FINAL REPORT

IMPACT EVALUATION OF 2013-2014 PRODUCTION EFFICIENCY PROGRAM

Submitted to

ENERGY TRUST OF OREGON
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sbw

ENERGY + WATER + EFFICIENCY

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ACKNOWLEDGEMENTS

We want to acknowledge the tremendous efforts made by Energy Trust evaluation and program staff. We also acknowledge the Program Delivery Contractors (PDCs), Allied Trade Assistance Contractors (ATACs), and customers that provided working analysis data and calculations, supplemental information and data for this evaluation, and significant other support. Many hours were spent reviewing plans and draft work products along with time spent gathering documentation, answering questions from the evaluation team and assisting the evaluation team with inspections and data collection for the 111 evaluated projects that were implemented throughout Oregon. This study could not have been completed without these contributions to our efforts.

EXECUTIVE SUMMARY

Energy Trust of Oregon (Energy Trust) is an independent nonprofit organization, selected and overseen by the Oregon Public Utility Commission, to lead Oregon ratepayers in benefiting from saving energy and generating renewable energy. Their services, cash incentives, and solutions have helped participating customers of Portland General Electric, Pacific Power, NW Natural, Cascade Natural Gas and Avista save over $1.3 billion on their energy bills since 2002. The cumulative impact of their leadership since that time has been a contributing factor in the region's low energy costs and in building a sustainable energy future.

This report documents the impact evaluation of the Production Efficiency program for calendar years 2013 and 2014.

Background

Energy Trust has operated its Production Efficiency program since 2003. In 2013, the program provided financial incentives for over 1,000 projects, which yielded annual electric savings of over 110 million kWh and annual gas savings of just over 1 million therms. In 2014, the program provided incentives for over 1,000 projects, which yielded annual electric savings of over 172 million kWh and annual gas savings of just over 1 million therms. Energy Trust performs process and impact evaluations on all its programs on a regular basis.

Methodology

The objectives of this impact evaluation were to:

- Develop reliable estimates of Production Efficiency program working savings for 2013 and 2014. This information will be used for program savings projections and budget development and will be incorporated in Energy Trust's annual true-up of savings.
- Report observations and make recommendations to help Energy Trust improve the effectiveness of its estimates of working energy savings

To satisfy these objectives, the goal of this impact evaluation was to quantify the working energy savings (kWh and therms) achieved by the Production Efficiency program through an assessment of a representative sample of efficiency projects that were implemented during the 2013 and 2014 program years.

The total number of projects and reported working savings for the program is summarized in Table 1 by year and fuel. Also shown are the corresponding sample sizes and savings represented by the sampled projects. The sampled projects represent 28% of total electric savings and 52% of total gas savings for 2013, and 43% of total electric and 48% of total gas savings for 2014.

Table 1: Summary of Impact Evaluation Sample

Program Year	Fuel	Program Project Counts	Program Reported Working Savings (kWh or therms)	Sampled Project Counts	Sampled Savings (kWh or therms)	Sample Percent of Reported Working Savings
2013		**1,034**		**56**		

Program Year	Fuel	Program Project Counts	Program Reported Working Savings (kWh or therms)	Sampled Project Counts	Sampled Savings (kWh or therms)	Sample Percent of Reported Working Savings
	Electric	972	110,312,683	38	30,516,065	28%
	Gas	62	1,285,933	18	668,939	52%
2014		**1,136**		**55**		
	Electric	1,055	171,995,900	36	73,220,012	43%
	Gas	81	1,226,822	19	592,660	48%
All		**2,170**		**111**		

Specific tasks to complete the impact evaluation included the following:

- **Installation verification**. Verify through field inspection, customer interviews and the review of project documentation that the sampled measures were installed and operational. Also verify key determinants, such as equipment utilization, hours of operation and performance profiles, which affect the projected savings of program-installed measures.
- **Savings estimation methods**. Critique models and algorithms used by the program to estimate working savings and revise as needed to improve the reliability of these estimates.
- **Project-specific savings**. Estimate project-specific working savings and realization rates (kWh and therms) for the sampled projects in the program's four tracks: Streamlined, Custom, Custom O&M and Strategic Energy Management, or SEM.
- **Program level gross savings.** Estimate program-level energy savings and the associated savings realization rates (kWh and therms), separately for 2013 and 2014. Also, estimate savings by program track.
- **Program improvements.** Report observations that assist Energy Trust in understanding substantial deviations from the claimed savings. Recommend changes in the savings estimation methods or other program protocols that will enhance future realization rates and program cost effectiveness.

Program Savings

The evaluation verified that the savings for the programs were similar to the reported working savings. As shown in Table 2, the realization rates (RR)[1] for the entire program are 0.96 and 0.93 for 2013 and 2014, respectively. Realization rates vary across the program track domains with the lowest realization rates for the custom O&M domains for both years. This domain typically does result in lower realization rates due to the short measure lifetime (three years) and the dynamic nature of O&M measures which tend to degrade over time without due diligence in maintaining desired operation by facility operations staff.

Further breakdown of evaluated savings by fuel type is shown in Table 3.

[1] Realization rate is the ratio of evaluation savings to reported savings. Realization rates greater than one mean that we found more savings than was reported.

Table 2: Program Level Total Energy Savings and Realization Rates

Year	Program Track	Reported Working Energy Savings (MMBTU)	Evaluated Energy Savings (MMBTU)	Realization Rate
2013	Custom	160,768	153,245	0.95
2013	SEM	92,266	95,179	1.03
2013	Streamlined	170,659	168,877	0.99
2013	Custom O&M	27,946	19,978	0.71
2013	Remaining[2]	53,066	49,751	0.94
2013	**Total**	**504,706**	**487,032**	**0.96**
2014	Custom	206,216	165,944	0.80
2014	SEM	189,262	189,838	1.00
2014	Streamlined	196,840	201,848	1.03
2014	Custom O&M	40,864	26,671	0.65
2014	Remaining	75,922	76,324	1.01
2014	**Total**	**709,104**	**660,624**	**0.93**

Table 3: Program Level Electric and Gas Savings and Realization Rates

Year	Program Track	Reported Working Savings		Evaluated Savings		Realization Rate	
		Electric (kWh)	Gas (therms)	Electric (kWh)	Gas (therms)	Electric	Gas
2013	Custom	47,152,766	-	44,946,442	-	0.95	NA
2013	SEM	24,081,863	101,590	24,958,677	100,824	1.04	0.99
2013	Streamlined	30,881,443	653,686	30,358,759	653,687	0.98	1.00
2013	Custom O&M	8,196,611	-	5,859,629	-	0.71	NA
2013	Remaining	-	530,657	-	497,515	NA	0.94
2013	**Total**	**110,312,683**	**1,285,933**	**106,123,508**	**1,252,026**	**0.96**	**0.97**
2013					**Relative Precision (90-10)**	**0.03**	**0.02**
2014	Custom	60,482,437	-	48,670,917	-	0.80	NA
2014	SEM	54,572,777	31,953	54,826,193	29,074	1.00	0.91
2014	Streamlined	44,955,406	435,645	46,424,076	435,643	1.03	1.00
2014	Custom O&M	11,985,280	-	7,822,632	-	0.65	NA
2014	Remaining	-	759,224	-	763,235	NA	1.01
2014	**Total**	**171,995,900**	**1,226,822**	**157,743,818**	**1,227,953**	**0.91**	**1.00**
2014					**Relative Precision (90-10)**	**0.06**	**0.05**

[2] The "Remaining" program track domain includes both custom and custom O&M projects. There was not a sufficient number of custom O&M gas projects to justify separate domains.

Recommendations

Our key recommendations are:

1. **Consider faster or real-time evaluation**. We found that this evaluation was hampered by the long duration from project completion to evaluation. Evaluation delays also prevent timely implementation of any recommendations resulting from the evaluation for future improvements to the program. There were also significant delays for some projects due to problems obtaining customer cooperation in a timely fashion.
2. **Clarify M&V protocols related to savings duration**. Energy Trust's M&V protocols are not clear about whether evaluation savings estimates should be based on as observed conditions, conditions in the first year after measure implementation, or a combination of conditions prorated over the measure life cycle. We recommend that Energy Trust determine which savings estimates best serve the programs and define that protocol. Future evaluation requests for proposals should then clearly state the protocol in on how to appropriately handle all parameters in the savings models to achieve the required evaluation savings estimates. This will ensure methodological consistency over future years. This evaluation was based on typical savings as the average of historical production/operating hours and the working analysis. If we had used first year only or as observed conditions, then savings for some of the large projects would have been significantly lower, resulting lower realization rates.
3. **More pre- and post-installation metering.** Many projects are developed using baseline schedules provided by the customer and kW loads based on equipment nameplate data. We found several projects where the customer (at the time of the evaluation) stated different baseline conditions than used those in the working analysis. Therefore, the baseline conditions may have been simply assumed by the analyst. Also, we found post-installation kW equipment loads based on nameplate data, for which our metered results revealed substantial differences. Additional metering to determine schedule and kW profiles, or even one-time measurements to confirm nameplate kW, would improve the accuracy of some working savings estimates significantly.
4. **Consider maximum (design) capacity and realistic loads.** We found multiple projects that based savings on maximum equipment capacity or future expected loads, when in fact, the equipment was operating at significantly reduced loads. Realistic loading should be the analysis goal. This is also justification for post-installation metering. There are some cases of this that result from unforeseen market conditions, which cannot be anticipated and are beyond the control of the program, but due diligence with customer interviews during the verification site visit is warranted.
5. **Better QC of working analysis models.** We found errors in the working analysis calculations of eleven projects. About half the errors were significant (greater than 10% impact on savings) while the remaining errors were minor with little impact. The errors appeared randomly across most of the sample domains. Additional QC would be beneficial to identify and correct such errors. This would also help ensure well documented analyses. Consider

enlisting the efforts of an independent third-party QC contractor to improve analytical quality.

Memo

To: Board of Directors

From: Erika Kociolek, Evaluation Sr. Project Manager
Eric Braddock, Sr. Technical Manager – Industry and Agriculture

Date: July 15, 2019

Re: Staff Response to 2013-2014 Production Efficiency Impact Evaluation

The 2013-2014 Production Efficiency impact evaluation, conducted by SBW Consulting, demonstrates that the program generated substantial energy savings, and accurately estimated the majority of these savings, as evidenced by relatively high realization rates.

The evaluator made a number of recommendations related to increasing the reliability of savings and improving program documentation, including: performing more pre- and post-installation metering, waiting to close out projects until measures have been fully installed, using more realistic assumptions for capacity and loads, providing more documentation for complex analyses, improving QC of models, and requiring final models to be provided to Energy Trust. Starting in 2018, the program no longer closes out projects until the equipment is commissioned and online; prior to 2018, this was only done in a few unique situations. In addition, in an effort to address the recommendation regarding using more realistic assumptions for capacity and loads, as of 2018, the program only claims savings that are currently being realized, rather than claiming savings based on forecasted growth. The program continues to perform pre- and post-installation metering as it deems necessary, work with the PDCs to improve QC of models, and improve the documentation accompanying complex analyses. The program does not require final models to be provided across the board, but as of Q3 2017, it does require final models to be provided for some types of projects.

The evaluator also made two recommendations related to future evaluations: (1) shortening the time between measure installation and completion and evaluation, and (2) clarifying the protocols for *ex post* savings estimates – e.g., observed conditions, conditions in the first year after measure installation and completion, a combination of conditions prorated over the measure life, etc. Regarding the first recommendation, for a variety of reasons, finalizing the results from this impact evaluation took some time. Ensuring faster delivery of evaluation results is important because it provides program staff with more useful and timely information that they can use to improve program delivery and allows measures with shorter lifetimes to be evaluated closer to the time they are installed or completed. Energy Trust evaluation staff are continuing to explore options for shortening the time between measure installation and completion and evaluation; one possibility is to evaluate measures with shorter lifetimes (such as operations and maintenance measures) and very large or complex projects outside of the program impact evaluations and through a separate and ongoing process, which is more similar to the evaluation process for mega-projects and the process for evaluating large New Buildings projects. In addition, in an effort to shorten the time between measure installation and completion and evaluation, and due to high and relatively consistent realization rates over time, Energy Trust will not be evaluating the 2015 program year. However, the 2016-2017 Production Efficiency impact evaluation, which is well underway, will include a single 2015 project, which accounts for 60% of the Production Efficiency program's gas savings in 2015. Regarding the second recommendation, Energy Trust evaluation and program staff have put together a document outlining policies for industrial impact evaluations, which will provide clarity to evaluators and ensure consistency over time.

1. INTRODUCTION

Energy Trust of Oregon (Energy Trust) is an independent nonprofit organization, selected and overseen by the Oregon Public Utility Commission, to lead Oregon ratepayers in benefiting from saving energy and generating renewable energy. Their services, cash incentives, and solutions have helped participating customers of Portland General Electric, Pacific Power, NW Natural, Cascade Natural Gas and Avista save over $1.3 billion on their energy bills since 2002. The cumulative impact of their leadership since that time has been a contributing factor in the region's low energy costs and in building a sustainable energy future.

1.1. Background

Energy Trust has operated its Production Efficiency program since 2003. In 2013, the program provided incentive for over 1,000 projects, which yielded annual electric savings of over 110 million kWh and annual gas savings of just over 1 million therms. In 2014, the program provided incentives for over 1,000 projects, which yielded annual electric savings of over 170 million kWh and annual gas savings of just over 1 million therms. Energy Trust performs process and impact evaluations on all its programs on a regular basis.

Energy Trust contracted with SBW Consulting, Inc. (SBW) to perform an independent evaluation of the 2013 and 2014 Production Efficiency program. This report describes in detail the primary tasks comprising the evaluation scope and presents the results of this evaluation effort.

1.2. Objectives

The objectives of this impact evaluation are to:

- Develop reliable estimates of Production Efficiency program working savings for 2013 and 2014. This information will be used for program savings projections and budget development and will be incorporated in Energy Trust's annual true-up of savings.
- Report observations and make recommendations to help Energy Trust improve the effectiveness of its estimates of working energy savings

To satisfy these objectives, the goal of this impact evaluation was to quantify the working energy savings (kWh and therms) achieved by the Production Efficiency program through an assessment of a representative sample of efficiency projects that were implemented during the 2013 and 2014 program years. Specific tasks included the following:

- **Installation verification**. Verify through field inspection, customer interviews and the review of project documentation that the sampled measures were installed and operational. Also verify key determinants, such as equipment utilization, hours of operation and performance profiles, which affect the projected savings of program-installed measures;
- **Savings estimation methods**. Critique models and algorithms used by the program to estimate working savings and revise as needed to improve the reliability of these estimates.

- **Project-specific savings**. Estimate project-specific working savings (kWh and therms) for a sample of projects in the program's four tracks (Streamlined, Custom, Custom O&M and Strategic Energy Management, or SEM) for the 2013 and 2014 program years. Also, calculate project-specific realization rates. For the projects that included multiple measures for the sampled fuel, we evaluated savings for all measures within the project.
- **Program level gross savings.** Estimate program-level energy savings and the associated savings realization rates (kWh and therms), separately for 2013 and 2014. Also, estimate savings by program track.
- **Program improvements.** Report observations that assist Energy Trust in understanding substantial deviations from the claimed savings. Recommend changes in the savings estimation methods or other program processes that will enhance future realization rates and program cost effectiveness.

Later in this report, we provide a detailed description of the tasks we completed to meet the above objectives. This work employed best practice energy program evaluation methods to provide the best available estimate of energy savings within the available resources.

1.3. About This Report

This report includes the following:

- **Executive Summary**. A brief overview of the main body of the report suitable for a broad audience.
- **Methods**. Description of the evaluation objectives, sample design and selection, site data collection procedures, procedures used to review program savings calculation and to estimate evaluation savings, and methods used to extrapolate sample estimate to estimates of total working savings by program year.
- **Findings**. Comparison of program and evaluation savings for each project and tabulation of savings by program year.
- **Recommendations**. Description of the recommendations developed from the review and analysis described above.
- **Appendices**. M&V plan/report template, sample report, customer survey instruments developed for the evaluation effort and the evaluation results for each sampled project. A confidential appendix has also been prepared that provides detailed descriptions of the methods used, data collected and findings for the Custom, Custom O&M and SEM sampled projects directly evaluated as part of this evaluation.

2. METHODOLOGY

SBW worked closely with the Energy Trust Evaluation staff to define the final sampling methodology, develop the project specific M&V plans and reports, and develop customer survey instruments and customer contact protocols. Details of these efforts are provided in the section below. Energy Trust program staff, PDCs and ATACs were also very helpful in providing supplemental energy saving calculations, assisting with customer contact, obtaining supplemental data and providing other customer information.

2.1. Develop the Evaluation Sample

Energy Trust provided the SBW evaluation team with the tracking database for the program years to be evaluated, consisting of tables listing all measures installed through the program during 2013 and 2014, as well as one table rolling up all measures by project, together with the corresponding working kWh and therm savings. We developed preliminary evaluation sampling plan options by following these steps:

1. **Create lists by year and fuel.** We created two lists of projects for each year, excluding solar projects and projects that spanned years, resulting in savings claimed in years other than 2013 or 2014. One list contained all projects with electric savings greater than zero. The other contained all projects with gas savings greater than zero. Some sites had both gas and electric projects in one or both years.
2. **Develop domains by track.** Within each of the fuel/year lists we developed domains by program track—namely, Streamlined, Custom, and SEM. These domains were used to control the sampling fraction for each track. We also developed an option for an additional Custom O&M track. Energy Trust requested that we consider the latter because Custom O&M measures have a measure life of only three years and given the fact that the evaluation was examining these projects nearly three years after completion in some cases, we expected to see significant measure failure, with implications on how to interpret the realization rate in this situation. Furthermore, preliminary results from the 2012 Production Efficiency impact evaluation showed relatively low realization rates for Custom O&M measures.
3. **Identify certainty selections.** Within each fuel/year/track domain, we identified the projects with the largest savings and selected them with certainty. This ensured that the sites we evaluated would account for a large fraction of the total savings claim for the program. Such certainty selections also make the sample more efficient, i.e., allow it to achieve higher sampling precision with smaller sample size.
4. **Randomly select projects.** For the remaining projects in each domain, we developed an optimal stratification design. Strata in each domain were defined based on the program estimate of savings. We defined these strata using the Dalenius and Hodges method, and applied a Neyman allocation to determine the optimum sampling fraction for each stratum. An overriding objective of this sampling plan was to develop reliable annual estimates of Production Efficiency program electric and gas savings and realization rates

for the 2013 and 2014 program years, with precision of ±10% or better at a 90% level of confidence. At the domain level, we aimed for precision of ±20% or better at an 80% level of confidence, though we exceeded this threshold for Custom O&M domains because it was difficult to justify relatively large sample fractions for such a small fraction of custom track savings.

Applying these steps, we developed four scenarios:

1. A **base** efficient scenario broken out by year, fuel and track (Streamlined, Custom, and SEM) into 12 domains.
2. The **Custom O&M track** scenario, offering a sample design where the custom O&M projects were sampled separately from the other custom projects where possible (there were insufficient numbers of gas Custom O&M savings projects to justify their own domains).
3. The **no lighting-only projects** scenario, consisting of Scenario 1 with lighting-only projects omitted from the sample design, owing to the stable realization rates of lighting measures found in past impact evaluations.
4. The **Custom O&M / No lighting-only** scenario, consisting of Scenario 3, but with Custom O&M projects placed into their own sampling tracks, as in Scenario 2.

Energy Trust ultimately selected the second scenario as the basis for final sample design, which is illustrated in Figure 1. The track domain listed as "Remaining" includes both Custom and Custom O&M projects since there were not sufficient gas Custom O&M projects in the program population to justify their own domain.

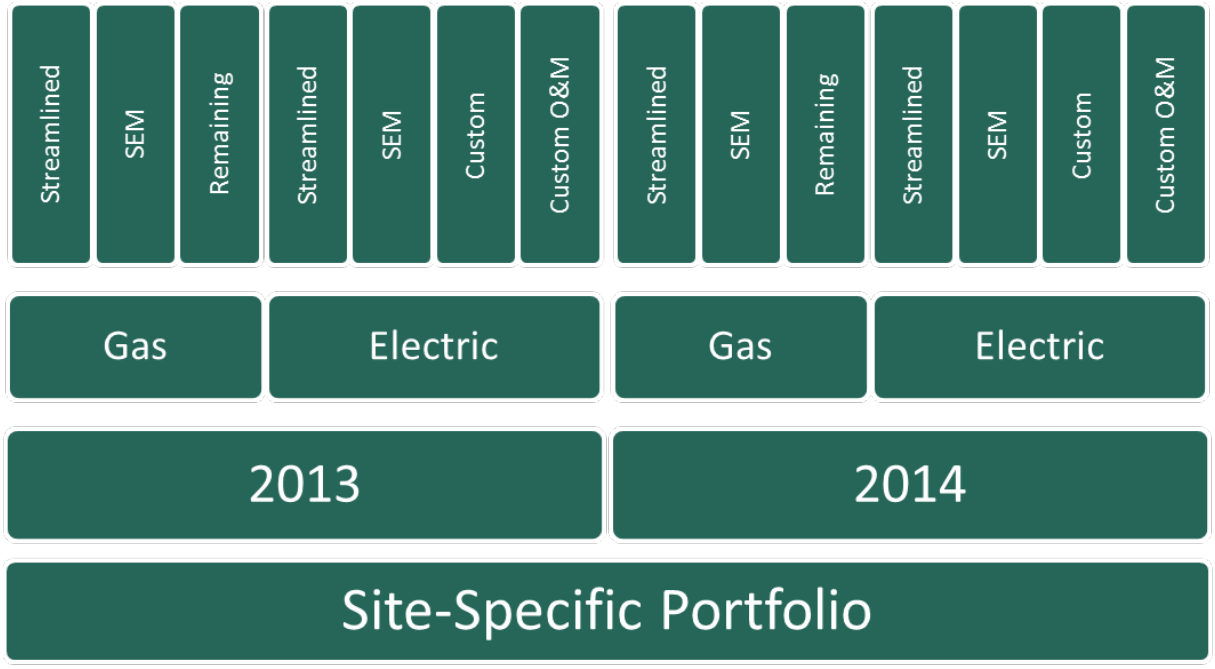

Figure 1: Impact Evaluation Domains

Table 4 shows the results of the sample draw for each year, and by year and fuel at the 90% confidence level. Table 5 shows the results of the sample draw further broken down by program track. All six of the sampled projects in the 2013 / Gas / Remaining domain were Custom projects. One of the nine sampled projects in the 2014 / Gas / Remaining domain was a Custom O&M project and eight were Custom projects.

Table 4: Sample Draw Summary

Program Year	Fuel	Program Projects	Program Working Savings (kWh or Therms)	Relative Precision	Sampled Projects	Sampled Savings (kWh or Therms)
2013		**1,034**		**11%**	**56**	
	Electric	972	110,312,683	11%	38	30,516,065
	Gas	62	1,285,933	9%	18	668,939
2014		**1,136**		**9%**	**55**	
	Electric	1,055	171,995,900	9%	36	73,220,012
	Gas	81	1,226,822	10%	19	592,660
All		2,170		7%	111	

Table 5: Sample Draw Summary by Program Track

Program Year	Fuel	Program Track	Program Projects	Program Working Savings (kWh or Therms)	Confidence Level	Certainty Strata Projects	Sampled Projects	Relative Precision	Sampled Savings (kWh or Therms)
2013	Electric	Streamlined	794	30,881,443	80%	1	14	12%	2,688,889
2013	Electric	SEM	32	24,081,863	80%	2	9	12%	13,647,176
2013	Electric	Custom	112	47,152,766	80%	1	9	14%	10,504,566
2013	Electric	Custom O&M	34	8,196,611	80%	2	6	49%[3]	3,675,434
2013	Gas	Streamlined	38	653,686	80%	0	7	13%	200,114
2013	Gas	SEM	9	101,590	80%	3	5	12%	86,150
2013	Gas	Remaining	15	530,657	80%	2	6	7%	382,675
2014	Electric	Streamlined	853	44,955,406	80%	3	13	13%	9,323,475
2014	Electric	SEM	36	54,572,777	80%	2	8	11%	39,706,461
2014	Electric	Custom	146	60,482,437	80%	2	10	15%	14,561,237
2014	Electric	Custom O&M	20	11,985,280	80%	3	5	17%	9,628,839

[3] 20% target threshold for relative precision exceeded due to difficultly in capturing a large percentage of total savings with the sampled sites in this domain.

Program Year	Fuel	Program Track	Program Projects	Program Working Savings (kWh or Therms)	Confidence Level	Certainty Strata Projects	Sampled Projects	Relative Precision	Sampled Savings (kWh or Therms)
2014	Gas	Streamlined	46	435,645	80%	1	8	12%	157,461
2014	Gas	SEM	2	31,953	80%	2	2	0%	31,953
2014	Gas	Remaining	33	759,224	80%	3	9	11%	403,246
	Electric Total			**282,308,583**					**103,736,077**
	Gas Total			**2,512,756**					**1,261,599**
	Project Total		**2,170**				**111**		

After the sample draw and review of the sampled projects, Energy Trust and the SBW evaluation team discussed and agreed upon several specific refinements and clarifications to the sample design, as follows:

1. **Large company no longer eligible to participate with Energy Trust.** One large company with multiple facilities in Energy Trust's service territory changed their electric utility provider and was no longer eligible to participate in Energy Trust programs. Our sample draw included three projects for this company, two of which were certainty selections. Knowing that obtaining customer cooperation for our evaluation activities would be highly unlikely and, that for at least some time after installation, the projects were likely yielding savings, Energy Trust agreed that we should keep these projects in our evaluation and that the realization rates from this impact evaluation would be applied to this company's projects.
2. **Recently and concurrently evaluated projects.** Energy Trust identified 18 projects in the sample draw that were associated with other evaluation efforts. Specifically, seven projects were included in the CORE program evaluation conducted by Navigant; nine projects were being evaluated as part of the 2012 Production Efficiency / Strategic Energy Management (SEM) impact evaluation by Cadmus; and two projects were also evaluated separately by MetaResource Group for a customer that closed their facility in early 2016. Energy Trust and the evaluation team concluded there was no need to redesign the sample to account for these, and used the project-level information reported for these other evaluation efforts to inform this evaluation.
3. **Mis-assigned project.** Energy Trust's tracking data indicated one sampled project was an SEM project, but our file review determined that it was in fact a custom O&M (boiler tune-up) project. Per Energy Trust policy, we corrected the track for this project and included it in the Custom O&M track. After the correction the sample was drawn again and that particular project was not included in the final evaluation sample.

Table 6 lists all the sampled projects for items 1 and 2 above, and lists the sources of information that informed our evaluation. However, it is noted that ultimately the seven SEM projects that are listed with the information source as "CORE Pilot Evaluation (Navigant)" did

not provide information that was useful to our evaluation efforts so we obtained the project files for these and proceeded per the discussion in Section 2.4.1.3

Table 6: Sampled Projects Indirectly Evaluated

SBW Project ID	Year	Fuel	Program Track	Reported Working Savings (kWh or Therms)	Information Source
Elec2013069	2013	Electric	Custom	4,277,045	2012 PE Impact Evaluation (Cadmus)
Elec2013010	2013	Electric	SEM	261,223	CORE Pilot Evaluation (Navigant)
Elec2013018	2013	Electric	SEM	237,572	2012 PE SEM Evaluation (Cadmus)
Elec2013025	2013	Electric	SEM	5,111,702	2012 PE SEM Evaluation (Cadmus)
Elec2014026	2014	Electric	SEM	211,232	CORE Pilot Evaluation (Navigant)
Elec2014027	2014	Electric	SEM	654,177	CORE Pilot Evaluation (Navigant)
Elec2014029	2014	Electric	SEM	19,992,846	2012 PE SEM Evaluation (Cadmus)
Elec2013036	2013	Electric	SEM	3,146,474	2012 PE SEM Evaluation (Cadmus)
Elec2013040	2013	Electric	SEM	411,925	2012 PE SEM Evaluation (Cadmus)
Elec2013046	2013	Electric	Custom O&M	62,581	Average of PE 2013-2014 PE Impact Evaluation
Elec2014049	2014	Electric	Custom O&M	3,564,343	Average of PE 2013-2014 PE Impact Evaluation
Elec2014057	2014	Electric	Streamlined	2,495,770	Average of PE 2013-2014 PE Impact Evaluation
Elec2014065	2014	Electric	Custom O&M	4,108,222	Post-Closure Evaluation (MetaResource Group)
Elec2013072	2013	Electric	SEM	314,565	2012 PE SEM Evaluation (Cadmus)
Elec2014073	2014	Electric	Custom O&M	1,439,911	Post-Closure Evaluation (MetaResource Group)
Gas2013081	2013	Gas	SEM	26,277	2012 PE SEM Evaluation (Cadmus)
Gas2013082	2013	Gas	SEM	12,375	CORE Pilot Evaluation (Navigant)
Gas2013084	2013	Gas	SEM	2,177	CORE Pilot Evaluation (Navigant)
Gas2014085	2014	Gas	SEM	3,164	CORE Pilot Evaluation (Navigant)
Gas2014097	2014	Gas	SEM	25,910	CORE Pilot Evaluation (Navigant)
Gas2013107	2013	Gas	SEM	42,414	2012 PE SEM Evaluation (Cadmus)

2.2. Project File Review and M&V Plans

In this task, we obtained and reviewed project files for the sampled projects (excluding projects for which we assigned savings based on other evaluation efforts) and then, as needed, we developed site-specific M&V plans for Custom and Custom O&M projects. We accomplished this as described below.

2.2.1. Obtain Project Files

Energy Trust provided scanned copies of the project files for each selected project. For the SEM projects, Energy Trust also provided electronic versions of supplemental documents,

when available, such as opportunity registers, savings calculation spreadsheets, and regression models that supported the project savings estimates. For the Custom and Custom O&M projects, we requested supplemental electronic files containing data and calculations from the PDCs and ATACs as needed.

2.2.2. Review Project Files

We assigned each project to a qualified member of our team. The lead analyst was given primary responsibility for both data collection and the analysis of savings. The lead analyst also reviewed all relevant information in the project file and extracted data important to the evaluation. This included the performance specifications of each measure (baseline and post-implementation) and key determinants of the measure's savings, such as operating hours and performance parameters.

For each Streamlined project, we examined the program application form and determined the key determinants for each measure. This included information needed as inputs to the standardized algorithm that the program uses to estimate working savings for these measures. We also made an assessment as to the appropriateness of the algorithm that was used to determine working savings, in that an alternative algorithm might require different data collection. We reviewed the project invoice documentation to assess if the unit quantities were consistent with the installed unit counts used in the algorithm. Based on this review, we determined whether a site inspection was needed and if so what observations would be made to confirm the operational status of the project measure(s).

2.2.3. Develop M&V Plans for Custom and, Custom O&M Projects

We first submitted an example M&V plan, which through useful feedback from Energy Trust evaluation staff, was developed into a final M&V plan/report template (provided in Appendix A). The M&V plan template was designed to be easily converted into a project-specific report after the evaluation work was completed, based on the M&V plan proposed approach.

For each Custom and Custom O&M projects, we reviewed the working savings analysis that was performed by the program and determined the input parameters (key determinants) that were required to re-estimate savings. Based on the findings from this review, we identified appropriate measure-specific data collection methods. Some of the required data, especially for baseline inputs, was obtained from the project files. We assessed which data must be obtained by site inspection or may be obtained through customer interviews. We also assessed if any of the inputs required trend logging and whether that trend logging required short-term metering or could be obtained from customer control systems.

The draft M&V plans were submitted to Energy Trust for review and comment. We then incorporated needed changes and developed the final M&V plans that guided the interviews, site visits, and savings estimation.

2.2.4. Develop Interview Guides

We developed separate interview guides for non-SEM (Streamlined, Custom and Custom O&M) and SEM projects. These interview guides were based on the interview guides from previous Energy Trust Production Efficiency impact evaluations.

The non-SEM guide focused on collecting information about changes to the facility since the project was completed that might impact the performance of the implemented measure(s). It included items such as operating hours, production levels, process changes, control or equipment changes, and other modifications. It also contained a blank area that was filled in by the interviewer after the M&V plans were complete or the Streamlined project files were reviewed. This blank area allowed space for other measure-specific items, such as number of units affected, setpoints or other operating conditions that were specified as key determinant values in the working analysis. Questions to confirm baseline conditions as described in the project documentation were also included. This interview guide is included in Appendix B.

The SEM interview guide contained similar questions as the non-SEM guide, but also featured additional areas of inquiry focused on SEM engagement. It contained questions about if and how the customer has continued with conservation efforts after the SEM engagement, including ongoing updates to the energy models and opportunity registers, energy planning procedures, goals, and how engaged their organization has been in continued SEM efforts. The interview guide included space for the evaluation engineer to place the list of completed SEM actions per the opportunity register or completion report and a list of actions identified but not completed before the engagement ended. This interview guide in included in Appendix C.

2.3. Recruitment, Customer Interviews and Data Collection

After the file reviews were complete, M&V plans were finalized and the interview guides were customized for each project, we systematically began facility recruitment, customer interviews and data collection. We coordinated the contact efforts so that one SBW engineer was responsible as the primary contact person for sites with multiple projects, to avoid multiple persons contacting the customer for different projects.

2.3.1. Facility Recruitment

Recruitment of facilities required careful coordination between SBW evaluation staff, the Energy Trust Evaluation Project Manager, Energy Trust program staff and PDC staff with the goal of minimizing customer effort and time, preserving the relationship between customers and the program, and enabling the evaluation to efficiently move to completion. Based on our review of the project files and development of the M&V plans, we provided the Energy Trust Evaluation Project Manager a list of the type of information to be requested for each customer project, and whether a site visit or only a telephone interview was needed. Once this was completed, the Energy Trust Evaluation Project Manager passed this information on to Energy

Trust program staff and PDC staff. The Energy Trust program staff reviewed the information requests and identified any potential problems, such as if a customer is difficult to work with, or other current projects were underway that needed to be considered. The PDC staff then reviewed the information and decided to either make the initial customer contact introducing SBW's evaluation activities, or asked us to recruit the customer directly and provided any updated contact information that they had. If customers proved difficult to contact or recruit, we avoided pushing too aggressively, and consulted with the PDC or program staff for assistance and guidance.

We called the best available number from the project documentation or from updated information provided by the PDC staff or Energy Trust program staff to connect with the appropriate site contact to recruit the customer for the evaluation. The call confirmed that the customer was able to provide a person who was knowledgeable about the location and operation of the measure(s) that comprised the sampled project and could provide access for our inspection, if one was needed. This recruitment approach worked quite well, though a few customers proved challenging to obtain desired information from even with very helpful PDC assistance. Because of these customers' lack of availability, we adjusted our data request expectations to minimize customer inconvenience. In a few instances, customers declined to participate in our evaluation efforts. Customers of two Streamlined projects refused to participate so we selected replacements for these projects from the same sample domains and size strata. There were also three custom projects that ultimately refused to participate, including Elec2013003, Elec2014071 and Gas2014076. These three customers initially indicated that they would participate but delayed for many months before finally stating that they would not participate. However, at that point, it was too late in the evaluation to replace these projects, so we performed complete file reviews of all available documents associated with these projects and based our evaluation on the file reviews.

2.3.2. Site Data Collection and Interviews

During the project file review and M&V plan development processes, we tailored the interview guides to meet the data collection goals of the evaluation for each project or site based on the measures that comprise each project. We worked with Energy Trust and PDC staff on customer recruitment, according to the established customer recruitment plan described above. We then completed the interview with the recruited site contact and/or most appropriate site person. For sites that we determined needed a site visit for thorough data collection (such as sites requiring the installation of short-term metering equipment), we worked with the site contact to schedule the visit while minimizing disruption to site personnel. In some cases, the site contact was able to provide data in the form of control system trend data and/or control screen printouts that satisfied data collection requirements without a site visit.

For Streamlined projects, the on-site data collection involved collection of measure performance information (baseline and as-implemented) that was needed to re-estimate savings using the standard algorithm. The Streamlined projects most in need of site visits were those where the project files were missing confirming information, such as invoices, that showed equipment counts or performance. Others included projects with key operational

parameters only verifiable through site visits, such as setpoints. Invoices were missing for four of the projects and equipment cutsheets were missing for eight of the projects. If the evaluation values were significantly different than the program values, then we made inquiries as to the reasons for the differences.

The site visits for Custom projects were similar. However, in these cases, the observations made, and the questions asked reflected the inputs of the custom models and algorithms used to estimate working savings. The M&V plans specified what observations were needed or questions to ask facility staff. Special attention was placed on understanding and documenting post-installation changes in operating parameters and associated assumptions and the implication of these changes for the estimates of energy savings. As needed and when available, we collected billing data to support the calibration of the models to post-retrofit billing records or to confirm calculated consumption as a reality check. If the evaluation values were significantly different from the program values, then we made inquiries as to the reasons for the differences.

For SEM projects, no site inspections were completed. We relied on interviews with site staff to collect information primarily to confirm that SEM actions had been complete as reported and to identify if any additional action items had been implemented after the SEM engagement. Only one SEM site was able to provide updated data for the SEM savings model.

For all sites, it was particularly important that when we identified changes that affected measure energy savings, we also determined when the changes occurred. This was important to calculate average energy savings over the life of the measure. We asked customers for relevant information, such as production history or when operating hours were changed. If the customer was reluctant to provide detailed production or other such detailed data, we asked for relative changes that occurred, e.g., a 20% increase in production one year after implementation.

We worked extensively with PDC staff and the Energy Trust program staff when customers were difficult to contact, recruit, interview or failed to follow through with data collection requests. A summary of our recruitment, interviews and data collection efforts for the sites that we directly evaluated (not including the projects where we obtained information or results from other evaluation efforts) is as follows:

- **Streamlined Projects.** There were 41 Streamlined projects which we directly evaluated, with one additional project for which the results were calculated based on program average realization rates. Of the 41 projects, we were not able to contact one of the customers and one other customer declined to participate in the evaluation. Two replacement sites were selected to maintain the total sample count of 41.

  We were able to complete interviews with the customers of all 41 projects. We completed 17 site visits that included 19 projects. Four of the site visits were for customers for which we also collected data for Custom or Custom O&M projects.

- **SEM Projects.** There were nine SEM projects which we directly evaluated, with 15 additional projects for which the results were based on other evaluation efforts. The

Energy Trust Evaluation Project Manager agreed that we would not conduct site visits for any of the SEM projects.

Of the nine SEM projects, we were able to complete seven interviews. One of the sites had permanently closed during the summer of 2016 and no one from that site was available for a telephone interview. We were not able to contact anyone from the other site even with the assistance of PDC staff. For the two sites for which we were unable to complete customer interviews, we performed qualitative assessments of the working savings estimates based on the project documentation that was available. For the sites for which we were able to complete customer interviews, we incorporated the resulting interview information with the project documentation to make a qualitative assessment of the of the working savings. We were able to obtain supplemental production and facility billing data for recalculating energy savings for only one of the sites.

- **Custom Projects.** There were 33 Custom projects which we directly evaluated, with one additional project for which the results were based on another evaluation effort.

  Of the 33 projects, we were able to recruit customers for 32 of the projects. One customer was not responsive after many months of contact attempts even with support from the PDC and Energy Trust program staff. Customer interviews were completed with customers for 30 projects. Two customer interviews failed to materialize after the customers were recruited and indicated that they would participate in the evaluation. Many attempts to complete the interview were made with the assistance of the PDCs and Energy Trust program staff, but one customer became non-responsive and the other customer finally declined to participate. Replacement sites were not chosen due to the significant effort to develop the M&V plans. We reviewed the project documentation and calculations to complete the evaluation.

  We completed site visits for 11 of the sampled projects. Short-term metering was installed at five of these sites and we obtained control system trend data at two of the other visited sites. Customers provided control system trend data in support of four projects combined with telephone interviews completed data collection without the expected need for site visits at those sites. Production data was provided by customers for four projects, three of which did not need site visits.

- **Custom O&M Projects.** There were seven Custom O&M projects which we directly evaluated, with four additional projects for which the results were based on another evaluation effort. Two of the four projects were assigned savings based on the results from the 2012 PE impact evaluation and the other two were assigned average program realization rates from this evaluation.

We were able to recruit, interview and complete data collection for all eight of the Custom O&M projects. We completed site visits for three of the sampled projects. Short-term metering was installed at one of the sites. Customers provided control system trend data for four

projects. The trend data provided for three of the projects combined with telephone interviews provided adequate information and avoided the need for site visits.

We summarized the interview, data collection and evaluation findings in each project-specific report for the Custom, Custom O&M and the SEM projects that we directly evaluated. The project-specific reports are included in the confidential appendix.

2.4. Estimating Project Savings

We used the data collected through customer interviews and site visits to re-estimate savings for each project measure and used those estimates to calculate realization rates for each measure and project. The project-level savings were used to estimate total program electric and gas savings, and savings by program track. Similarly, we calculated the corresponding realization rates. Projects with realization rates significantly different than unity (less than 0.9 or greater than 1.1), are individually discussed in the Findings section of this report.

2.4.1. Site-Specific Savings

Evaluated savings were based roughly on average savings over the lifetime of the measures. For projects where data collection indicated that savings has been reduced or increased due to reductions or increases in operating hours, production, or other operational changes such as setpoints, we attempted to determine the history of the changes from the customer and first estimated savings as the average of the conditions since the measure was implemented. We also considered the customer's projections concerning expected changes up to one year into the future. We then averaged that savings estimate with the working saving estimate at expected operation to determine the evaluation savings estimate. Exceptions to averaging with the working savings estimate included cases where the measure lifetime was already exceeded, or when the customer indicated that operation would very likely never resume at the level documented in the working savings assumptions. This approach was discussed extensively with Energy Trust Evaluation staff.

We recalculated savings for each measure included in each project and identified the reason for any differences that we identified. The differences were documented into the following standardized categories:

- **Number of affected units.** This included cases where we found that the number of units installed was greater or less than the number of units identified in the project documentation. Examples included such items as number of lighting fixtures, number of zero-loss drains on compressed air systems or length of pipe insulation installed.
- **Operating hours.** This included cases where we found that hours of operation for the measure affected equipment were greater or less than identified in the project documentation.
- **Production Level.** When savings was directly impacted by facility production, such as the number of annual batches processed in a lumber drying kiln when the measure

directly impacted kiln efficiency, we accounted for differences in production levels when customer production data significantly varied from expected levels.

- **Load.** This included changes in load that effected measure equipment, such as the load on new equipment that was identified to be significantly less than or greater than anticipated.
- **Efficiency.** When the efficiency of the project installed equipment was found to be different than expected as stated in the working analysis, we made adjustments as appropriate.
- **Data entry error.** This included cases where it was obvious that the working savings documented in the final project reporting documentation was different than the savings in the tracking database. We found one case (Gas2013110) where savings listed in the calculation page of the project verification report was consistent with the tracking database, but other places in the report displayed a value incorrectly copied from the calculation page in the same report and carried through to the results.
- **Algorithm error.** This included cases where the algorithm was either incorrectly applied, used incorrect data or where we found calculation errors within the algorithm.

Project-specific results are discussed in the Findings section of this report.

2.4.1.1. Steamlined Projects

Our analysis of savings for these 41 projects was based on the customer interviews and data collection described above. When we identified key parameter values that were different than the values from the working savings analysis, we recalculated savings using the working savings algorithm.

There was also one Streamlined project for the customer that was no longer within the Energy Trust program service area, because they changed energy providers. For this project we assigned savings based on the overall realization rate for that program track.

2.4.1.2. Custom and Custom O&M Projects

We performed analysis of savings for 33 Custom and eight Custom O&M projects consistent with the M&V plans developed for those projects. Baseline and post-implementation inputs to these algorithms came from our data collection activities described above. In cases where short-term metering occurred or when longer term control system trend data was obtained, the data was analyzed and incorporated into the analysis. In a few cases, the analysis included the comparison of calculated energy use to post-implementation billing records as a reasonableness check of the calculations. In most cases, we used the same algorithm used in the working savings analysis. There were a few special cases where we changed the calculation algorithm, including the following situations:

- **Algorithm not available.** There were a few gas savings projects where the Department of Energy Steam System Assessment Tool (SSAT) software tool was used by the ATAC for

the working analysis; however, that tool was no longer available. For some of those projects where we found key determinant value different than used in the working analysis, we adjusted the results by applying a ratio of the key determinant values when appropriate.

- **Algorithm errors.** When we found errors in the algorithm calculation, we corrected the errors, and in some cases changed the calculation to correctly represent energy use or savings. Tables 9 – 14 show five projects where an algorithm error comprised the primary reason for the difference between the evaluated savings and the reported working savings. Errors sometimes increased savings and sometimes decreased savings. In addition to the five projects listed in the Tables, there were six additional projects (**Elec2013020**, **Elec2013034**, **Elec2013050**, **Elec2014031**, **Gas2013096**, and **Gas2013110**) for which we identified errors but in most of those cases the error corrections resulted in small savings impacts or the errors were offset by other factors, such as for **Elec2014031** as discussed below.
- **Baseline capacity.** In most projects where production capacity was increased beyond the capacity of the existing baseline equipment as part of the measure, the analysis accounted for the capacity upgrade of the baseline equipment and included the cost associated with the upgrade. We found one project, **Elec2014031**, where this was not accounted for in the analysis. The installed measure facilitated a production increase of about 18%, but the equipment was operating at 100% capacity during the baseline period. Our analysis only allowed energy savings of the new, more efficient equipment up to the production capacity of the baseline equipment. However, for this project we also found an algorithm error that offset the baseline capacity savings reduction which resulted in a final realization rate of 0.99.

We produced a project-specific report for each of Custom and Custom O&M projects that we analyzed. This report included a description of the project measure(s), the working analysis algorithms and key determinant values, the evaluation data collection and recalculation of savings and a results summary including the primary reason for differences from the working savings. These project-specific reports are included in the confidential appendix to this report.

There was one Custom project and four Custom O&M projects that we did not directly evaluate but determined savings using other sources. These projects are discussed below.

2.4.1.3. SEM Projects

Of the nine SEM projects that we directly evaluated, we were able to interview seven of these customers. Only one of these nine customers provided supplemental energy use and production data so that we could recalculate savings. For the other eight SEM projects where we were not able to obtain updated data, we reviewed the models for errors and reasonableness and made a qualitative assessment of the working savings model, incorporating interview information to develop an evaluation savings estimate. Based on our qualitative assessment, we assigned a realization rate of either 0.90 (model unreliable or likely overestimates savings), 1.00 (model appears reasonable), or 1.10 (model likely underestimates

savings) to each project. We also produced project-specific reports for these nine projects, which are included in the confidential appendix.

Of the other 15 SEM projects, listed in Table 6, that we were to assign savings for based on other evaluation efforts, only one of the projects included calculated energy savings. The evaluation reports for seven of the remaining 14 projects included information which we used to make a qualitative assessment and similarly assign a realization rate. There were seven projects that did not included enough information to substantiate a qualitative assessment, and so Energy Trust provided project documentation for those projects which we then reviewed, completed the qualitative assessment, and assigned realization rates. Appendix D contains a complete list of the 24 SEM projects, which includes the evaluation realization rates, the source of information used in determining the realization rates, and comments describing the qualitative assessments that were made to assign the realization rates.

2.4.2. Projects with savings from other evaluation efforts

There were four projects in the evaluation sample that were evaluated by other contractors, listed in Table 6, who re-calculated energy savings during their evaluation efforts. We assigned those evaluated savings directly for one of the projects in our sample, **Elec2013010**. For the other three projects, we modified the savings using information provided in the evaluation report as follows:

- **Custom project Elec2013069.** The evaluation report indicated a realization rate of 0.58 primarily due to partial implementation of the measure. This capital measure also was only operational for 26 months before the affected equipment was permanently shut down. In accordance with this evaluation's calculation of savings, we calculated the average of the savings at 0.58 realization rate prior to permanent shut down and zero savings due to the permanent shutdown which resulted in a realization rate of 0.29 with the primary reason being operating hours.
- **Custom O&M project Elec2014065.** The evaluation report stated that the measure was operating as expected and assigned the full reported savings to this measure. However, the report also stated that the measure only operated for 20 months before the affected equipment was permanently shut down. We prorated the savings over the three-year lifetime of the O&M measure with a resulting realization rate of 0.56.
- **Custom O&M project Elec2014073.** The evaluation report stated that the measure was operating at about 75% of the expected savings. However, the report also stated that the measure only operated for 17 months before the affected equipment was permanently shut down. We prorated the savings over the three-year lifetime of the O&M measure with a resulting realization rate of 0.35.

There were eight additional SEM projects in the evaluation sample that were reviewed by Cadmus as part of the 2012 PE SEM evaluation, listed in Table 6, including **Elec2013018**, **Elec2013025**, **Elec2013036**, **Elec2013040**, **Elec20130072**, **Elec2014029**, **Gas2013081** and **Gas2013107**. These SEM project reviews discussed the calculations developed for each project and identified if obvious problems were detected. Based on these reviews, we assessed that all

eight of the SEM models appeared reasonable and that there were no significant problems with the working analyses. Therefore, we assigned a realization rate of 1.0 to these projects for this evaluation.

The other three projects listed in Table 6 (**Elec2013046**, **Elec2014049** and **Elec2014057**) are discussed in the following section.

Table 7 summarizes the savings results based on calculated savings and information from other evaluation reports as discussed above.

Table 7: Projects With Savings From Other Evaluations

SBW Project ID	Year	Fuel	Program Track	Reported Working Savings (kWh)	Evaluated Savings (kWh)	Realization Rate
Elec2013010	2013	Electric	SEM	261,223	487,148	1.86
Elec2013069	2013	Electric	Custom	4,277,045	1,240,343	0.29
Elec2014065	2014	Electric	Custom O&M	4,108,222	2,284,171	0.56
Elec2014073	2014	Electric	Custom O&M	1,439,911	509,728	0.35
Elec2013018	2013	Electric	SEM	237,572	237,572	1.00
Elec2013025	2013	Electric	SEM	5,111,702	5,111,702	1.00
Elec2013036	2013	Electric	SEM	3,146,474	3,146,474	1.00
Elec2013040	2013	Electric	SEM	411,925	411,925	1.00
Elec2013072	2013	Electric	SEM	314,565	314,565	1.00
Elec2014029	2014	Electric	SEM	19,992,846	19,992,846	1.00
Gas2013081	2013	Gas	SEM	26,277	26,277	1.00
Gas2013107	2013	Gas	SEM	42,414	42,414	1.00

2.4.3. Customer No Longer Within Energy Trust Service

For the three sampled projects where the customer changed electric service providers and is no longer in Energy Trust service territory, as listed in Table 6 we calculated savings using the average realization rates for the program based on this evaluation. The procedure we used was as follows:

- Roll-up the evaluated projects to the program level (excluding the three projects) by year/fuel/track domain and calculate realization rates
- Using these domain program level realization rates, calculate the project-specific savings for each of the corresponding projects

Table 8 shows the average realization rates calculated and the resulting saving for these three projects.

Table 8: Projects With Savings From Program Averages

SBW Project ID	Year	Fuel	Program Track	Size Strata	Reported Working Savings (kWh)	Evaluated Savings (kWh)	Realization Rate
Elec2013046	2013	Electric	Custom O&M	1	62,581	44,738	0.71
Elec2014049	2014	Electric	Custom O&M	9	3,564,343	2,326,399	0.65
Elec2014057	2014	Electric	Streamlined	9	2,495,770	2,572,251	1.03

2.5. Estimating Program Savings

2.5.1. Program-Level Gross Savings

We extrapolated gross savings from the sampled projects to the program level for the 2013-2014 program years. This was accomplished through the following steps:

- We computed a project-specific savings realization rate for each sampled project. This is the ratio of the evaluation estimate of savings for the project to the original estimate of working savings in the program tracking database. This result was greater than 1.0 when the evaluation savings was greater than the tracking value, less than 1.0 when less than the tracking value and equal to 1.0 when they were the same.
- We assigned an appropriate sample weight to each project. We assigned the large savers selected with certainty a sample weight of 1.0. Other projects, selected at random, represented more than one project in the population and thus were assigned a weight greater than 1.0 corresponding to the number of projects that they represented.
- We applied the aggregate realization rates by sample stratum to all other projects in the respective stratum. In this manner, sample results were extrapolated to the populations for each program year, yielding evaluation estimates of total program savings by year. Separate estimates were derived for gas and electric savings by program track.
- We computed a program-level savings realization rate for 2013 and 2014 by dividing the evaluated program savings by the original Energy Trust program estimates of working savings, for gas and electric fuel types.
- We calculated the relative precision achieved for each program track, fuel, and year as follows:
  - First the standard error was calculated using Equation 1[4].

[4] Taylor, J. R. (1997). An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements. Sausalito: University Science Books.

$$\delta(b) = \frac{\sqrt{\sum_{i}^{n} w_i (w_i - 1) e_i^2}}{\sum_{i=1}^{n} w_i x_i} \sqrt{1 - \frac{n}{N}} \quad \textbf{(1)}$$

where:

$$e_i = y_i - bx_i$$

n = the sample size of the study or domain being summarized

N = the population of the study or domain being summarized

- Next, the 90% confidence interval (CI) around the savings realization rate, b, is calculated using Equation 2 by multiplying the appropriate t-statistic by the standard error of the savings realization rate, δ(b).

$$CI = b \pm (1.645 \times \delta(\mathrm{b})) \quad \textbf{(2)}$$

- Finally, the 90% relative precision (rp) of the savings realization rate was calculated, as shown in Equation 3, by multiplying the t-statistic by the standard error of the savings realization rate, δ(b) and dividing by the savings realization rate, b.

$$rp = 1.645 \frac{\delta(b)}{b} \quad \textbf{(3)}$$

3. FINDINGS

This section summarizes the evaluation results at the project and program levels. Observations made during the evaluation about the program and specific projects with realization rates significantly different than unity were the basis for future recommendations presented in the subsequent Recommendations section of this report.

3.1. Evaluated Project Savings

The section summarizes project-specific impact evaluation results by year, fuel and program track domains. Evaluation savings were determined as described in the Methodology section above. Projects with realization rates less than 90% and greater than 110% are discussed further below.

3.1.1. Streamlined

The Streamlined projects included a variety of measures, including efficient lighting fixtures and controls, greenhouse measures, efficient HVAC equipment, compressed air measures and a variety of irrigation measures. The evaluation results for all the sampled electric Streamlined projects are shown in Table 9, which includes the comparison of evaluated savings to reported working savings, along with the primary reason for differences. As shown in the table, most projects were determined to save energy as expected, with a few projects that only had energy savings that were only slightly different than the reported working savings (realization rates between 0.90 and 1.10).

Project **Elec2014057** was implemented at a facility of the customer that changed electric service providers and is no longer eligible for Energy Trust programs. This was one of the three sampled projects for this customer and was not directly evaluated during this study. Energy savings for this project was calculated using the program level realization rate for the 2014/Electric/Streamlined domain. This realization rate was calculated for all projects in the population domain, excluding this project, as discussed in the Methodology section above.

Project **Elec2013039** included an air compressor measure, which was found to operate fewer hours per year than was assumed in the working analysis. This resulted in significantly less savings than the working analysis estimate.

Project **Elec2014066** included adding irrigation scheduling control to an irrigation system. The working analysis assumed 10% water and electric savings would be achieved with the new controls. We found that the system had achieved savings of about 20%, which doubled the saving compared to the working analysis savings.

Table 9: Evaluation Savings Results For Electric Streamlined Projects

SBW Project ID	Fuel	Year	Track	Reported Working Savings (kWh)	Evaluated Savings (kWh)	Realization Rate	Primary Reason for Difference
Elec2013006	Electric	2013	Streamlined	414,713	422,393	1.02	Operating hours
Elec2013007	Electric	2013	Streamlined	39,035	39,035	1.00	N/A
Elec2013008	Electric	2013	Streamlined	141,350	141,350	1.00	N/A
Elec2013013	Electric	2013	Streamlined	345,537	378,196	1.09	Number of affected units
Elec2013015	Electric	2013	Streamlined	1,060,409	1,060,409	1.00	N/A
Elec2013017	Electric	2013	Streamlined	74,895	74,895	1.00	N/A
Elec2013019	Electric	2013	Streamlined	8,762	8,762	1.00	N/A
Elec2013032	Electric	2013	Streamlined	13,748	13,748	1.00	N/A
Elec2013037	Electric	2013	Streamlined	240,032	231,526	0.96	Operating hours
Elec2013038	Electric	2013	Streamlined	81,825	81,825	1.00	N/A
Elec2013039	Electric	2013	Streamlined	57,233	39,403	0.69	Operating hours
Elec2013048	Electric	2013	Streamlined	6,509	6,509	1.00	N/A
Elec2013052	Electric	2013	Streamlined	12,371	12,371	1.00	N/A
Elec2013074	Electric	2013	Streamlined	192,470	192,470	1.00	N/A
Total	**Electric**	**2013**	**Streamlined**	**2,688,889**	**2,702,892**	**1.01**	
Elec2014014	Electric	2014	Streamlined	2,101,198	2,101,198	1.00	N/A
Elec2014022	Electric	2014	Streamlined	29,182	30,549	1.05	Algorithm error
Elec2014023	Electric	2014	Streamlined	536,005	532,784	0.99	Number of affected units
Elec2014033	Electric	2014	Streamlined	13,010	13,010	1.00	N/A
Elec2014055	Electric	2014	Streamlined	224,061	209,300	0.93	Operating hours
Elec2014056	Electric	2014	Streamlined	998,217	998,217	1.00	N/A
Elec2014057	Electric	2014	Streamlined	2,495,770	2,577,306	1.03	N/A
Elec2014060	Electric	2014	Streamlined	419,480	406,015	0.97	Operating hours
Elec2014062	Electric	2014	Streamlined	68,347	68,347	1.00	N/A
Elec2014063	Electric	2014	Streamlined	708,473	708,473	1.00	N/A
Elec2014066	Electric	2014	Streamlined	13,841	27,681	2.00	Efficiency
Elec2014068	Electric	2014	Streamlined	1,657,714	1,657,714	1.00	N/A
Elec2014070	Electric	2014	Streamlined	58,177	58,177	1.00	N/A
Total	**Electric**	**2014**	**Streamlined**	**9,323,475**	**9,388,771**	**1.01**	

The evaluation results for all the sampled gas Streamlined projects are shown in Table 10 and include the comparison of evaluated savings to reported working savings along with reasons for differences. As shown in the table, all projects were found to save energy as estimated in the working analysis.

Table 10: Evaluation Savings Results For Gas Streamlined Projects

SBW Project ID	Fuel	Year	Program Track	Reported Working Savings (Therm)	Evaluated Savings (Therm)	Realization Rate	Primary Reason for Difference
Gas2013078	Gas	2013	Streamlined	13,410	13,410	1.00	N/A
Gas2013083	Gas	2013	Streamlined	11,250	11,250	1.00	N/A
Gas2013087	Gas	2013	Streamlined	55,691	55,691	1.00	N/A
Gas2013090	Gas	2013	Streamlined	4,845	4,845	1.00	N/A
Gas2013091	Gas	2013	Streamlined	27,936	27,936	1.00	N/A
Gas2013094	Gas	2013	Streamlined	63,460	63,460	1.00	N/A
Gas2013100	Gas	2013	Streamlined	23,522	23,522	1.00	N/A
Total	**Gas**	**2013**	**Streamlined**	**200,114**	**200,114**	**1.00**	
Gas2014075	Gas	2014	Streamlined	42,792	42,792	1.00	N/A
Gas2014086	Gas	2014	Streamlined	15,120	15,120	1.00	N/A
Gas2014093	Gas	2014	Streamlined	2,507	2,507	1.00	N/A
Gas2014099	Gas	2014	Streamlined	13,110	13,110	1.00	N/A
Gas2014103	Gas	2014	Streamlined	20,486	20,486	1.00	N/A
Gas2014104	Gas	2014	Streamlined	23,632	23,632	1.00	N/A
Gas2014106	Gas	2014	Streamlined	4,282	4,282	1.00	N/A
Gas2014111	Gas	2014	Streamlined	35,532	35,532	1.00	N/A
Total	**Gas**	**2014**	**Streamlined**	**157,461**	**157,461**	**1.00**	

3.1.2. SEM

The Strategic Energy Management (SEM) projects included a variety of actions to reduce energy use, such as shutting equipment off when not needed, installing thermostats or adjusting setpoints to improve heater control, optimization of process equipment, improving refrigeration efficiency by adjusting suction and condensing setpoints, reducing the maximum speed of VFD controlled fans, and repairing compressed air leaks. The evaluation results for all sampled SEM projects are shown in Table 11, and include the comparison of evaluated savings to reported working savings, along with reasons for differences.

For only two of the projects did we recalculate savings based on data collection. Project **Elec2013002** savings were calculated based on additional data that we obtained from the customer to update the regression model for the facility. Project **Elec2013010** savings were obtained from the CORE Pilot Evaluation report, which stated that the evaluator was able to obtain additional production data to update the regression model.

The remaining projects were qualitatively assessed and realization rates of either 0.90, 1.00 or 1.10 were assigned, based on whether the model was assessed to likely over-estimate savings, estimate savings reasonably or likely to under-estimate savings, respectively. A complete listing of the project assessments is included in Appendix D.

It should be noted that there were only two gas SEM project engagements in 2014, both of which were included in the evaluation sample.

Table 11: Evaluation Savings Results For SEM Projects

SBW Project ID	Fuel	Year	Program Track	Reported Working Savings (kWh or Therm)	Evaluated Savings (kWh or Therm)	Realization Rate	Primary Reason for Difference
Elec2013002	Electric	2013	SEM	1,803,744	1,833,779	1.02	N/A
Elec2013010	Electric	2013	SEM	261,223	487,148	1.86	Production level
Elec2013016	Electric	2013	SEM	1,186,745	1,068,071	0.90	Load
Elec2013018	Electric	2013	SEM	237,572	237,572	1.00	N/A
Elec2013021	Electric	2013	SEM	1,173,226	1,173,226	1.00	N/A
Elec2013025	Electric	2013	SEM	5,111,702	5,111,702	1.00	N/A
Elec2013036	Electric	2013	SEM	3,146,474	3,146,474	1.00	N/A
Elec2013040	Electric	2013	SEM	411,925	411,925	1.00	N/A
Elec2013072	Electric	2013	SEM	314,565	314,565	1.00	N/A
Total	**Electric**	**2013**	**SEM**	**13,647,176**	**13,784,462**	**1.01**	
Elec2014026	Electric	2014	SEM	211,232	190,109	0.90	Algorithm error
Elec2014027	Electric	2014	SEM	654,177	719,595	1.10	Load
Elec2014029	Electric	2014	SEM	19,992,846	19,992,846	1.00	N/A
Elec2014043	Electric	2014	SEM	5,348,363	5,348,363	1.00	N/A
Elec2014047	Electric	2014	SEM	11,321,788	11,321,788	1.00	N/A
Elec2014054	Electric	2014	SEM	190,885	190,885	1.00	N/A
Elec2014058	Electric	2014	SEM	380,132	418,145	1.10	Algorithm error
Elec2014059	Electric	2014	SEM	1,607,038	1,446,334	0.90	Load
Total	**Electric**	**2014**	**SEM**	**39,706,461**	**39,628,065**	**1.00**	
Gas2013080	Gas	2013	SEM	2,665	2,665	1.00	N/A
Gas2013081	Gas	2013	SEM	26,277	26,277	1.00	N/A
Gas2013082	Gas	2013	SEM	12,375	12,375	1.00	N/A
Gas2013084	Gas	2013	SEM	2,419	2,177	0.90	Load
Gas2013107	Gas	2013	SEM	42,414	42,414	1.00	N/A
Total	**Gas**	**2013**	**SEM**	**86,150**	**85,908**	**1.00**	
Gas2014085	Gas	2014	SEM	3,164	3,164	1.00	N/A
Gas2014097	Gas	2014	SEM	28,789	25,910	0.90	Efficiency
Total	**Gas**	**2014**	**SEM**	**31,953**	**29,074**	**0.91**	

3.1.3. Custom Electric

The Custom electric projects included a variety of measures, such as efficient compressed air equipment, refrigeration system improvements, efficient HVAC equipment and improvements

to or replacement of a variety of process equipment. The evaluation results for all the sampled electric Custom projects are shown in Table 12, and include the comparison of evaluated savings to reported working savings along with reasons for differences. As shown in the table, 10 projects were determined to save energy as expected or were only slightly different than the reported working savings (realization rates between 0.90 and 1.10). The other nine projects had wide-ranging realization rates and are briefly discussed below:

- Project **Elec2013009** (1.33) included the replacement of 12 timer-controlled condensate drain valves on a compressed air system with no-loss condensate drain valves. We found that 15 valves had been replaced, which was consistent with the enhanced scoping report for this project. The verification was completed before all scheduled drains were replaced and the working analysis only claimed savings for the 12 drains installed at the time of the verification site visit. We included savings for all 15 valves, which resulted in greater savings than the working analysis estimate.
- Project **Elec2013024** (1.16) included the replacement of two heated diffusion pumps with more efficient pumps. We metered the electric power of the new pumps and determined that the new pumps consumed less power than assumed in the working analysis due to the ability of one of the pumps to cycle off when lightly loaded. This reduced average power draw of the new pumps, resulting in greater savings than the working analysis estimated.
- Project **Elec2013069** (0.29) was evaluated as part of the 2012 PE Impact Evaluation. The project included process modifications that allowed the shutoff of three vacuum pumps**.** The evaluation report indicated a realization rate on 58%, with the shortfall primarily due to partial implementation of the measure. This capital measure also was only operational for 26 months before the affected equipment was permanently shut down. In accordance of our evaluation savings calculation methodology, we calculated the savings based on the average of the 58% realization rate and zero savings due to the shutdown, which resulted in a realization rate of 29%.
- Project **Elec2014005** (1.21) included two measures that improved the aeration efficiency at a waste water treatment plant. Our data collection from the customer showed that the plant had experienced increased loading since the measures were installed. We recalculated saving based on load levels that were the average of the recent increase and the working analysis load levels, resulting in greater savings than estimated by the working analysis.
- Project **Elec2014041** (0.61) included the replacement of a heatless desiccant dryer serving a compressed air system with a purge air optimized heated desiccant dryer. The customer stated that the baseline operation hours were less than assumed in the working analysis. We metered the new dryer and discovered that the purge hours were greater than assumed and that the heater power draw was twice the assumed value. We re-calculated savings using adjusted baseline operating hours and incorporating the updated information that the metering provided. This resulted in significantly less savings than the working analysis estimate.

- Project **Elec2014042** (0.43) included the replacement of a single dust collection system serving two production lines with two new separate dust collection systems. The customer stated that shortly after the new system was installed, they reconfigured the process lines and changed the operating hours of the equipment. We also metered the new fans to obtain the power draw and confirm the operating schedule. We recalculated the savings with the adjusted operating hours and slightly adjusted power draws, which resulted in significantly less savings than the working analysis estimate.
- Project **Elec2014045** (0.66) included the addition of an evaporative cooling tower and closed loop fluid cooler system serving a new building to reduce the cooling load on the main chiller plant that serves the campus of buildings. The working analysis used a load profile provided by the customer based on an assumed full build-out load for the new building, which was expected to occur by 2016. During our data collection, the customer stated that the full build-out had not occurred as expected. They did expect some additional build-out to occur, but did not have an expected date for the significant load additions as originally expected. We obtained trend data of cooling loads from the control system, which were significantly less than projected loads. We recalculated savings using loads that were the average of the obtained trend data and the working analysis expected loads, which resulted in significantly less savings that the working analysis estimate.
- Project **Elec2014051** (0.65) included a project to install an efficient VFD chiller to an existing chiller plant and enable optimal sequencing control to enable continuous operation of the new chiller as the trim chiller for optimal plant efficiency. We obtained trend data for all chillers in the chiller plant and discovered that the new chiller did not operate for portions of the year. The customer stated that they had abandoned the sequencing control. This reduction in operating hours of the new chiller resulted in significantly less savings than the working analysis estimate.
- Project **Elec2014064** (0.54) included the installation of automatic shutoff timers on electric space heaters in a manufacturing facility. The new timers required the heaters to be manually turned on and would automatically shut off after a set time. We metered a sample of the heaters and found that they operated significantly more than the verification metering indicated. We discussed the results with the facility staff and could only conclude that the workers had gotten more adept at promptly restarting the heaters after shutoff. We used an average of our metered data and that of the working analysis, which resulted in significantly less savings than the working analysis estimate.

Table 12: Evaluation Savings Results For Electric Custom Projects

SBW Project ID	Fuel	Year	Program Track	Reported Working Savings (kWh)	Evaluated Savings (kWh)	Realization Rate	Primary Reason for Difference
Elec2013001	Electric	2013	Custom	928,889	912,467	0.98	N/A
Elec2013003	Electric	2013	Custom	596,516	577,972	0.97	Algorithm error
Elec2013004	Electric	2013	Custom	441,781	441,781	1.00	N/A

SBW Project ID	Fuel	Year	Program Track	Reported Working Savings (kWh)	Evaluated Savings (kWh)	Realization Rate	Primary Reason for Difference
Elec2013009	Electric	2013	Custom	138,633	184,732	1.33	Number of affected units
Elec2013024	Electric	2013	Custom	120,888	139,656	1.16	Load
Elec2013028	Electric	2013	Custom	1,269,668	1,171,977	0.92	Load
Elec2013035	Electric	2013	Custom	360,729	373,034	1.03	N/A
Elec2013053	Electric	2013	Custom	2,370,417	2,370,417	1.00	N/A
Elec2013069	Electric	2013	Custom	4,277,045	1,240,343	0.29	Operating hours
Total	**Electric**	**2013**	**Custom**	**10,504,566**	**7,412,379**	**0.71**	
Elec2014005	Electric	2014	Custom	1,675,174	2,022,710	1.21	Load
Elec2014031	Electric	2014	Custom	3,923,398	3,918,062	1.00	N/A
Elec2014041	Electric	2014	Custom	110,909	67,191	0.61	Operating hours
Elec2014042	Electric	2014	Custom	440,957	187,879	0.43	Operating hours
Elec2014044	Electric	2014	Custom	641,891	641,891	1.00	N/A
Elec2014045	Electric	2014	Custom	3,914,391	2,590,205	0.66	Load
Elec2014051	Electric	2014	Custom	1,044,159	683,788	0.65	Operating hours
Elec2014061	Electric	2014	Custom	62,976	62,709	1.00	N/A
Elec2014064	Electric	2014	Custom	2,391,480	1,302,777	0.54	Operating hours
Elec2014071	Electric	2014	Custom	355,902	365,855	1.03	N/A
Total	**Electric**	**2014**	**Custom**	**14,561,237**	**11,843,067**	**0.81**	

3.1.4. Custom O&M Electric

The Custom O&M electric projects included a variety of O&M measures, such as compressed air leak repair; operating hours reductions; improvements to HVAC system control settings; and refrigeration system improvements, such as adjustments to suction and condensing pressure setpoints, optimizing defrost control and improving VFD fan speed control. The evaluation results for all the sampled electric Custom O&M projects are shown in Table 13 and include the comparison of evaluated savings to reported working savings, along with reasons for differences. As shown in the table, only three projects were determined to save energy as expected or were only slightly different than the reported working savings (realization rates between 0.90 and 1.10). The other eight projects had wide-ranging realization rates and are briefly discussed below.

Two of the projects, **Elec2013046** and **Elec2014049**, were implemented at facilities of the customer that changed electric service providers and is no longer eligible for Energy Trust programs. These were not directly evaluated during this study. Energy savings for these projects were calculated using the program-level realization rate for the Year/Electric/Custom O&M domains. The program-level realization rates were calculated for all projects in the population domains excluding these projects as described in the Methodology section above.

- Project **Elec2013034** (0.3) included the recommissioning of 29 air conditioning units and four rooftop HVAC units in two buildings. Most of the working analysis savings was due to reducing operating hours to be more consistent with occupancy and additional savings was a result of repair of economizers in five units. Our query of the control system showed that three of the rooftop units were operating continuously. We also found minor errors in the hourly calculation workbook, which caused slightly more savings than intended. We corrected the calculation error and assigned operating hours that were the average from the working analysis and our data collection. This resulted in significantly less savings that the working analysis estimate.
- Project **Elec2013050** (0.6) included five measures to improve the efficiency of large refrigeration systems at a food processing facility. The measure with the greatest savings involved increasing the suction pressure for the freezer storage rooms. The working analysis incorporated extensive baseline trend data to develop a complex hourly spreadsheet model to represent the refrigeration systems. Very little post-implementation data was available for the working analysis and was not always consistent with the spreadsheet model. We obtained extensive trend data, though for this measure, it was not useful due to subsequent projects that had been implemented and affected this measure. We summarized the limited trend that had been obtained shortly after measure implementation and incorporated it into the model, which resulted in significantly less savings that the working analysis estimate. Two of the other four measures we evaluated resulted in no savings adjustments, one resulted greater savings and one resulted in less savings with little impact on project total savings. Overall project savings were significantly less than the working analysis estimate due to the one significantly under-performing measure.
- Project **Elec2014011** (0.8) included four measures to improve the efficiency of a compressed air system. The leak reduction measure was the source of over 90% of the project savings. We confirmed with the customer that no system operation or load changes had occurred since project implementation and that they are actively pursuing leak detection and repair. The working analysis extrapolated the post-installation compressor power draw based on an airflow meter reading during non-production hours. The reading was significantly below the capability of the meter and judge to be invalid. We were unable to visit this site to meter the compressor as we proposed in the M&V plan, so therefore we reviewed the working analysis and adjusted the minimum compressor power draw to realistically reflect minimum power draw for the compressor type and control. Based on our adjustments, the recalculation resulted significantly less savings that the working analysis estimate.
- Project **Elec2014065** (0.56) included a process change that allowed the shutdown of three pumps. We incorporated the results from the Post-Closure Evaluation Report, which stated that the measure was operating as expected and assigned the full reported savings to this measure. However, the report also stated that the measure only operated for 20 months before the facility was permanently shut down. We prorated the savings over the three-year lifetime of an O&M measure, with a resulting realization rate of 0.56.

- Project **Elec2014067** (1.32) included leak repair of a compressed air system. A leak survey of the system was conducted to support the TAS. At the time of the verification site visit, not all the identified leaks had been repaired and the working analysis only claimed savings for the leak repairs that had been completed. During our evaluation interview, the customer stated that all the remaining identified leaks had been repaired and that they have maintained an ongoing leak identification and repair program. We included the savings for all identified leaks, which resulted in significantly more savings than the working analysis estimate.
- Project **Elec2014073** (0.35) included manually reducing the run time of blowers providing pneumatic product conveyance within the facility. We incorporated the results from the Post-Closure Evaluation Report which stated that the measure was operating at about 75% of the expected savings due to the manual operator control nature of the measure. However, the report also stated that the measure only operated for 17 months before the affected equipment was permanently shut down. We prorated the savings over the three-year lifetime of an O&M measure with a resulting realization rate of 0.35.

Table 13: Evaluation Savings Results For Electric Custom O&M Projects

SBW Project ID	Fuel	Year	Program Track	Reported Working Savings (kWh)	Evaluated Savings (kWh)	Realization Rate	Primary Reason for Difference
Elec2013012	Electric	2013	Custom O&M	1,115,099	1,049,428	0.94	Efficiency
Elec2013020	Electric	2013	Custom O&M	1,636,611	1,646,472	1.01	Efficiency
Elec2013030	Electric	2013	Custom O&M	56,104	56,104	1.00	N/A
Elec2013034	Electric	2013	Custom O&M	73,662	22,464	0.30	Operating hours
Elec2013046	Electric	2013	Custom O&M	62,581	44,738	0.71	N/A
Elec2013050	Electric	2013	Custom O&M	731,377	436,533	0.60	Efficiency
Total	**Electric**	**2013**	**Custom O&M**	**3,675,434**	**3,255,739**	**0.89**	
Elec2014011	Electric	2014	Custom O&M	438,555	352,273	0.80	Efficiency
Elec2014049	Electric	2014	Custom O&M	3,564,343	2,326,399	0.65	N/A
Elec2014065	Electric	2014	Custom O&M	4,108,222	2,284,171	0.56	Operating hours
Elec2014067	Electric	2014	Custom O&M	77,808	102,935	1.32	Load
Elec2014073	Electric	2014	Custom O&M	1,439,911	509,728	0.35	Operating hours
Total	**Electric**	**2014**	**Custom O&M**	**9,628,839**	**5,575,506**	**0.58**	

3.1.5. Remaining

The Remaining domain includes 14 gas Custom projects and one gas Custom O&M project. During sample design, we determined that there were an insufficient number of gas Custom O&M projects to justify separate domains. The Custom projects include measures such as boiler efficiency improvements; heat recovery; pipe or process equipment insulation; and other

process equipment efficiency improvements. The one Custom O&M project included two measures to reduce energy use of several HVAC systems. Table 14 includes the results for all projects in the Remaining domain. The Custom O&M project is listed as SBW Project ID GAS2014089. As shown in the table, seven projects were determined to save energy as expected or were only slightly different than the reported working savings (realization rates between 0.90 and 1.10). The other eight projects had wide-ranging realization rates and are briefly discussed below.

- Project **Gas2013079** (0.54) included the replacement of a bottle pasteurizer at a bottling plant. The new pasteurizer had significantly greater capacity than the existing unit and the analysis correctly accounted for an upgrade to the existing unit to meet the new desired capacity. The ATAC that performed the scoping study assumed the new equipment operated at maximum capacity and at high pasteurizing temperatures. Our data collection determined that the new unit was operating at about 40% of maximum capacity and that about 40% of the processed bottles were heated to much lower temperatures. We recalculated savings based on operating conditions that were an average of the evaluation data collection and the working analysis, which resulted in significantly less savings than the working analysis estimate.
- Project **Gas2013096** (0.89) included the insulation of uninsulated steam piping at a food processing facility. We found that the calculated effectiveness of the insulation was less than expected because the ATAC did not correctly account for the baseline heat loss from the pipes. Our recalculation resulted in less savings than the working analysis estimate.
- Project **Gas2013102** (1.77) included three measures to improve the performance of a boiler at a food processing facility. One measure included the addition of a stack gas economizer to recover heat used to preheat domestic hot water. We metered the inlet and outlet temperatures and recalculated the amount of heat recovered for water preheating, which resulted in significantly greater savings than the working analysis estimate for this measure and for the project overall.
- Project **Gas2013109** (0.75) included the installation of a stack gas economizer on a boiler that provides steam to lumber drying kilns at a forest products facility. We obtained lumber production data that showed significantly reduced lumber processing after installation of the economizer. We also obtained boiler operator logs that showed economizer performance slightly less than expected. We recalculated savings based on lumber production as an average of production data obtained during this evaluation and the level assumed in the working analysis, which resulted in significantly less savings than the working analysis estimate.
- Project **Gas2014088** (0.83) included the upgrade to high efficiency boilers at a new food processing facility. We obtained production data that showed significantly less production than expected in the working analysis. We also obtained recent boiler efficiency test results that showed greater efficiency than the post-installation test results. We recalculated savings using the improved efficiency and production, calculated as an average of the level assumed in the working analysis and the level obtained during this evaluation. This resulted in significantly less savings than the working analysis estimate.

- Project **Gas2014089** (0.72) included two recommissioning measures of HVAC systems serving non-production areas within a processing facility. We obtained detailed operational parameters from the control system, which we compared with the hourly spreadsheet model and discovered that modeled assumptions of VAV box airflows during heating were significantly different than actual conditions. We recalculated savings using the correct airflow control settings, which resulted in significantly less savings than the working analysis estimate.
- Project **Gas2014098** (0.85) included the insulation of a large tank containing heated oil. We verified key parameters with the customer but found an error in the working savings calculations which, when corrected, resulted in 15% less savings than the working analysis estimate.
- Project **Gas2014101** (1.39) included three measures to improve the performance of a steam boiler at a food processing plant. We found that the facility recently experienced significant production increases which we averaged with working analysis production. Recalculation of savings at the higher production resulted in significantly greater savings than the working analysis estimate.

Table 14: Evaluation Savings Results For Remaining Gas Projects

SBW Project ID	Fuel	Year	Program Track	Reported Working Savings (kWh)	Evaluated Savings (kWh)	Realization Rate	Primary Reason for Difference
Gas2013077	Gas	2013	Remaining	111,690	119,960	1.07	Operating hours
Gas2013079	Gas	2013	Remaining	144,892	77,771	0.54	Load
Gas2013096	Gas	2013	Remaining	9,116	8,111	0.89	Efficiency
Gas2013102	Gas	2013	Remaining	40,624	71,762	1.77	Efficiency
Gas2013109	Gas	2013	Remaining	66,943	50,098	0.75	Production level
Gas2013110	Gas	2013	Remaining	9,410	9,526	1.01	Data entry error
Total	**Gas**	**2013**	**Remaining**	**382,675**	**337,228**	**0.88**	
Gas2014076	Gas	2014	Remaining	80,642	80,643	1.00	N/A
Gas2014088	Gas	2014	Remaining	85,498	70,874	0.83	Production level
Gas2014089	Gas	2014	Remaining	18,848	13,537	0.72	Load
Gas2014092	Gas	2014	Remaining	8,780	8,337	0.95	Operating hours
Gas2014095	Gas	2014	Remaining	15,450	15,450	1.00	N/A
Gas2014098	Gas	2014	Remaining	44,495	37,821	0.85	Algorithm error
Gas2014101	Gas	2014	Remaining	47,002	65,099	1.39	Production level
Gas2014105	Gas	2014	Remaining	99,996	90,777	0.91	Production level
Gas2014108	Gas	2014	Remaining	2,535	2,535	1.00	N/A
Total	**Gas**	**2014**	**Remaining**	**403,246**	**385,073**	**0.95**	

3.1.6. All Domains Totals

The summary of our evaluated savings for the 111 projects in the drawn sample compared to the reported working savings are summarized by year, fuel and program track in Table 15. The totals for each year are also summarized for both electric and gas. Realization rates for both Streamlined and SEM had very close to 1.00 realization rates both years, while Custom and Custom O&M were lower. The 2013 Custom electric realization rate was highly influenced by one very large project that performed poorly at a facility that had been shut down.

The overall gas realization rates were 0.93 and 0.96 for 2013 and 2014, respectively.

Table 15: Savings Results By Domain For The Sampled Projects

Year	Program Track	Reported Working Savings		Evaluated Savings		Realization Rate	
		Electric (kWh)	Gas (therms)	Electric (kWh)	Gas (therms)	Electric	Gas
2013	Custom	10,504,566	-	7,412,379	-	0.71	NA
2013	SEM	13,647,176	86,150	13,784,462	85,908	1.01	1.00
2013	Streamlined	2,688,889	200,114	2,702,892	200,114	1.01	1.00
2013	Custom O&M	3,675,434	-	3,255,739	-	0.89	NA
2013	Remaining	-	382,675	-	337,228	NA	0.88
2013	**Total**	**30,516,065**	**668,939**	**27,155,472**	**623,250**	**0.89**	**0.93**
2014	Custom	14,561,237	-	11,843,067	-	0.81	NA
2014	SEM	39,706,461	31,953	39,628,065	29,074	1.00	0.91
2014	Streamlined	9,323,475	157,461	9,388,771	157,461	1.01	1.00
2014	Custom O&M	9,628,839	-	5,575,506	-	0.58	NA
2014	Remaining	-	403,246	-	385,073	NA	0.95
2014	**Total**	**73,220,012**	**592,660**	**66,435,409**	**571,608**	**0.91**	**0.96**

The following four figures show the distribution of realization rates by program year and fuel for each program track.

The realization rate distributions for the 2013 electric projects are shown in Figure 2 where it is seen that one large savings custom project with a low realization rate has driven the 2013 custom electric rate down to 0.71 in the table above. The figure also shows three low realization rate custom O&M projects that have negatively impacted that overall realization rate.

The realization rate distributions for the 2014 electric projects are shown in Figure 3 where multiple custom and custom O&M projects are observed with low realization rates. These low values have negatively impacted those associated domains in the table above.

The realization rate distributions for the 2013 gas projects are shown in Figure 4 where the Remaining domain (custom) projects are observed with both low and high realization rates. However, the one project with the high value is has relatively small savings to offset the one large saver with a low realization rate.

The realization rate distributions for the 2014 gas projects are shown in Figure 5 where the Remaining domain (custom) projects are observed with both low and high realization rates. However, the one project with the high value does not have sufficient savings to offset the multiple projects with low realization rates. Also observed is that there is only one SEM project which defines the realization rate for that domain.

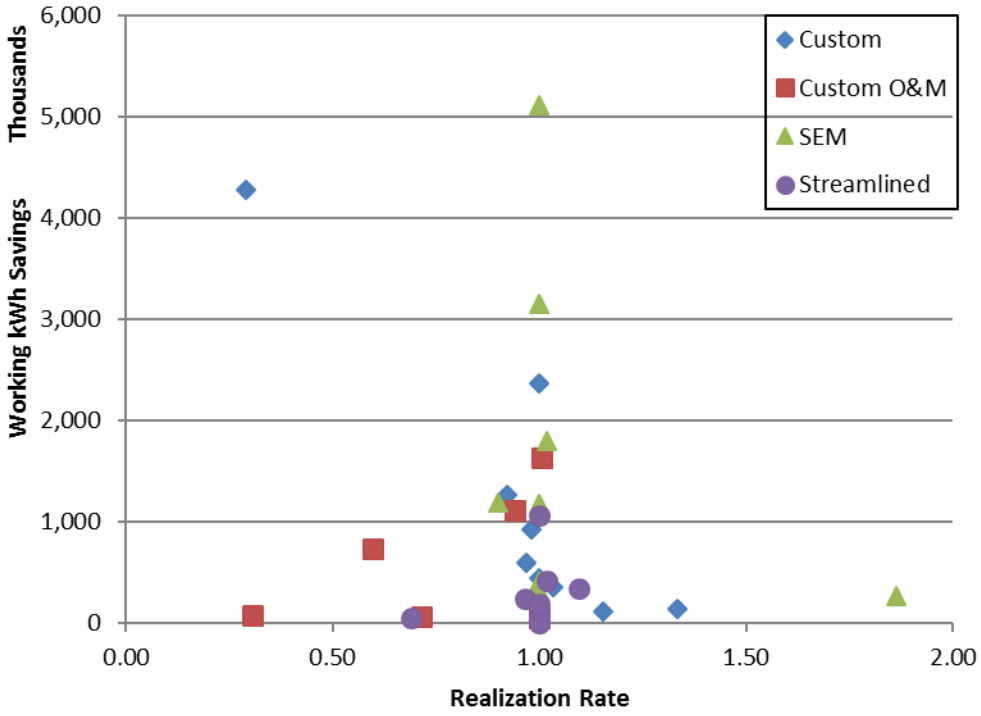

Figure 2: Electric results for program year 2013.

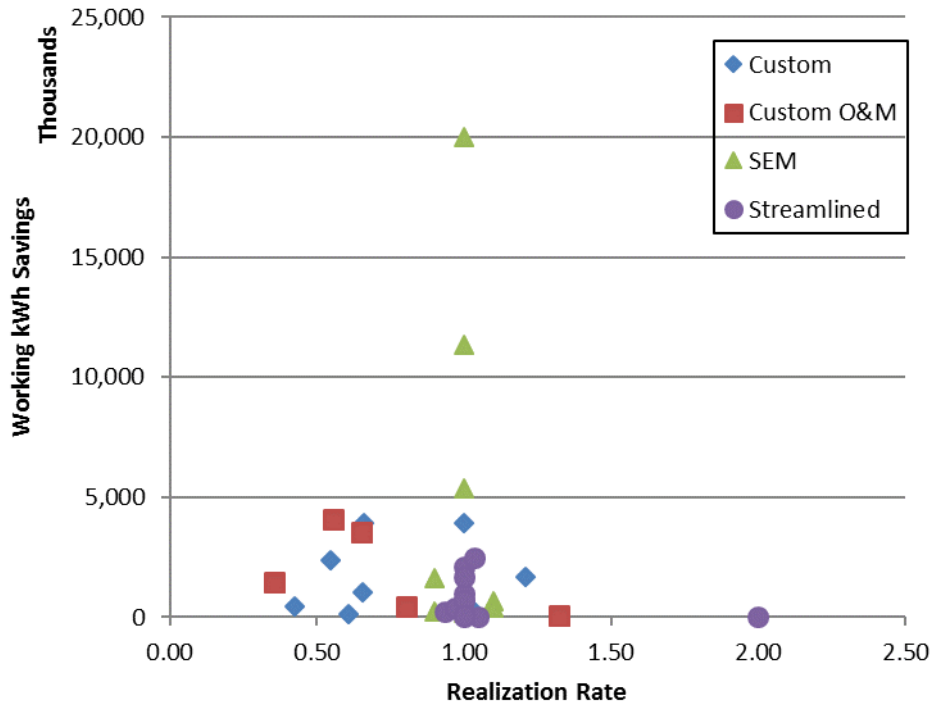

Figure 3: Electric results for program year 2014.

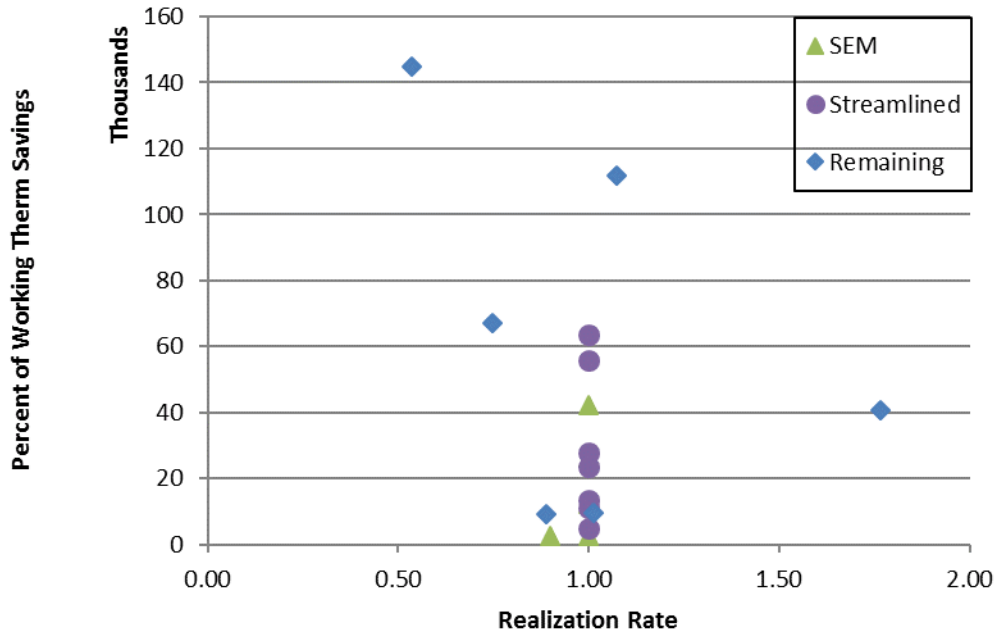

Figure 4: Gas results for program year 2013.

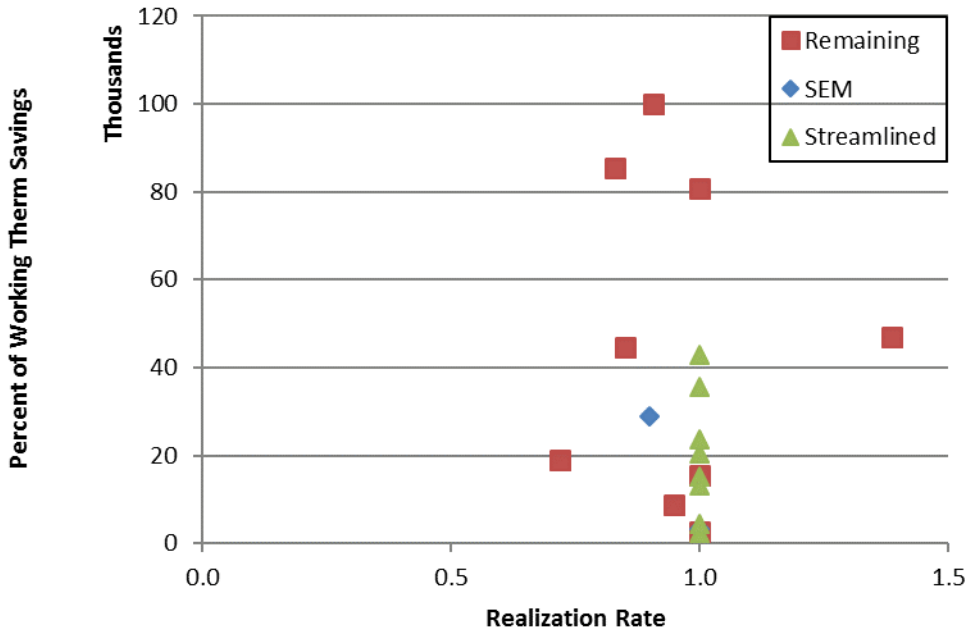

Figure 5: Gas results for program year 2014.

3.2. Program-Level Results

We extrapolated gross savings from the sampled projects to the program population for the 2013-2014 program years as described previously in Section 2.5of this report.

3.2.1. Sample Extrapolation to the Program Population

The extrapolated results are shown in Table 16. They include the relative precision that was achieved compared to the relative precision target when the sample was drawn at the 80% confidence level for all Year/Fuel/Program Track domains. As shown in the table, only two domains were slightly greater than 10%.

Table 16: Savings Results by Domain for the Program Population

Domain			Realization rate	Confidence level	Relative Precision		Reported Savings (kWh or Therms)	Evaluation Savings	
Year	Fuel	Track			Achieved	Target		kWh or Therms	% of Portfolio by fuel type
2013	Gas	Streamlined	1.00	80%	0%	13%	653,686	653,687	26%
		SEM	0.99	80%	0%	12%	101,590	100,824	4%

		Remaining	0.94	80%	10%	7%	530,657	497,515	20%
	Electric	Streamlined	0.98	80%	3%	12%	30,881,443	30,358,759	12%
		SEM	1.04	80%	4%	12%	24,081,863	24,958,677	9%
		Custom	0.95	80%	4%	14%	47,152,766	44,946,442	17%
		Custom O&M	0.71	80%	11%	49%	8,196,611	5,859,629	2%
2014	Gas	Streamlined	1.00	80%	0%	12%	435,645	435,643	18%
		SEM	0.91	80%	0%	0%	31,953	29,074	1%
		Remaining	1.01	80%	10%	11%	759,224	763,235	31%
	Electric	Streamlined	1.03	80%	5%	13%	44,955,406	46,424,076	18%
		SEM	1.00	80%	1%	11%	54,572,777	54,826,193	21%
		Custom	0.80	80%	12%	15%	60,482,437	48,670,917	18%
		Custom O&M	0.65	80%	7%	17%	11,985,280	7,822,632	3%

Table 17 presents the comparison of program to evaluated electric and gas savings without the confidence precision statistics for a simpler view of the results, however it does include the relative precision for each year at the 90-10 level. Due to the project weighting from the sample to roll-up the result the program, the overall realization rates are generally greater than the values in Table 15. The similar comparison of evaluated savings to working savings for total energy (gas and electric combined) is presented in Table 18.

Table 17: Program-Level Electric and Gas Savings and Realization Rates

Year	Program Track	Reported Working Savings		Evaluated Savings		Realization Rate	
		Electric (kWh)	Gas (therms)	Electric (kWh)	Gas (therms)	Electric	Gas
2013	Custom	47,152,766	-	44,946,442	-	0.95	NA
2013	SEM	24,081,863	101,590	24,958,677	100,824	1.04	0.99
2013	Streamlined	30,881,443	653,686	30,358,759	653,687	0.98	1.00
2013	Custom O&M	8,196,611	-	5,859,629	-	0.71	NA
2013	Remaining	-	530,657	-	497,515	NA	0.94
2013	**Total**	**110,312,683**	**1,285,933**	**106,123,508**	**1,252,026**	**0.96**	**0.97**
2013				**Relative Precision (90-10)**		**0.03**	**0.02**
2014	Custom	60,482,437	-	48,670,917	-	0.80	NA
2014	SEM	54,572,777	31,953	54,826,193	29,074	1.00	0.91
2014	Streamlined	44,955,406	435,645	46,424,076	435,643	1.03	1.00
2014	Custom O&M	11,985,280	-	7,822,632	-	0.65	NA
2014	Remaining	-	759,224	-	763,235	NA	1.01
2014	**Total**	**171,995,900**	**1,226,822**	**157,743,818**	**1,227,953**	**0.91**	**1.00**

Year	Program Track	Reported Working Savings		Evaluated Savings		Realization Rate	
		Electric (kWh)	Gas (therms)	Electric (kWh)	Gas (therms)	Electric	Gas
2014				**Relative Precision (90-10)**		**0.06**	**0.05**

Table 18: Program-Level Total Energy Savings and Realization Rates

Year	Program Track	Reported Working Energy Savings (MMBTU)	Evaluated Energy Savings (MMBTU)	Realization Rate
2013	Custom	160,768	153,245	0.95
2013	SEM	92,266	95,179	1.03
2013	Streamlined	170,659	168,877	0.99
2013	Custom O&M	27,946	19,978	0.71
2013	Remaining	53,066	49,751	0.94
2013	**Total**	**504,706**	**487,032**	**0.96**
2014	Custom	206,216	165,944	0.80
2014	SEM	189,262	189,838	1.00
2014	Streamlined	196,840	201,848	1.03
2014	Custom O&M	40,864	26,671	0.65
2014	Remaining	75,922	76,324	1.01
2014	**Total**	**709,104**	**660,624**	**0.93**

4. RECOMMENDATIONS

In this section we provide recommendations on how to improve program operations and future evaluations.

4.1. Increasing Reliability of M&V Savings Estimates

1. **More pre- and post-installation metering.** Many projects are developed using baseline schedules provided by the customer and kW loads based on equipment nameplate data. We found several projects where the customer (at the time of the evaluation) stated different baseline conditions than those used in the working analysis. Therefore, the baseline conditions may have been simply assumed by the analyst. Also, we found post-installation kW equipment loads based on nameplate data, for which our metered results revealed substantial differences. Additional metering to determine schedule and kW profiles, or even one-time measurements to confirm nameplate kW, would improve the accuracy of some working savings estimates significantly.
2. **Avoid rushing project completions**. We found two projects that were administratively closed out prior to actual physical completion. One case, project **Elec2013009**, featured a completion report that indicated that 12 zero-loss condensate drains were installed on a compressed air system. Our data collection showed that 15 drains had been installed, which was consistent with the proposed measure implementation described in the Technical Analysis Study. The customer indicated that additional drains were installed shortly after the verification site inspection. The other case, project **Elec2014067**, involved a significant number of leaks in a compressed air system that were identified during the Technical Analysis Study. At the time of the verification inspection, some of the leaks had not yet been repaired because system shutdown was required for repair. Therefore, the completion report did not include repair of all leaks however the customer indicated that all the leaks were subsequently repaired and that they have continued an active monthly leak detection and repair program. We assume that these cases of under reported completions were due to the end-of-year push to claim savings, but this results in unclaimed savings.
3. **Consider maximum (design) capacity and realistic loads.** We found multiple projects that based savings on maximum equipment capacity or future expected loads, when in fact, the equipment was operating at significantly reduced loads. Realistic loading should be the analysis goal. This is also justification for post-installation metering. There are some cases of this that result from unforeseen market conditions, which cannot be anticipated and are beyond the control of the program, but due diligence with customer interviews during the verification site visit is warranted.

4.2. Improving Program Documentation

The following recommendations are based on what we observed in the documentation obtained for the sample.

1. **Clarify complex analysis.** Some Custom and Custom O&M projects utilized complex hourly spreadsheet models for the working analysis. The TAS or completion reports generally provided good descriptions explaining the analysis. When we obtained models from the PDC, however, some models lacked a great deal of documentation within the model to allow us to easily follow the analysis. There were also some models that contained significant extra calculations that were not used in the analysis. They appeared to be an alternative analysis attempt that had been abandoned. Extraneous calculations and data should be deleted from the final analysis workbooks. We also found some models with analyses that were not consistent with the report descriptions of the analysis.
2. **Better QC of working analysis models.** We found errors in the working analysis calculation of eleven projects. About half the errors were significant (greater than 10% impact on savings) while the remaining errors were minor with little impact. The errors appeared randomly across most of the sample domains. Additional QC would be beneficial to identify and correct such errors. This would also help ensure well documented analyses. Consider enlisting the efforts of an independent third-party QC contractor to improve analytical quality.
3. **Require working models**. We could not obtain working analysis models for some projects. This makes evaluation and verification by PDCs much more difficult. We recommend requiring submission of working analysis models. SSAT models were used for some gas measures by the ATAC, but the working software was not available to the PDCs or the evaluator.

4.3. Conducting Future Evaluations

1. **Consider faster or real-time evaluation**. We found that this evaluation was hampered by the long duration from project completion to evaluation. Evaluation delays also prevent timely implementation of any recommendations resulting from the evaluation for future improvements to the program. There were also significant delays for some projects due to problems obtaining customer cooperation in a timely fashion.
2. **Clarify M&V protocols related to savings duration**. Energy Trust's M&V protocols are not clear about whether evaluation savings estimates should be based on as observed conditions, conditions in the first year after measure implementation, or a combination of conditions prorated over the measure life cycle. We recommend Energy Trust determine which savings estimates best serve the programs and define that protocol. Future evaluation requests for proposals should then clearly state the protocol on how to appropriately handle all parameters in the savings models to achieve the required evaluation savings estimates. This will ensure methodological consistency over future years. This evaluation was based on typical savings as the average of historical production/operating hours and the working analysis. If we had used first year only or as observed conditions, then savings for some of the large projects would have been significantly lower, resulting in lower realization rates.

APPENDICES

A. PROJECT-SPECIFIC M&V PLAN/REPORT TEMPLATE

SUMMARY

Sample Track: Custom

Sample Fuel: Electric

Program Year: 2013

Site ID: XXXX

Project ID: PEXXXX

Table 19: Reported Measure Savings

Measure ID	Measure Description	Working Annual Savings	
		kWh	Therms
M0000xxxx [from tracking data]	Install equipment [from tracking data]	[tracking data]	-

PROJECT DESCRIPTION

Facility and Measure Summary

[brief description of facility including baseline equipment addressed by measure(s) and operating hours]

[brief description of measure(s) including basic changes from baseline condition and how energy will be saved]

Working savings from Energy Trust's Project Tracking database are shown above in Table 1.

Project Documentation

[describe documentation obtained for the evaluation effort and if reported savings are consistent with the database]

Project documentation included the project workbook, the enhanced scoping report, and the verification report. In addition, the PDC provided a spreadsheet with calculations. The energy savings in the project documentation is consistent with the working savings from the Project Tracking database.

Documented Savings Calculation Methodology

[describe how savings were calculated]

Average annual unit savings was estimated based on……. Data from a previous project was used to generate a bin model for the baseline annual energy consumption. The energy consumption for the proposed case was estimated by reducing the xxx in each bin by the average annual hourly xxx savings, and adjusting the corresponding kW value according to the performance data. Table 2 provides the values and sources of the key determinant variables used in calculating the working savings for this measure.

Table 20: M0000xxxxx Documented Key Determinant Values Used To Estimate Working Savings

Key Determinants	Baseline Value	Source	Program Estimated Value	Source
Number of units	xx	Verification report	xx	Verification report
Loss per unit (units)	xxx	Enhanced scoping report (based on charts)	xxx	Verification report
Average annual hourly savings (units)	NA	NA	xxx	Verification report
Annual run-time (hrs/yr)	8,760	Verification report	8,760	Verification report

Evaluation

Evaluation Savings Calculation Methodology

[describe evaluation calculations]

The evaluation followed the same savings calculation methodology used for the program working savings. Based on data collection, we updated values based on our data collection. We accepted key determinant values from the project documentation and update the values based on data collection, as shown in Table 3.

Table 21: M0000xxxx Documented Key Determinant Values Compared To Values Used To Estimate Working Savings

Key Determinants	Working Savings Analysis				Evaluation Savings Analysis			
	Baseline Value	Source	Program Est. Value	Source	Baseline Value	Source	Eval. Value	Source
Number of units	xx	Verification report	xx	Verification report	xx	Verification report	xx	Data collection
Loss per unit (units)	xxx	Enhanced scoping report (based on charts)	xxx	Verification report	xxx	Enhanced scoping report (based on charts)	xxx	Data collection

Average annual savings (units)	NA	NA	xxx	Verification report	NA	NA	xxx	Data collection
Annual run-time (hrs/yr)	8,760	Verification report	8,760	Verification report	8,760	Verification report	8,760	Data collection

Data Collection

[description of data collection]

The evaluation team contacted the customer to verify key determinants and gather information about changes to plant equipment, loads, and operating sequences since the project was completed. We confirmed that the plant equipment, operating sequences and schedule remained unchanged. We also learned that additional savings were being realized by… analysis.

Evaluated Savings Results

[describe results of the evaluation and reason for difference, if any]

We used the spreadsheet provided by the PDC to calculate the average annual savings for all installed units, which was xxx, instead of xxx.

The evaluation savings results and comparison with working savings is presented in Table 4.

Table 22: Evaluation Savings Results [same as Table 1 for sampled fuel]

Measure ID	Measure Description	Annual Electric Savings, kWh		
		Working	Evaluated	Realization Rate
M0000xxx	Install equipment	xxx	xxx	xxx.x%

Facility Interview Guide for Custom, Custom O&M and Perscriptive Projects

B. Facility Interview Guide for Custom, Custom O&M and Prescriptive Projects

ENERGY TRUST PRODUCTION EFFICIENCY SITE INTERVIEW GUIDE

2013 – 2014 Impact Evaluation

11/21/2016 version

[*Interviewer, please make sure you are clear about which project(s) you are asking about. Many sites have completed a large number of projects. Be specific about what the project was, which equipment was impacted, the changes made and when it was completed (per the project documentation).*

This is an interview guide not a script, so adjust as appropriate for the project. Not all questions apply to all projects, such as "1. Baseline" does not apply to an O&M project that changed a setpoint. The questions here are generic, so customize wording to project specifics, i.e., 1.a. What was the condition of the old 50 hp compressor that was replaced with the new 50 hp VFD compressor?]

3. **Baseline** [*Ask these questions if the project replaced existing equipment, and the existing equipment was used as the baseline in the program savings analysis.*]
   - **a.** What was the condition of the existing equipment? (e.g., good, poor, not functioning)
   - **b.** Had the existing equipment not been replaced, about how long do you think that equipment would have lasted (in years)?
   - **c.** If existing equipment was not functioning or near end of life, what would you have replaced the existing equipment with had you not received Energy Trust services and/or incentives? *[This question is not meant to determine free-ridership, but rather to provide the analysis with an alternative baseline, which may be used if applicable, (e.g., old motor with 87% efficiency was replaced with HE motor at 93% efficiency, but old motor was failing and would have been replaced with standard efficiency motor at 90% efficiency).]*
4. **Schedules:** Per the project analysis documentation,
   - **a.** the operating hours/schedules before the project was completed/equipment was installed were [*insert documented schedules*].
   - **b.** and after the project was completed/equipment was installed on [*insert installed date*] the operating hours/schedules were [*insert documented schedules*].
   - **c.** Are these hours/schedules correct for the periods before and immediately after project implementation?
     - If "no" to any part of 2c: Please describe the operating hours/schedules before and/or immediately after the project was completed/equipment was installed.

d. Have the operating hours/schedules changed since the project was completed/equipment was installed?

- If yes: Please describe the hours/schedules changes and approximately when the changes occurred (including both the start and end dates, if applicable).

  (1) Why were operating hours/schedules changed?

  (2) If project was the cause of (or allowed) the change or if unclear: Did the project have any role in this change?

  (a) If yes: What was its role?

  (3) Do you have planned future changes to operating hours/schedules (e.g., increase, decrease, varies seasonally)?

  (a) If yes: When do you expect them to change again and to what extent? [*If needed, prompt for clarity around their plans over the next year from the date of the interview.*].

5. **Production Levels:** Has there been any changes in production levels since the project was completed/equipment was installed on [*insert installed date*]?

a. If yes: Can you provide data showing baseline (before) and post-project completion/equipment installation production levels? If can't provide data, can you give us an indication of the change (percent increase or decrease)?

- What were the reason(s) for these production changes? (e.g., does production vary seasonally?)

b. If the project was the cause of the change or if unclear: Did the project have any role in this change?

- If yes: What was its role?

c. Are these changes to production levels permanent?

- If no: When do you expect them to change again and to what level?

d. *[Ask these questions in cases where production increased and the project documentation does not consider alternative baseline equipment.]*

- Was the existing equipment capable of the production increase?
- How likely is it that you would have increased production if the project had not been implemented/the new equipment had not been installed? (e.g., likely, not likely)

  (1) If likely: How would you have carried out the production increase?

6. **Other Changes** [*Note: This question is open ended and intended to uncover other unanticipated changes that have occurred at the facility. It might reveal something like the replacement of a load/unload air compressor with a VFD compressor for a compressed air leak repair measure, which would significantly change compressor efficiency and resulting savings.*]

a. Have there been any other facility changes since the project was completed/equipment was installed that impacted the project/installed equipment or the facility as a whole?

- If yes: Please describe the changes.

7. Project Performance

a. How is the implemented change/equipment working?

b. Have there been any issues with the performance of the implemented change/equipment since the installation?

c. Have you changed any operating parameters, such as setpoints, since the project was completed/equipment was installed?

- If yes: Please specify what has changed and when the changes were made.

d. Are you planning any operating changes in the next year?

- If yes: Please specify what will change and when the changes are planned to take effect.

8. Other Benefits: Have you noticed any additional benefits from the project/new equipment?

9. Project-Specific Questions [*Use this section to list project-specific questions, such as the availability of trend data or control system screen shots. If you are planning a site visit to install loggers, ask for permission and determine if the customer has an electrician available (if needed). Also inquire about any other items that will help you to understand the measures installed or information needed to complete the evaluation analysis (if Ray, Energy Trust's Sr. Technical Manager, doesn't have the answers). If the customer is willing to provide missing or updated data via email or to upload to our secure server, perhaps a site visit can be avoided.*]

C. SEM INTERVIEW GUIDE

ENERGY TRUST SEM SITE INTERVIEW GUIDE

2013 – 2014 Impact Evaluation

9/07/2017 version

Researchable Topics	Item
Company and contact information	Section A
SEM Background	Section B
Customer Commitment – Resources	Section C
Customer Commitment – Policy and Goals	Section D
Planning and Implementation – Project Register (Opportunity Register), Employee Engagement, and Implementation	Section E
Planning and Implementation – Metrics and Goals, Measurement and Reporting	Section F
Future Engagement	Section G

These questions are meant to be a guide and will be modified by the interviewer as needed based on the conversation and knowledge level of the respondent.

Variables to be pulled into interview

- Opportunity Register activities
- Contact Name
- Facility/company name
- Facility address
- Phone Number
- SEM Program Year

A. Introduction

A1. May I speak with [CONTACT NAME]? [IF THAT PERSON IS NOT AT THIS PHONE NUMBER, ASK FOR NAME AND PHONE NUMBER AND START AGAIN]

1. (Yes)
2. (No, person is not able to come to phone) [GET NAME, PHONE NUMBER, AND SCHEDULE CALLBACK]
3. (No, person no longer works there) [ASK FOR THE CONTACT NAME AND PHONE NUMBER FOR THE PERSON MOST FAMILIAR WITH PARTICIPATING IN {SEM TYPE} IN {SEM YEAR}]

98. (Don't know) [ASK TO SPEAK WITH SOMEONE WHO KNOWS AND BEGIN AGAIN]
99. (Refused) [THANK AND TERMINATE]

A2. Hello, I'm [INSERT NAME] calling from SBW Consulting on behalf of Energy Trust of Oregon. We are conducting an important study with current and past participants in industrial energy management programs to understand their impact and opportunities for improvement. Are you the person who is most familiar with strategic energy management or SEM at your facility?

1. (Yes)
2. (No, person is able to come to phone) [RECORD NAME AND REPEAT A2]
3. (No, person is not able to come to phone) [SCHEDULE CALLBACK]
98. (Don't know) [ASK FOR THE CONTACT NAME AND PHONE NUMBER FOR THE PERSON MOST FAMILIAR WITH PARTICIPATING IN {SEM TYPE} IN {SEM YEAR}]
99. (Refused) [THANK AND TERMINATE]

[READ DESCRIPTON IF NEEDED]
SEM provides technical support such as audits and workshops to help facilities adopt Strategic Energy Management as an important part of how they do business.

Is this a good time to have a discussion about your experience with the SEM program? I expect it to take about 20-30 minutes. If not now when would be a better time to schedule the discussion?

Before we get started, I'd like to note that your responses are confidential and will only be publicly reported in aggregate. Individual facility responses will not be identified in public documents, but will be made available to Energy Trust of Oregon. [IF NEEDED: individual responses will be reported anonymously as part of a group. We will not publicly report any identifying information] Recording the responses.

A3. What is your job title?

A4. How long have you been with **[facility name]**?

A5. How long have you had this role?

A6. How familiar are you with the activities implemented as part of SEM?

A7. What is your role in your company's SEM program?

Some of my questions are about components of SEM. If you are not familiar enough to answer, just let me know and I'll move on to the next question. If SEM was implemented at multiple facilities, please base your answers on how SEM was implemented at **[facility address]**.

B. Overall SEM Questions

First I would like to ask some general questions about your experience with SEM and about how your organization manages energy. Then we will get into the specifics of the energy-saving opportunities that were documented and implemented and the current status of other opportunities.

B1. To what degree has your organization continued the energy management practices identified during your participation in the SEM program in **[SEM YEAR]**? What did it take to make this happen?

B2. Have you encountered any challenges implementing SEM? What were they and when did they occur? How did you overcome them?

B3. Have you maintained the energy savings you achieved during SEM?

[INSTRUCTION TO INTERVIEWER: USE TABLE B BELOW TO RECORD ANSWERS TO QUESTIONS IN SECTION B]
[ANSWER OPTIONS WILL NOT BE READ; THEY ARE INCLUDED HERE FOR EASE IN CODING AND TRACKING RESPONSES]

Table B				
Question	**Energy Performance Goals**	**Answers to listen for**	**Check box**	**CEE Element[1]**
B1a	To what degree has your organization continued to implement the energy management practices identified during SEM?	1. Open end 2. Don't know		
B1b	What did it take to make this happen?	1. Open end 2. Don't know		
B2a	Have you encountered any challenges implementing SEM?	1. Open end 2. Don't know		
B2b	What were they and when did they occur?	1. Open end 2. None 3. Don't know		
B2c	How did you overcome them?	1. Open end 2. Don't know		
B3	Have you maintained the energy savings you achieved during SEM?	1. Yes 2. No 3. Don't know		

[1]Note that the CEE Element column is intended to track the questions associated with each element. Not all questions require a direct mapping to a CEE element, but each element requires at least on question. Having the questions marked in the tables will help to ensure that the interviewer prioritizes these questions.

C. Energy Champion & Energy Team

Energy Champion

C1. Do you have an "energy champion" or "energy manager," someone in charge of coordinating energy management activities and spearheading efficiency projects? Is this the same person (or people) who served as the energy champion during SEM in **[SEM YEAR]**?

Energy Team

C2. Do you have an **energy [management] team** [dedicated staff for energy and energy efficiency]?

[ASK C3 THROUGH C4 IF C2= YES]

C3. Does your energy team meet [regularly]? How frequently is it currently meeting?

C4. Has your energy team changed since you first started meeting? Have any staff ceased to participate in the energy team?

[INSTRUCTION TO INTERVIEWER: USE TABLE C BELOW TO RECORD ANSWERS TO QUESTIONS IN SECTION C]
[ANSWER OPTIONS WILL NOT BE READ; THEY ARE INCLUDED HERE FOR EASE IN CODING AND TRACKING RESPONSES]

Table C				
Question	**Staff**	**Answers to listen for**	**Check box**	**CEE Element[1]**
C1a	Do you have an energy manager or someone in charge of energy efficiency at this location?	1. Yes 2. No 3. Don't know		1b
C1b	Is it the same person as the one who worked on SEM?	1. Yes 2. No 3. Don't know		
C2a	Do you have an energy management team [dedicated staff for energy and energy efficiency]?	1. Yes 2. No 3. Don't know		1b
C3a	Does your energy team meet [regularly]?	1. Yes 2. No 3. Don't know		1b
C3b	How frequently is it currently meeting?	1. Daily 2. Weekly 3. Monthly 4. Quarterly 5. Twice a year 6. Annually 7. Other [SPECIFY] 8. Don't know 9. Bi-monthly (every other week		
C4	Has your energy team changed? (Have any staff ceased to participate in the energy team?)	1. Yes [specify] 2. No 3. Don't know		

[1]Note that the CEE Element column is intended to track the questions associated with each element. Not all questions require a direct mapping to a CEE element, but each element requires at least on question. Having the questions marked in the tables will help to ensure that the interviewer prioritizes these questions.

D. Energy Policies & Goals

D1. Does your company or facility have any policies or plans in place that incorporate energy or energy efficiency? A simple example would be things like always buying efficient equipment or setting energy performance goals.]

D2. Does your company or facility currently have goals related to energy or energy efficiency? [READ IF NEEDED: This goal(s) may be expressed as a percentage or an absolute number in units of energy use intensity (EUI). The goal(s) must be stated as a comparison to a defined baseline. It could also be defined through adoption of other systems such as LEED or ENERGY STAR.] How are the goals defined and what are they (e.g. 5% reduction in energy use in 3 years)? How are you doing meeting the goals?

[INSTRUCTION TO INTERVIEWER: USE TABLE D BELOW TO RECORD ANSWERS TO QUESTIONS D1 – D2]
[ANSWER OPTIONS WILL NOT BE READ; THEY ARE INCLUDED HERE FOR EASE IN CODING AND TRACKING RESPONSES]

Table D				
Question	**Energy Performance Goals**	**Answers to listen for**	**Check box**	**CEE Element[1]**
D1	Does your company or facility have any policies or plans in place that incorporate energy efficiency?	1. Yes 2. No 3. Don't know		1a
D2a	Does your company or facility currently have goals related to energy or energy efficiency?	1. Yes 2. No 3. Don't know		1a
D2b	How are the goals defined and what are they (e.g. 5% reduction in energy use in 3 years)?	1. percentage energy reduction per quantity product over time 2. absolute number energy reduction per quantity product over time 3. Other [SPECIFY]		2c
D2c	How are you doing meeting the goals?	1. We have met 100% of our goals 2. We are on track to meet 100% of our goals 3. We are falling behind on our goals 4. We expect to meet 75% of our goal 5. We expect to meet 50% of our goal 6. We expect to meet 25% of our goal 7. We expect to meet 0% of our goal 8. Other [SPECIFY] 9. Don't know		

Table D				
Question	**Energy Performance Goals**	**Answers to listen for**	**Check box**	**CEE Element[1]**

[1]Note that the CEE Element column is intended to track the questions associated with each element. Not all questions require a direct mapping to a CEE element, but each element requires at least on question. Having the questions marked in the tables will help to ensure that the interviewer prioritizes these questions.

E. Opportunity Register & Employee Engagement

Opportunity Register

While participating in SEM in **[SEM YEAR]**, an opportunity register was developed listing potential energy-efficiency projects and activities at your facility.

E1. Did you find the Opportunity Register useful in helping you prioritize and implement projects? Are you still using it? Do you regularly update your opportunity register? [INCLUDES ADDING NEW PROJECTS TO THE REGISTER OR UPDATING PROJECTS ALREADY ON THE REGISTER] If not, do you track potential opportunities using a different system? If so, please describe. [IF UPDATE REGISTER, ASK IF WE CAN GET A COPY OF THE REGISTER.]

E2. I have some questions about the status of the activities included in your opportunity register at the time you participated in SEM. I am going to list a few activities which were implemented during your SEM participation. Can you confirm these were implemented and tell me whether they remain in place? [INTERVIEWER: Check the Opportunity Register and ask about the most significant projects. For example, control set point projects: three were completed and two were still planned? Did the ones that were completed change and were the ones identified implemented?] Have you implemented any other items on the opportunity register? If not, do you have any plans to do so?

E3. Have you added any energy-efficiency projects to the opportunity register since your SEM engagement in **[SEM YEAR]**? [If they no longer use the opportunity register, make this a generic question: "Have you implemented any other energy efficiency projects since your SEM engagement?"] Describe the projects, where they "came" from, [INTERVIEWER: Look for whose idea it was – someone within the facility, a contractor, a contact from a different firm that they met through the SEM workshops, etc.] and tell me when they were implemented or when you plan to implement them. [ASK IF E1c INDICATES REGULAR UPDATE: You mentioned earlier that you update the opportunity register. Are you tracking the status of these projects in the register?] [ASK IF E1c INDICATES **NO** REGULAR UPDATE: Have you kept track of these projects? If so, how?]

Employee Engagement

E4. How has the level of engagement in SEM changed overall at your company since your SEM engagement in **[SEM YEAR]**, is the company more involved with SEM? Less involved? How has it changed specifically among your company's: [ASK EACH ITEM SEPARATELY]

1. Management?
2. Executive Sponsor?
3. Energy Team?
4. Operations and maintenance personnel?
5. Production employees?

Other Facility Changes

E5. Now, I'd like to ask a few questions about your facility. Since participating in SEM in **[SEM YEAR],** have there been any changes to the facility? If so, please describe.

E6. Since participating in **SEM** in **[SEM YEAR],** has there been any change in operating hours/schedules? [IF THEY ARE NOT FAMILIAR ENOUGH TO ANSWER QUESTIONS SKIP TO END.] If so, please describe the operating hours/schedules before and after participating in SEM.

- E6a. Why were operating hours/schedules changed? [Please note if SEM was the cause of the change and if unclear ask, Did the SEM program have any role in this change? If yes, what was its role?]
- E6b. When did these changes occur?
- E6c. Are the changes still in place? [IF NOT: How long did they last?]
- E6d. [ASK IF YES TO E6] Are these changes permanent? [If NO: When do you expect them to change again and to what level?]

E7. Has there been any change in production levels since implementing **SEM** in **[SEM YEAR]?** [IF THEY ARE NOT FAMILIAR ENOUGH TO ANSWER QUESTION SKIP TO END.]

- E7a. If so, would you be able to provide data showing production levels before and after **[SEM YEAR]?** [INTERVIEWER: AT THE END, PROVIDE AN EMAIL ADDRESS FOR THEM TO SEND US THESE DATA]
- E7b. What was the reason for these production changes? (e.g., does production vary seasonally?)
- E7c. If the program was the cause of the change or if unclear ask: Did the program have any role in this change? If yes, what was its role? Are these changes permanent? If no, when do you expect them to change again and to what level?

E8. Since participating in **SEM** in **[SEM YEAR],** have you changed the product line or added any different products to your production facility? If so, did the program have any role in how you set up production of these new products?

E9. Can you provide any additional information on operational changes that may impact the energy consumption of the facility as a whole?

[INSTRUCTION TO INTERVIEWER: USE TABLE F BELOW TO RECORD ANSWERS TO QUESTIONS E1-E5]
[ANSWER OPTIONS WILL NOT BE READ; THEY ARE INCLUDED HERE FOR EASE IN CODING AND TRACKING RESPONSES]

Table F				
Question	**Opportunity Register**	**Answers to listen for**	**Check box**	**CEE Element**
E1a	Did you find the Opportunity Register useful in helping you prioritize and implement projects?	1. Yes 2. No 3. Don't know		
E1b	Are you still using the opportunity register?	1. In place and using it 2. In place but not using it 3. In development 4. No 5. Don't know		2d
E1c	Do you regularly update your opportunity register? [ADD NEW PROJECTS TO THE LIST OR TRACK PROGRESS OF PROJECTS]	1. Update regularly 2. Update occasionally 3. Almost never update it 4. Haven't updated since SEM ended 5. Don't know		2g
E1d	Can we get a copy of the updated opportunity register?	1. Yes 2. No 3. Don't know		
E1e	If not, do you track potential opportunities using a different system? If so, please describe. [INTERVIEWER: Request the files if customer uses a different system.]	1. Yes [SPECIFY] 2. No 3. Don't know		2d
E2a	I have some questions about the status of the projects included in your opportunity register from when you participated in SEM. Can you describe them [projects included in your opportunity register] and tell me if they were complete or whether you removed them or plan to complete them? [INTERVIEWER: Check the Opportunity Register and ask about the most significant projects. For example, control set point projects: three were completed and two were still planned? Did the ones that were completed change and were the ones identified implemented?]	Record for each project / SEM activity 1. Completed 2. Planned 3. Removed		2f
E2b	If completed, did they change since they were recorded in the opportunity register during your participation in SEM?	Record for each project / SEM activity completed 1. Yes [SPECIFY] 2. No 3. Don't know		
E2c	When were they completed or when are they planned to be completed?	Record for each project / SEM activity if completed or planned 1. Open end 2. Don't know		

Table F				
Question	**Opportunity Register**	**Answers to listen for**	**Check box**	**CEE Element**
E2d	ASK IF REMOVED: Are you planning to implement them?	Record for each removed project. 1. Yes 2. No 3. Don't know		2f
E3a	Have you added any energy-efficiency projects added to the opportunity register since your SEM engagement?	1. Yes [SPECIFY] 2. No 3. Don't know 4. Yes, but not to official register [SPECIFY] 5. Haven't added to OR or potential project list but have done other projects		2g
E3b	IF YES: Describe the projects?	1. Open end 2. Don't know		
E3c	IF YES: Describe where they "came" from?	1. Staff requests for energy efficiency 2. Suggestions from PDC 3. Generating internally 4. Peers met through SEM program 5. Activities other than energy efficiency 6. Other [SPECIFY] 7. Don't know		
E3d	When were they implemented or if not implemented when do you plan to implement them?	1. Open end 2. Don't know		
E3e	[ASK IF UPDATING THE REGISTER] Are you tracking the status of these projects in the register?	1. Yes [SPECIFY what the status is] 2. No 3. Don't know		
E3f	[ASK IF NOT UPDATING IN THE REGISTER] Do you have a different tracking system of these projects? If so, how?	1. Yes [SPECIFY] 2. No 3. Don't know		

Table F				
Question	**Opportunity Register**	**Answers to listen for**	**Check box**	**CEE Element**
E4	How has the level of engagement in SEM changed overall at your company since your SEM engagement, is the company more involved with SEM? Less involved? 1. Company? 2. Management? 3. Energy Team? 4. Operations and maintenance personnel? 5. Production employees?	[ASK ABOUT EACH ITEM ON LIST] 1. More involved with SEM 2. Less involved with SEM 3. No change 4. Don't know		

Table F				
Question	**Opportunity Register**	**Answers to listen for**	**Check box**	**CEE Element**
E5	Now, I'd like to ask a few questions about your facility. Since participating in SEM in [SEM YEAR], have there been **any changes to the facility**? If so, please describe.	1. Yes [SPECIFY] 2. No 3. Don't know		
E6	Since participating in SEM in [SEM YEAR], have there been any changes **in operating hours/schedules**? [IF THEY ARE NOT FAMILIAR ENOUGH TO ANSWER QUESTIONS SKIP TO END.] If so, please describe the operating hours/schedules before and after participating in SEM.	1. Yes [SPECIFY] 2. No 3. Don't know		
E6a	Why were operating hours/schedules changed? [Please note if SEM was the cause of the change and if unclear ask: Did SEM have any role in this change? If yes, what was its role?]	1. Open end 2. Don't know		
E6b	When did these changes occur?	1. Month/Year[SPECIFY] 2. Don't know		
E6c	Are the changes still in place? [IF NOT: How long did they last?]	1. Yes 2. No [SPECIFY] 3. Don't know		
E6d	[ASK IF YES TO E7] Are these changes permanent? If no: When do you expect them to change again and to what level?	1. Yes 2. No [SPECIFY] 3. Don't know		
E7	Has there been any **change in production levels** since implementing SEM in [SEM YEAR]? [IF THEY ARE NOT FAMILIAR ENOUGH TO ANSWER QUESTION SKIP TO END.]	1. Yes [SPECIFY] 2. No 3. Don't know		
E7a	If so, please provide an indication of the change from the baseline (before) production and post-measure installation production levels (percent change).	1. Open end 2. Don't know		

Table F				
Question	**Opportunity Register**	**Answers to listen for**	**Check box**	**CEE Element**
E7b	What was the reason for these production changes? (e.g., does production vary seasonally?)	1. Open end 2. Don't know		
E7c	[If the program was the cause of the change or if unclear ask]: Did the program have any role in this change? If yes, what was its role?	1. Yes [SPECIFY ROLE] 2. No 3. Don't know		
E7d	Are these changes permanent? If no, when do you expect them to change again and to what level?	1. Yes 2. No [SPECIFY] 3. Don't know 4. Open end level of change		
E8	Since participating in SEM in [SEM YEAR], have you **changed the product line or added any different products** to your production facility?	1. Yes 2. No 3. Don't know		
E8a	If so, did the program have any role in how you set up production of these new products?	1. Yes 2. No 3. Don't know		
E9	Can you provide **any additional information on other changes that may impact the energy consumption** of the facility as a whole?	1. Yes [SPECIFY] 2. No 3. Don't know		

F. Energy Model

F1. Are you currently using the energy model and workbook developed during SEM in **[SEM YEAR]** to track your energy use? If not, are you using another type of electronic system to track your energy use over time? [Note: Some projects had an MT&R model developed and some had another model type developed for the project. Refer to the provided model type for each project.]

If using MT&R model and workbook:

1. How easy is it to maintain the energy model? How much time does it take? What would help to maintain it?
2. In what ways are you *currently* using information from the energy model? [Probe about: Monthly reports to staff/management on energy savings; tracking toward annual savings goals; cost tracking, e.g. cost per unit of production]
3. Have you changed the variables for your facility's energy model? If so, how? If not, is the current model still good at tracking energy and the impacts of energy efficiency projects?

If using another type of electronic system to track energy use:

4. Please describe how the system or tool works.
5. Why did you use this system instead of the energy model and workbook?
6. How could the energy model and workbook be improved so that you would have continued to use it?
7. What data did your company choose to collect in your energy model?
8. How did you decide which data to collect and record?
9. Do you plan to continue using this electronic system to track energy use?

If not using a system to track energy use:

10. What discouraged or prevented you from using your energy model or any other system to track energy use?
11. How could the energy model and workbook been improved so that you would have continued to use it?

F2. Who is responsible for tracking energy use? How frequently are energy use data reviewed? How often are energy use data shared with others in your organization? With whom are these data shared?

[ASK PAST PARTICIPANTS WHO STILL USE THE ENERGY MODELS]

Part of our research with Energy Trust of Oregon is to calculate the energy savings during the years after participants finish the program. Would you be willing to provide us with your updated energy models (including billing and production data) through the end of 2016? [IF NEEDED: These data will be kept confidential. These data will help Energy Trust understand how savings change in years after participants finish the program, and will help Energy Trust improve their program.]

[INSTRUCTION TO INTERVIEWER: USE TABLE G BELOW TO RECORD ANSWERS TO QUESTIONS F1 –F2] [ANSWER OPTIONS WILL NOT BE READ; THEY ARE INCLUDED HERE FOR EASE IN CODING AND TRACKING RESPONSES]

Table G				
Question	**Measuring and Reporting**	**Answers to listen for**	**Check box**	**CEE Element**
F1	Are you currently using the energy model and workbook developed during SEM to track your energy use? If not, are you using another type of electronic system to track your energy use over time? [explicitly ask about MT&R and EMIS if not mentioned]	1. MT&R 2. EMIS 3. Other [SPECIFY] 4. No 5. Don't know		3a, 3b, 3c
F1(1a)	[IF G1=MT&R] How easy is it to maintain the model?	1. Very easy 2. Somewhat easy 3. Not easy 4. Don't know		
F1(1b)	[IF G1=MT&R] How much time does it take?	1. Minutes 2. Hours 3. Days 4. Weeks 5. Months 6. Don't know		
F1(1c)	[IF G1=MT&R] What would help to maintain it?	1. Open end 2. Don't know		
F1(2)	[IF G1=MT&R] In what ways are you currently using information from the energy model and workbook after SEM? [Probe about: Monthly reports to staff/management on energy savings; tracking toward annual savings goals; cost tracking, e.g. cost per unit of production]	1. **Monthly reports to staff/management on energy savings (CEE 3d)** 2. Tracking toward annual savings goals 3. Cost tracking, e.g. cost per unit of production 4. **Reassess goals, metrics, or planned projects to ensure they align with business and energy performance priorities (CEE 2g)** 5. Other [SPECIFY] 6. Don't know		2g, 3d
F1(3a)	[IF G1=MT&R] Have you changed the variables for your facility's MT&R model? If so, how?	1. Yes [SPECIFY] 2. No 3. Don't know		
F1(3b)	[IF G1=MT&R and G1(3a) = No] If not, is the current model still good at tracking energy and the impacts of energy efficiency projects?	1. Yes [SPECIFY] 2. No 3. Don't know		
F1(4)	[IF G1=EMIS or OTHER] If using another type of electronic system to track energy use, please describe how the system or tool works.	1. Open end 2. Don't know		3a, 3b, 3c

Table G				
Question	**Measuring and Reporting**	**Answers to listen for**	**Check box**	**CEE Element**
F1(5)	[IF G1=EMIS or OTHER] Why did you use this system instead of the MT&R model and workbook?	3. Open end 4. Don't know		
F1(6)	[IF G1=EMIS or OTHER] How could the MT&R model and workbook been improved so that you would have continued to use it?	1. Open end 2. Don't know		
F1(7a)	[IF G1=EMIS or OTHER] What data did your company choose to collect in your monitoring and reporting model?	1. Open end 2. Don't know		
F1(8)	[IF G1=EMIS or OTHER] How did you decide which data to collect and record?	1. Open end 2. Don't know		
F1(9)	[IF G1=EMIS or OTHER] Do you plan to continue using this electronic system to track energy use?	1. Yes 2. No 3. Don't know		
F1(10)	[IF G1=NO] If not using a system to track energy use: What discouraged or prevented you from using your MT&R model or any other system to track energy use?	1. Open end 2. Don't know		
F1(11)	[IF G1=NO] How could the MT&R model and workbook been improved so that you would have continued to use it?	1. Open end 2. Don't know		
F2a	Who is responsible for tracking energy use?	1. Energy champion 2. An assigned energy team member 3. Other [SPECIFY] 4. Don't know		
F2b	How frequently is energy use data reviewed?	1. Daily 2. Weekly 3. Monthly 4. Quarterly 5. Twice a year 6. Annually 7. Continuously 8. Other [SPECIFY] 9. Don't know 10. Bi-monthly (every other week		
F2c	How often is energy use data shared with others in your organization?	1. Daily 2. Weekly 3. Monthly 4. Quarterly 5. Twice a year 6. Annually		3d

Table G				
Question	**Measuring and Reporting**	**Answers to listen for**	**Check box**	**CEE Element**
		7. Other [SPECIFY] 8. Don't know		
F2d	With whom is this data shared?	1. Energy team 2. Management 3. Staff 4. Other [SPECIFY] 5. Don't know		
0	Part of our research with Energy Trust of Oregon is to calculate the energy savings during the years after participants finish the program. Would you be willing to provide us with your updated MT&R models (including billing and production data) through the end of 2014? [IF NEEDED: These data will be kept confidential.]	1. Yes 2. No [SPECIFY] 3. Don't know		

G. Future Engagement

G1. After participating in SEM in **[SEM YEAR]**, would you say your facility was more likely or less likely to conduct energy efficiency projects or did it make no difference? Why do you say that?

G2. Did participating in SEM make identifying and implementing future energy efficiency projects easier? Why do you say that?

G3. Since your SEM experience ended in **[SEM YEAR]**, which aspect(s) of SEM do you feel has **most** contributed toward your facility doing additional energy efficiency projects? Why?

G4. What could Energy Trust do to help your company sustain your strategic energy management practices and continue to identify and implement changes to save energy?

G5. How helpful would it be if Energy Trust were to stay engaged with you on a more regular basis, such as extending the program to multiple years? Would you welcome more of that type of ongoing engagement?

[INSTRUCTION TO INTERVIEWER: USE TABLE H BELOW TO RECORD ANSWERS TO QUESTIONS G1-G4]
[ANSWER OPTIONS WILL NOT BE READ; THEY ARE INCLUDED HERE FOR EASE IN CODING AND TRACKING RESPONSES]

Table H				
Question	**Measuring and Reporting**	**Answers to listen for**	**Check box**	**CEE Element**
G1a	After participating in SEM, was your facility more likely or less likely to conduct energy efficiency projects or did it make no difference	1. More likely 2. Less likely 3. No difference		
G1b	Why?	1. Open end 2. Don't know		
G2a	Did participating in SEM make identifying future energy efficiency projects easier?	1. Easier 2. Not easier 3. No difference 4. Don't know		
G2b	Why?	1. Open end 2. Don't know		
G2c	Did participating in SEM make implementing future energy efficiency projects easier?	1. Easier 2. Not easier 3. No difference 4. Don't know		
G2d	Why?	1. Open end 2. Don't know		
G3a	Since your SEM experience ended, which aspect(s) of SEM do you feel has **most** contributed toward your facility doing additional energy efficiency projects?	1. Energy scan 2. Opportunity register Energy model that shows predicted vs. actual energy use 4. Energy team 5. Energy Management Plan & Goals 6. Energy Management Assessment 7. Employee Engagement Activities 8. Reports to Management 9. Peer Network 10. Other [SPECIFY] 11. Don't know		
G3b	Why?	1. Open end 2. Don't know		
G4	What could Energy Trust do to help your company sustain your strategic energy management practices and continue to identify and implement changes to save energy?	1. Open end 2. Don't know 3. Nothing		

G5a	How helpful would it be if Energy Trust Engineers were to stay engaged with you on a more regular basis, such as extending the program to multiple years?	1. Very helpful 2. Maybe somewhat helpful 3. No difference 4. Don't know		
G5b	Would you welcome more of that type of ongoing engagement?	1. Yes 2. No 3. Don't know		

H. Closing

Those are all my questions. You agreed to send us the following data [INTERVIEWER: LIST ALL THAT ARE APPLICABLE]

- Updated energy models [PAST PARTICIPANTS WHO USE ENERGY MODELS (G1)]
- Updated opportunity register

We will send you an email with instructions about how to upload these items onto a secure server. It will come from SBW Consulting. What email address should we sent the information to? [RECORD EMAIL ADDRESS]
Can you please provide the information by [INSERT DUE DATE]?
Thank you very much for your time and participation with Energy Trust and for your support of this important study. Have a great day!

D. SEM Realization Rate Justifications

This appendix lists the evaluation justifications for assigning realization rates based on the qualitative reviews.

SBW Project ID	Fuel	Year	RR Value	RR Source	Information source	Justification for RR Assignment
Elec2013002	Electric	2013	1.02	Calculated	2013-2014 PE Eval: customer data	Re-calculated using customer data
Elec2013010	Electric	2013	1.86	Calculated	Core Pilot Evaluation	Re-calculated using customer data
Elec2013016	Electric	2013	0.90	Qualitative assessment	2013-2014 PE Eval: Assessment with customer interview	Model reasonable overall, but the performance periods were selected for best results, ignoring other periods with poor performance.
Elec2013018	Electric	2013	1.00	Qualitative assessment	2012 PE SEM Evaluation	No model developed. Savings based on engineering calculations which appeared reasonable.
Elec2013021	Electric	2013	1.00	Qualitative assessment	2013-2014 PE Eval: Assessment, no interview	Baseline model appeared reasonable with small accumulative error.
Elec2013025	Electric	2013	1.00	Qualitative assessment	2012 PE SEM Evaluation	Baseline model appeared reasonable with small accumulative error.
Elec2013036	Electric	2013	1.00	Qualitative assessment	2012 PE SEM Evaluation	Baseline model appeared reasonable with small accumulative error.
Elec2013040	Electric	2013	1.00	Qualitative assessment	2012 PE SEM Evaluation	Baseline model appeared reasonable with small accumulative error and the performance period was a full year.
Elec2013072	Electric	2013	1.00	Qualitative assessment	2012 PE SEM Evaluation	Model had high residuals month to month, but annually ok. Performance period was full year.
Elec2014026	Electric	2014	0.90	Qualitative assessment	2013-2014 PE Eval: Assessment, no interview	The baseline model tended to overpredict savings during the performance period which likely overpredicted savings when extrapolated to the year.
Elec2014027	Electric	2014	1.10	Qualitative assessment	2013-2014 PE Eval: Assessment, no interview	Baseline model appeared reasonable, but capital measures were implemented during warmer months which likely caused overstatement of savings and likely caused an overcorrection in the SEM model. This would have resulted in underprediction of SEM savings.
Elec2014029	Electric	2014	1.00	Qualitative assessment	2012 PE SEM Evaluation	Baseline model appeared reasonable with small accumulative error.

SBW Project ID	Fuel	Year	RR Value	RR Source	Information source	Justification for RR Assignment
Elec2014043	Electric	2014	1.00	Qualitative assessment	2013-2014 PE Eval: Assessment with customer interview	Baseline model appeared reasonable with small accumulative error.
Elec2014047	Electric	2014	1.00	Qualitative assessment	2013-2014 PE Eval: Assessment with customer interview	Baseline model appeared reasonable with small accumulative error.
Elec2014054	Electric	2014	1.00	Qualitative assessment	2013-2014 PE Eval: Assessment with customer interview	Baseline model appeared reasonable with small accumulative error.
Elec2014058	Electric	2014	1.10	Qualitative assessment	2013-2014 PE Eval: Assessment, no interview	Model reasonable overall, but we found calculation errors that likely cause underestimation of savings.
Elec2014059	Electric	2014	0.90	Qualitative assessment	2013-2014 PE Eval: Assessment with customer interview	Model performance varied across the year. The performance period occurred during period when baseline model over-predicted energy use.
Gas2013080	Gas	2013	1.00	Qualitative assessment	2013-2014 PE Eval: Assessment with customer interview	No regression model. Savings from a TAS which appeared reasonable.
Gas2013081	Gas	2013	1.00	Qualitative assessment	2012 PE SEM Evaluation	Baseline model appeared reasonable with relatively small residual error.
Gas2013082	Gas	2013	1.00	Qualitative assessment	2013-2014 PE Eval: Assessment, no interview	Model performance varied across the year, but the performance period was sufficiently long to span the variations and produce reasonable results.
Gas2013084	Gas	2013	0.90	Qualitative assessment	2013-2014 PE Eval: Assessment, no interview	The Model tended to overpredict saving during the extrapolated performance period which could cause an overestimate of savings.
Gas2013107	Gas	2013	1.00	Qualitative assessment	2012 PE SEM Evaluation	Reasonable models (12 models). 7 resulting savings and 5 with negative savings set to zero savings. Difficult to assess results because many had electric measures such as lighting implemented in same time frame which would have heat takeback which was not accounted for (maybe reason for increases). assumed 100% RR.
Gas2014085	Gas	2014	1.00	Qualitative assessment	2013-2014 PE Eval: Assessment, no interview	Baseline model appeared reasonable with small accumulative error, and the performance period included a full year.

SBW Project ID	Fuel	Year	RR Value	RR Source	Information source	Justification for RR Assignment
Gas2014097	Gas	2014	0.90	Qualitative assessment	2013-2014 PE Eval: Assessment, no interview	Baseline model did not perform well and a capital measure was not accounted for during the performance period.

E. CUSTOM PROJECT M&V REPORTS

These individual site reports are confidential and are provided under separate appendix cover, for Energy Trust of Oregon use only. This confidential appendix includes project reports for the following projects:

SBW Project ID	Fuel	Year	Track
Elec2013001	Electric	2013	Custom
Elec2013003	Electric	2013	Custom
Elec2013004	Electric	2013	Custom
Elec2013009	Electric	2013	Custom
Elec2013024	Electric	2013	Custom
Elec2013028	Electric	2013	Custom
Elec2013035	Electric	2013	Custom
Elec2013053	Electric	2013	Custom
Elec2013012	Electric	2013	Custom O&M
Elec2013020	Electric	2013	Custom O&M
Elec2013030	Electric	2013	Custom O&M
Elec2013034	Electric	2013	Custom O&M
Elec2013050	Electric	2013	Custom O&M
Elec2013002	Electric	2013	SEM
Elec2013016	Electric	2013	SEM
Elec2013021	Electric	2013	SEM
Elec2014005	Electric	2014	Custom
Elec2014031	Electric	2014	Custom
Elec2014041	Electric	2014	Custom
Elec2014042	Electric	2014	Custom
Elec2014044	Electric	2014	Custom
Elec2014045	Electric	2014	Custom
Elec2014051	Electric	2014	Custom
Elec2014061	Electric	2014	Custom
Elec2014064	Electric	2014	Custom
Elec2014071	Electric	2014	Custom
Elec2014011	Electric	2014	Custom O&M
Elec2014067	Electric	2014	Custom O&M
Elec2014043	Electric	2014	SEM
Elec2014047	Electric	2014	SEM
Elec2014054	Electric	2014	SEM
Elec2014058	Electric	2014	SEM
Elec2014059	Electric	2014	SEM
Gas2013077	Gas	2013	Remaining
Gas2013079	Gas	2013	Remaining

Gas2013096	Gas	2013	Remaining
Gas2013102	Gas	2013	Remaining
Gas2013109	Gas	2013	Remaining
Gas2013110	Gas	2013	Remaining
Gas2013080	Gas	2013	SEM
Gas2014076	Gas	2014	Remaining
Gas2014088	Gas	2014	Remaining
Gas2014089	Gas	2014	Remaining
Gas2014092	Gas	2014	Remaining
Gas2014095	Gas	2014	Remaining
Gas2014098	Gas	2014	Remaining
Gas2014101	Gas	2014	Remaining
Gas2014105	Gas	2014	Remaining
Gas2014108	Gas	2014	Remaining