the cut-off point that your organization uses to decide to go ahead? _______________ (for payback: maximum yrs, for ROI: minimum %)

    88 Don't Know

    99 Refused

PAST PROGRAM INFLUENCE

23. Did your organization participate in any **utility** energy efficiency programs before you installed energy efficient equipment through the Energy Trust's Building Efficiency program?

    1. Yes

    2. No

    8. Don't Know

    9. Refused

    [If No, Don't Know, or Refused, skip to **Q26**; if yes, continue:]

    Please indicate the extent to which you agree or disagree with the following statement. A 0 indicates that you **strongly disagree** with the statement, a 10 indicates that you **strongly agree** with the statement. (Key in 88 for Don't Know or 99 for Refused on the following 4 queries.)

a. Thinking about the other utility incentive program(s) you've participated in, how satisfied are you with the current Building Efficiency Program compared to these other programs? 0 indicates that you are **very dissatisfied** with the current Program and a 10 indicates that your are **very satisfied** with the current Program.

___ Response (0-10)   88 Don't Know   99 Refused to Answer

i. Why do you say that? (Probe for specific practices.)

Open:____

ii. *{If less satisfied (answer <= 5), and if not apparent from above comment, Probe},* Do you have any suggestions for how the Energy Trust might make the program more satisfactory for you?

Open: ____

b. My organization had a positive experience participating in previous utility energy-efficiency programs.

___ Response (0-10)   88 Don't Know   99 Refused to Answer

c. Our experience with the previous program(s) led us to ask our contractor to look into energy efficient options for mechanical equipment.

___ Response (0-10)   88 Don't Know   99 Refused to Answer

d. Our experience with the previous program(s) led us to consider the cost-effectiveness of energy efficient mechanical equipment when evaluating different options.

___ Response (0-10)   88 Don't Know   99 Refused to Answer

e. Our experience with the previous program(s) led us to select energy-efficient mechanical equipment.

___ Response (0-10)   88 Don't Know   99 Refused to Answer

Spillover

24. Since participating in the program, have you installed any ***additional energy efficient*** equipment ***without any incentives*** from the Energy Trust's Building Efficiency program?

    1. Yes
    2. No
    8. Don't Know
    9. Refused

    [If yes ask a and b; otherwise skip to 27:]

    a. Please describe the type and quantity of the efficient equipment or measures installed. This could include lighting and or other efficiency measures such as heating, air conditioning, motors, or refrigeration. (Open-ended)

    b. Overall, how influential would you say the program was in your decision to install additional efficient equipment? 0 indicates the Program was not at all influential in your decision to install additional equipment and a 10 indicates that the Program was very influential?

    ___ Response (0-10)   88 Don't Know   99 Refused to Answer

Energy-Related Decision Making

25. Has your organization developed any policies to govern the selection or specification of energy efficient equipment?

    1. Yes
    2. No
    8. Don't Know
    9. Refused

[If yes:]

a. And were these policies put in place BEFORE or AFTER you began participating in the Energy Trust's Building Efficiency program?

   1. Yes
   2. No
   8. Don't Know
   9. Refused

   [If after:]

   i. To what extent were these policies influenced by your participation in the Energy Trust's Building Efficiency program? Please provide your answer on a 10 point scale, with a 0 indicating **not at all influential** and a 10 indicating **very influential**.

   ___ Response (0-10) 88 Don't Know 99 Refused to Answer

Super T8 Potential

26. Are you aware of a type of T8 lamp that has recently become available that is even more efficient than the previous types of T8 lamps? Some people refer to these as "Super T8s"? Have you heard of these?

   1. Yes
   2. No
   8. Don't Know
   9. Refused

   [If yes:]

   a. Did you install these or consider installing these?

      1. Yes, installed
      2. Considered but did not install
      3. Did not consider

Process Questions

Now I want to ask about your experience in participating in the Building Efficiency program.

27. Do you recall any phone conversations or other interactions with the Energy Trust of Oregon or the program administrator concerning the Building Efficiency program? {If necessary, identify program administrator as Aspen Systems}

    1. Yes
    2. No
    8. Don't Know
    9. Refused

    [If yes:]

    a. Do you recall which one? To the best of your knowledge, was it the Energy Trust, the program administrator, or both?

        1. The Energy Trust
        2. The program administrator (Aspen)
        3. Both
        8. Don't know

28. Have you experienced any delays in any step of the project or has it taken longer for something to happen than you expected?

    1. Yes
    2. No
    8. Don't Know
    9. Refused

    [If yes:]

    a. Describe (Probe: What was delayed, reason for delay (if known), length of delay): ____

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b. What in your view would have been a reasonable turn-around time? [open] ______________________________

29. Can you tell me how you came to be working with the mechanical contractor or vendor you worked with? (open; do not read, prompt if needed)

1. Had worked with contractor in the past
2. Selected contractor from yellow pages, colleagues, etc.
3. Contractor approached respondent
4. Got name from Energy Trust of Oregon
5. Other
8. Don't know

[If other]

a. Describe: ______________________________

30. What reasons to purchase energy-efficient mechanical equipment did your contractor discuss with you? [open; do not read; record all mentions]

1. Decreased energy use or electricity bill
2. Incentive, rebate (lowers the first cost of equipment)
3. Better light/ high quality of light output/ better color
4. Decreased maintenance costs
5. Tax credit
6. Environmental benefits
7. Other
8. Don't know

[If other]

a. Describe: ______________________________

31. Did you decide to install all of the energy-efficient items that your contractor proposed?

    1. Yes
    2. No
    8. Don't Know
    9. Refused

    [If no:]

    a. What did you decide not to install, and why? [open]: ____________

32. Do you have any plans to install this equipment at a later date? _

    [If yes:]

    a. What, when: ____

Satisfaction

We'd like to get a sense of your satisfaction with the program. Please use a scale from 1 to 5, where 1 indicates **not at all satisfied** and 5 indicates **completely satisfied**. Please rate…(For Questions 33-38, key in 88 for Don't Know or 99 for Refused.)

33. …Your satisfaction with the performance of the mechanical equipment you installed __________

    [If <=2]

    a. Why did you say that? [open]: _________________________________

34. …Your satisfaction with the savings on your monthly energy bill

    [If <=2]

    a. Why did you say that? [open]: _________________________________

35. …Your satisfaction with the rebate amount

[If <=2]

a. Why did you say that? [open]: ________________________________

36. …Your satisfaction with the application process

[If <=2]

a. Why did you say that? [open]: ________________________________

37. …Your satisfaction with the quality of work conducted by your contractor/ vendor

[If <=2]

a. Why did you say that? [open]: ________________________________

38. Your overall satisfaction with your program experience

[If <=2]

a. Why did you say that? [open]: ________________________________

Satisfaction with Energy Trust and PMC (Ask if Q27=Yes)

This next set of questions deals specifically with any interactions you may have had with the Energy Trust. If you have had more than one interaction with the Energy Trust, please give use your response based on all experiences with them, not just a single event. Please use a scale from 1 to 5, where 1 indicates **extremely unsatisfactory** and 5 indicates **extremely satisfactory**. Please rate …(For Questions 39 to 43 key in 88 for Don't Know or 99 for Refused.)

39. The Energy Trust's courtesy on the phone: 1 2 3 4 5

[If <=2]

a. Can you describe the factors leading to your lack of satisfaction? [open]: ____

40. The Energy Trust's helpfulness on the phone: 1 2 3 4 5

[If <=2]

a. Can you describe the factors leading to your lack of satisfaction? [open]: ______________________________

41. The Energy Trust's knowledge of program services: : 1 2 3 4 5

[If <=2]

a. Can you describe the factors leading to your lack of satisfaction? [open]: ______________________________

42. The ease of your transactions (paperwork / payments): 1 2 3 4 5

[If <=2]

a. Can you describe the factors leading to your lack of satisfaction? [open]: ______________________________

43. Your satisfaction with any issue that needed resolution: 1 2 3 4 5 77 (77=no issues needed resolution)

[If <=2]

a. Can you describe the factors leading to your lack of satisfaction? [open]: ______________________________

BETC and SELP

44. Are you aware that the State of Oregon offers a tax credit for qualifying energy-efficient investments, called the Business Energy Tax Credit, or BETC?

1. Yes
2. No
8. Don't Know
9. Refused

[If yes:]

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a. Did your contractor mention the tax credit program to you?

   1. Yes
   2. No
   8. Don't Know
   9. Refused

   [If yes:]

   i. Did your organization apply to receive a tax credit?

      1. Yes
      2. No
      8. Don't Know
      9. Refused

      [If yes:]

      1. Did your organization receive a tax credit from the State?

         1. Yes
         2. No [Probe for reason]: ___
         8. Don't Know
         9. Refused

45. Are you aware that the State offers loans for qualifying energy-efficient investments, called the Energy Loan program, or SELP?

    1. Yes
    2. No
    8. Don't Know
    9. Refused

    [If yes:]

a. Did your contractor mention the loan program to you?

1. Yes
2. No
8. Don't Know
9. Refused

[If yes:]

i. Did your organization apply to receive a loan?

1. Yes
2. No
8. Don't Know
9. Refused

[If yes:]

1. Was your organization approved to receive a loan from the State? [Allow verbatim if needed]

1. Yes
2. No
3. Waiting approval
8. Don't Know
9. Refused

Firmographics

46. What is the primary activity that occurs at this facility? (DO NOT READ)

1. Office
2. Retail
3. Warehouse/ wholesale
4. Food service
5. Hotel
6. Other: ________________

47. Approximately, how many full-time equivalent (FTE) employees work at this facility?

_____ Number of FTEs

8. Don't Know

9 Refused

48. How many other sites does your organization operate?

_____ Number of Other Sites (Numeric)

_____ Number of Other Sites (Verbatim)

8. Don't Know

9 Refused

49. How many years has your organization been in business at **this** site?

____ Number of Years

8. Don't Know

9 Refused

8. Don't Know

9 Refused

50. Approximately how many square feet of lighted area are in your business?

_____ Square Feet

8. Don't Know [Skip to Q. 50]

9. Refused [Skip to Q. 50]

51. Of this square footage, what percent is conditioned?

_____ Square Feet

8. Don't Know

9. Refused

Conclusion

52. **In conclusion**, are there any other comments you would like to make on the incentive program, or any feedback you would like for program manager to hear? [open]

53. May we call you another time in the course of this evaluation?

    1. Yes
    2. No

As part of this research, you may be visited sometime this summer or fall so that we As part of this research, you may be visited sometime this summer or fall so that we might inspect the mechanical equipment you installed through the program. An independent contractor hired by the Energy Trust would conduct the inspection. The inspection will not result in any changes to your incentive. While not all sites are slated to be audited, you may receive a call to set up a time or the inspector may simply drop by your establishment to look at any efficient motors you may have installed.

We thank you for your time

TECHNICAL ANALYST (ATAC) SURVEY GUIDE
BUILDING EFFICIENCY PROGRAM – ENERGY TRUST OF OREGON, INC.

Name: ______________________________ **Date:** ______________________________

Firm: ______________________________ **Telephone:** __________________________

Marketing

1. Does the number of studies you've conducted under the program compare with your expectations?

2. Have you brought any customers to the program?
   [If yes] About what proportion of the studies that you've done have been for customers you've brought in?

3. Prior to the program did you (or to areas outside the program, like Washington do you now) actively sell your analytical services?

4. What proportion of your customers appear to be aware that the Building Efficiency program is being offered by Energy Trust?

5. What proportion of your customers appear to be aware that Aspen Systems is implementing the Building Efficiency program for Energy Trust?

Customer Response to Studies

6. After you've completed the study, what happens?

   Probes:

   7. Who delivers the report to the customer?
      How? (Any in-person or by phone conversation about the report?)

[If more than one approach:] How do you decide which approach to use with a customer?

8. Do you know who, if anyone, from the Building Efficiency program follows up with customers as they decide about implementing the recommendations and taking the next steps?

9. Do you ever receive any feedback from customers on the studies?
   [If yes:] What feedback have you received?

10. Do the customers typically decide to install all of the recommended measures? (or most? Or some? Or don't know?)

11. Do customers give you any reasons for not installing measures you recommend?
    [If yes:] What reasons have you heard?

Direction from the PMC

12. Has Aspen Systems been clear in its expectations for the studies?

13. Have you ever been asked to revise any of the studies? (N/Y)

14. [If yes:] What types of revisions have you been asked to make?

    [Probe:] Anything else?

15. Is there a set price for the studies, or do you negotiate each one?

16. [If negotiate:] Have you had any difficulty negotiating with Aspen Systems regarding the fee you will charge them for the study?

17. [If yes:] What has been your experience?

18. Has the fee been generally appropriate to the needs of the study?
[If no:] What has been your experience?

19. What BEP meetings or training have you had with Aspen?

20. Have you received any instruction or direction from Aspen Systems on methods to use in the audits, or to convey the findings?

21. Would you like to receive additional direction from Aspen?
[If yes:] What would you like?

22. Regarding the forms required for the program, do you have any concerns or feedback about them?

Overall Assessment

23. Has your involvement in the program met your expectations?

24. [If not:] In what way?

25. Overall, how satisfied are you with your involvement in Building Efficiency? Please use a 1 to 5 scale, where 1 is not at all satisfied and 5 is highly satisfied. Open:
RATE: 1 2 3 4 5

26. Do you have any concerns about the program, or about your participation in the program?

27. [If yes:] What are they?
Anything else?

28. Do you think these concerns will have any ongoing effect on your experience participating in the program?

    29. [If yes:] What? [open]

    30. Do you think these concerns will have any effect on your customers?

    31. [If yes:] What? [open]

Final Questions

32. What do you believe are the current strengths of the Building Efficiency program?

33. What are its current weaknesses?

34. Are there any changes you would like to see made in the program?

    35. [If yes:] What?

    36. Thinking about the other utility incentive programs you've participated in, how satisfied are you with the BEP compared to those programs? Please use a 5-point scale in which 5 means "much more satisfied" and 1 means "much less satisfied."
    1 much less satisfied 2 3 4 5 much more satisfied
    NA (no utility experience)

37. Why do you say that? [Probe for specific practices or lessons learned.]

38. May we call you another time in the course of this evaluation?

PARTICIPATING MECHANICAL VENDORS SURVEY
BUILDING EFFICIENCY PROGRAM – ENERGY TRUST OF OREGON, INC.

Name: ______________________________ **Date:** ______________________________

Firm: ______________________________ **Telephone:** ______________________________

Learning about the Program

1. How did you first hear about the Building Efficiency program?

2. How did you learn the procedures you needed to follow to participate in the program?

3. Do all of your sales staff know about the program and understand how to participate?

Customer Awareness and Interest

4. When did you learn about the program?
   Did you decide to start offering it to your customers at that time, or a later date?
   (When?)

5. What proportion of your customers seem to be aware of the BE program before you mention it?

6. About what proportion seem to be already aware of the Energy Trust?

7. Are there also customers who ask you whether any incentives are available, who haven't heard of the BE program?
   (What proportion?)

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8. About what proportion of your customers raise the issue of energy efficiency?

9. Do you mention the program to all or most customers as a general approach, or do you target customers that you think might be interested?

10. (If target:) Who do you target?

11. When you mention the program to customers, about what proportion would you say consider participating?

12. What are the advantages of efficient equipment and the BE program that you tell customers about? (probe for all)

13. Are there ever disadvantages to efficient equipment, other than the cost?

14. What are reasons that some customers don't participate?

15. Do you think the level of incentive offered is persuasive?

Background

16. What products and services do you offer?

17. About how many years has your company been in business?

18. About how many employees do you have?

Program Experience

19. Would you say the program provides a good fit with your services and products? (elaborate)

20. Do you have any difficulty getting from your suppliers equipment that is eligible for incentives?

21. Are you satisfied with the range of equipment that is eligible for incentives? (elaborate)

22. Have you had any paperwork you've submitted to the program returned to you for changes?

23. Are you satisfied with the steps required for program participation? (elaborate)

24. Does the timing of the steps (what needs to be submitted at what point in the project) work for you and your customers?

25. How about the turn around time for paperwork you've submitted?

26. Has your involvement with the program ever resulted in any delays for your customers?

27. Would you like to see any changes in the participation process?

28. How about in the paperwork?

29. Are there any stumbling blocks to participation for you or your customers?

30. Did you participate in the previous utility programs run by the utilities?

31. (If yes:) Thinking about the other utility incentive programs you've participated in, how satisfied are you with the Energy Trust program compared to these other programs? Please use a 5-point scale in which 5 means "much more satisfied" and 1 means "much less satisfied."

    1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

32. Why do you say that?

33. Have you had any interactions with the Energy Trust?

34. Have you had any conversations or email correspondence with Aspen staff (other than program application paperwork)?

(If yes to contact w Energy Trust or Aspen:) I have a few questions that deal specifically with any interactions you may have had with Aspen staff or the Energy Trust . If you have had more than one interaction with them, please give me your response based on all experiences with them, not just a single event. Please use a scale from 1 to 5, where 5 indicates extremely satisfactory and 1 indicates extremely unsatisfactory. Please rate …(key in 88 for Don't Know or 99 for Refused)

35. The Energy Trust's courtesy on the phone:

    1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

36. The Energy Trust's helpfulness on the phone:

    1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

37. The Energy Trust's knowledge of program services:

    1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

38. The ease of your transactions (paperwork / payments):

    1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

39. Your satisfaction with any issue that needed resolution:

    1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 77 ☐ (77=no issues needed resolution)

Future

40. Are there any changes you would like to see in the program? (elaborate)

41. Over the coming year, about what proportion of your customers do you anticipate will decide to participate in the program?

42. In conclusion, are there any other comments you would like to make on the program or any feedback you would like for the Energy Trust to hear?

43. May we call you another time in the course of this evaluation? [y ☐ n ☐]

PROGRAM STAFF INTERVIEW GUIDE
BUILDING EFFICIENCY PROGRAM – ENERGY TRUST OF OREGON, INC.

Name: ______________________________ **Date:** ____________________________

Update from Last Evaluation

1. What, if any, features of the program have changed since mid-2003?

2. Have any staff changed?

3. Any new areas of program activity?

4. Did you see the mid-first-year process evaluation report?

    a. Have any actions been taken or changes been made as a result of the evaluation findings?

Assessment of Energy Trust Processes

5. The first evaluation found the Energy Trust was slow to provide direction to the program and that actions of its contracts/legal staff delayed program implementation. Have these conditions changed? In what ways?

6. Are there any outstanding issues about which the PMC is awaiting Energy Trust input or direction?

[To ask of only Energy Trust staff (program manager and EE director):]

7. What activities has the BE program manager [or you] engaged in since joining the Energy Trust?

    a. What activities will the manager/you continue to pursue now that he's come up to speed with the program?

8. How do you get input from the market or feedback about the program?

    a. In what ways do you interact with the PMC?

   b. Have you had any interactions with participating commercial firms or participating contractors and vendors?

9. Do you review the program and project tracking data?

10. How satisfied are you with PMC and program performance?

11. What changes are you contemplating for the program?

12. What challenges or problems does the program face?

Assessment of PMC Processes

[To ask of only PMC staff:]

13. What activities have you been engaged in?

14. What steps have you taken, and will you be taking, to develop and support the network of contractors?

   a. Explore lighting, mechanical electric, and mechanical gas-fired

15. What tools have you made available to contractors to make it easier for them to submit applications?

16. Are contractors expressing any problems—or are you observing any problems—with the participation procedures?

17. What are your methods for reviewing applications and assessing cost effectiveness?

18. How do you work with ATACs?

   a. What direction have you given them?

19. What types of projects are assigned ATACs?

   a. How do you determine which ATAC to assign projects to?

20. How satisfied are you with contractors' ability to bring projects into the program?

21. How are you serving large institutional customers?

22. Do you help participants with BETC applications?

    a. How well would you say the BE and BETC programs are coordinating?

    b. Any problems?

23. What challenges does the program currently face?

24. What are your plans for the future?

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P.O. Box 12312, Portland, Oregon 97212

503 / 287-9136