Public Service Company of Oklahoma
2013 Energy Efficiency & Demand Response Programs: Annual Report

Prepared for:

Oklahoma Corporation Commission

In accordance with annual reporting requirements:
Title 165: Oklahoma Corporation Commission
Chapter 35. Electric Utility Rules
Subchapter 41. Demand Programs
165:35-41-7. Reporting

June 1, 2014

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1. Executive Summary

This report presents an evaluation of the performance of the energy efficiency and demand response programs offered by Public Service Company of Oklahoma (PSO) in 2013. PSO is submitting this report to fulfill the requirements outlined in Title 165: Oklahoma Corporation Commission Chapter 35. Electric Utility Rules Subchapter 41. Demand Programs 165:35-41-7.

On June 28, 2012, PSO submitted a comprehensive portfolio of energy efficiency and demand response programs to the Oklahoma Corporation Commission (OCC) for Program Years 2013-2015. This portfolio was approved by the OCC in Cause No. PUD 201200128 by Order No. 604214 on November 15, 2012. The focus of this report is participation during the first program year (PY2013) of the implementation cycle, spanning from January 1, 2013 to December 31, 2013.

1.1 2013 Program Offerings

PSO offered six programs, four residential and two commercial/industrial, to its customers in 2013. Program names, PY2013 start dates, and customer sector targeted are shown in Table 1-1.

Table 1-1: Program Start Dates

Program	Sector	Start Date
Energy Efficiency Programs		
High Performance Business	Commercial & Industrial	January 01, 2013
Home Weatherization	Low-Income Residential	January 01, 2013
Energy Saving Products and Services	Residential	January 01, 2013
High Performance Homes	Residential	January 01, 2013
Demand Response Programs		
Business Demand Response	Commercial & Industrial	January 01, 2013
Education Programs		
Education	Residential	January 01, 2013

Program impacts during 2013 are summarized in the following sections. More specifically, projected, reported, and verified annual energy savings and peak demand reductions are compared.

For the purposes of this report, projected, reported, and verified impacts are defined as follows:

- **Projected Impacts** refer to the energy savings (kWh) and peak demand reduction (kW) estimates submitted to the OCC as part of PSO's initial 2013 – 2015 portfolio filing on June 28, 2012.[1]
- **Reported Impacts** refer to energy savings (kWh) and peak demand (kW) reduction estimates based on actual customer participation in PY2013, before program evaluation activities.
- **Verified Impacts** refer to energy savings (kWh) and peak demand (kW) reduction estimates for PY2013 developed through independent program evaluation, measurement, and verification (EM&V).

Verified impacts are useful as a program performance metric in that they reflect actual program participation (as opposed to projected participation) and they adjust for any findings from independent impact evaluation including detailed review of program materials, interviews with program participants, and in some cases detailed on-site data collection. A glossary of these and other energy efficiency and demand response evaluation specific terms is provided in Appendix A of this report.

1.2 Summary of Energy Impacts

At the portfolio level, reported energy savings in PY2013 exceeded projections by 79%. The vast majority of the energy savings above projections is a result of upstream CFL sales through the Energy Saving Products and Services program. Total gross verified energy savings developed through EM&V of PSO's portfolio of programs is estimated at 97,122 MWh. This represents a realization rate of 99% as compared to reported energy savings. The portfolio-level Net-to-Gross (NTG) ratio, indicating the percentage of gross savings directly attributable to program influences, is estimated to be 71%, resulting in net verified energy savings of 71,880 MWh.

Table 1-2 summarizes the energy impacts of PSO's energy efficiency and demand response programs during PY2013. The verified gross energy savings column is highlighted with a thick border for easy identification.

[1] Cause No. PUD 201200128, Direct Testimony of Eric Raines.

Table 1-2: Summary of Energy Impacts – PY2013[2]

Program	Gross Annual Energy Savings (MWh)				Net Impacts	
	Projected	Reported	Verified	Gross Realization Rate	NTG Ratio	Net Annual Energy Savings (MWh)
Energy Efficiency Programs						
High Performance Business	37,919	25,413	24,739	97%	0.78	19,188
Home Weatherization	2,119	5,095	5,113	100%	1.00	5,113
Energy Saving Products and Services	10,569	63,502	62,688	99%	0.70	43,823
High Performance Homes	3,973	3,799	3,949	104%	0.79	3,121
Energy Efficiency Totals	54,582	97,809	96,488	99%	0.74	71,245
Demand Response Programs						
Business Demand Response	0	0	634	NA	1.00	634
Demand Response Totals	0	0	634	NA	1	634
Portfolio Totals	***54,582***	***97,809***	***97,122***	***99%***	***0.74***	***71,880***
Education Programs[3]						
Education	0	2,785	NA	NA	NA	NA

1.3 Summary of Peak Demand Impacts

Reported peak demand reduction in PY2013 fell short of portfolio level projections by 11%. The 2013 EM&V study estimates verified gross peak demand of 55.93 MW. This represents a realization rate of 86% as compared to reported demand reduction. The portfolio-level Net-to-Gross (NTG) ratio, indicating the percentage of gross reduction directly attributable to program influences, is estimated to be 93% percent, resulting in net verified peak demand reduction of 52.19 MW.

A complete list of peak demand impacts resulting from the implementation of PSO's energy efficiency and demand response programs during PY2013 is provided in Table 1-3. Again, the column for verified peak demand reduction is highlighted with a thick border for easy identification.

[2] Rounding may affect totals and net-to-gross ratio multiplication/division in table.

[3] Energy savings attributable to the Education program are not claimed by PSO, and therefore are not included in portfolio totals. Reported energy savings in this table for the Education program represent calculations based on the number of energy efficiency kits distributed and estimated installation rates. EM&V was not performed for the Education program.

Table 1-3: Summary of Demand Impacts – PY2013[4]

Program	Gross Peak Demand Reduction (MW)				Net Impacts	
	Projected	Reported	Verified	Gross Realization Rate	NTG Ratio	Net Peak Demand Reduction (MW)
Energy Efficiency Programs						
High Performance Business	8.22	7.07	3.37	48%	0.78	2.61
Home Weatherization	1.3	1.33	1.41	106%	1.00	1.41
Energy Saving Products and Services	2.29	9.61	9.04	94%	0.70	6.36
High Performance Homes	2.55	1.48	1.46	99%	0.79	1.16
Energy Efficiency Totals	14.36	19.49	15.28	78%	0.76	11.53
Demand Response Programs						
Business Demand Response	58.89	45.65	40.66	89%	1	40.66
Demand Response Totals	58.89	45.65	40.66	89%	1	40.66
Portfolio Totals	***73.25***	***65.14***	***55.93***	***86%***	***0.93***	***52.19***
Education Programs[5]						
Education	0	0.65	NA	NA	NA	NA

1.4 Summary of Portfolio Benefit-Cost Ratios

ADM calculated the cost-effectiveness of PSO's 2013 programs based on reported total spending, verified net energy savings, and verified net demand reduction for each of the energy efficiency and demand response programs. Additional inputs to the cost effectiveness testing include estimates of natural gas savings, line-loss adjustments, emissions reductions, measure lives, discount rates, participant costs, and avoided costs. All program spending inputs were provided by PSO. The methods used to calculate cost-effectiveness are informed by the California Standard Practice Manual.[6]

The specific tests used to evaluate cost-effectiveness are: the Utility Cost Test, Total Resource Cost Test, Ratepayer Impact Measure, Societal Cost Test, and Participant Cost Test. PSO's 2013 portfolio of programs passes all of these tests except the

[4] Rounding may affect totals and net-to-gross ratio multiplication/division in table.

[5] Peak demand reduction attributable to the Education program is not claimed by PSO, and therefore is not included in portfolio totals. Reported peak demand reduction in this table for the Education program represents calculations based on the number of energy efficiency kits distributed and estimated installation rates. EM&V was not performed for the Education program.

[6] California Standard Practice Manual: Economic Analysis of Demand Side Management Programs, October 2001. Available at: http://www.cpuc.ca.gov/NR/rdonlyres/004ABF9D-027C-4BE1-9AE1-CE56ADF8DADC/0/CPUC_STANDARD_PRACTICE_MANUAL.pdf

ratepayer impact measure. Few programs pass the ratepayer impact measure, so the latter finding is not unusual. The benefit-cost ratios developed through the cost-effectiveness analysis are presented in Table 1-4. Detailed cost-effectiveness assumptions and findings are located in Appendix B.

Table 1-4: Benefit-Cost Ratios

Program	Utility Cost Test	Total Resource Cost Test	Ratepayer Impact Measure	Societal Cost Test	Participant Cost Test
Energy Efficiency Programs					
High Performance Business	2.20	1.29	0.73	1.54	1.87
Home Weatherization	1.55	2.14	0.59	2.60	>1
Energy Saving Products and Services	3.11	3.97	0.61	4.42	15.71
High Performance Homes	0.80	1.01	0.46	1.24	1.83
Energy Efficiency Total	1.81	1.76	0.61	2.06	4.15
Demand Response Programs					
Business Demand Response	0.53	0.80	0.52	0.81	2.04
Demand Response Total	0.53	0.80	0.52	0.81	2.04
Portfolio Total	**1.68**	**1.69**	**0.60**	**1.98**	**4.00**
Education Programs					
Education	0.00	0.00	0.00	0.00	>1

Another way to view portfolio performance for 2013 is on a levelized dollar per kWh savings or dollar per peak kW reduction basis. Energy efficiency programs are designed to reduce energy usage while providing the same or improved service level to the end-user in an economically efficient way. This includes energy usage at any time, inclusive of peak and non-peak periods. Energy savings occur for the lifetime of the energy efficiency measures installed. As such, it makes sense to assess program performance on a levelized dollar per kWh basis for energy efficiency programs. Levelized cost in $/kWh is calculated as shown in the formula below:

Levelized Cost (in $/kWh) = C x Capital Recovery Factor / D

Capital Recovery Factor = [A(1+A)^(B)]/[(1+A)^(B)-1]*

Where:

A = Discount rate (5%)

B = Estimated measure life in years

C = Total program costs

D = Annual kWh savings

Table 1-5 shows how PSO's portfolio of energy efficiency programs performed on a levelized cost basis for PY2013. The verified net lifetime energy savings in Table 1-5 include a line loss adjustment factor of 1.056.

Table 1-5: Levelized $/kWh for Energy Efficiency Programs

Program Year	Total Costs	Verified Net Lifetime Energy Savings (kWh)	Levelized $/kWh
2013	$19,954,124	732,152,745	0.026

A 2014 study conducted by the American Council for an Energy Efficient Economy (ACEEE)[7] compared levelized $/kWh for electric energy efficiency programs in 20 different states between 2009 and 2012. Levelized costs estimated as part of this study ranged from $0.016 to $0.048 with an average of $0.028 (2011$). The levelized $/kWh for PSO's energy efficiency programs are near average as compared to the 20 states from the ACEEE analysis.

Demand response programs are designed to encourage customers to change their normal consumption patterns during periods when prices are high or system reliability is in potential jeopardy. These programs encourage load reduction during a short period of time, usually a limited number of days during the summer. As such, it makes sense to assess demand response program performance on a peak kW reduction per dollar basis. Table 1-6 shows how PSO's portfolio of demand response programs performed on a $/kW reduction basis for PY2013.

Table 1-6: $/kW for Demand Response Programs

Program Year	Total Costs	Verified Net Peak Demand Reduction from DR (kW)	$/kW
2013	$2,381,055	40,656	$58.57

Overall, the $58.57 per kW of load reduction is lower than the $75.59 per kW from program year 2012, showing improved cost-efficiency in the overall demand response portfolio.

1.5 Reduced Emissions and Water Consumption

Reduced emissions occur as a result of energy savings achieved through PSO's Demand Side Management (DSM) portfolio displacing marginal fossil fuel based electric

[7] Molina, Maggie., "The Best Value for America's Energy Dollar: A National Review of the Cost of Utility Energy Efficiency Programs." *ACEEE,* March 2014.

generation. The EPA's Emissions and Generation Resource Integrated Database (eGRID) is a comprehensive source of emissions data related to the electric power sector in the U.S. The ninth edition of eGRID, based on 2010 data, was released in January of 2014. Included in the database are estimates of non-baseload emission rates for various greenhouse gases in different subregions of the country. The PSO service territory falls into eGRID subregion SPP South (SPSO). Table 1-7 below lists the most recent eGRID non-baseload output emission rates for SPSO.

Table 1-7: eGRID GHG Annual Output Emission Rates[8]

	Annual non-baseload output emission rates		
eGRID Subregion	**Carbon dioxide (CO2) (lb/MWh)**	**Methane (CH4) (lb/MWh)**	**Nitrous oxide (N2O) (lb/MWh)**
SPP South (SPSO)	1,436.29	27.94	12.10

Using the eGRID emission rates and lifetime energy savings for measures installed through the PSO Demand Side Management (DSM) portfolio results in the estimated emissions reductions listed in Table 1-8.

Table 1-8: Emission Reduction Estimates

Lifetime Energy Savings[9] (Net at Generator) (MWh)	**Carbon dioxide reduction (CO2) (tonnes)**	**Methane reduction (CH4) (tonnes)**	**Nitrous oxide reduction (N2O) (tonnes)**
732,153	476,990	9,279	4,018

Reductions in water consumption resulting from PSO's 2013 portfolio of programs were not tracked. Many of the energy efficiency measures commonly associated with water savings in the residential sector were not included in the portfolio design because of the high prevalence of natural gas water heating in the PSO service territory (faucet aerators, low-flow shower heads, efficient clothes washers and dishwashers, etc.). The High Performance Business program does offer inducements for certain measures that have water saving potential for C&I customers (e.g., variable frequency drives on pump motors). The effects on water consumption for these measures were not quantified for PY2013.

[8] Source: http://www.epa.gov/cleanenergy/documents/egridzips/eGRID_9th_edition_V1-0_year_2010_GHG_Rates.pdf

[9] Lifetime energy savings listed are based on measure lives from the OK Deemed Savings Documents or the AR TRM, annual net energy savings estimated through EM&V of the 2013 portfolio, and a line-loss adjustment factor of 1.056.

1.6 Cumulative Portfolio Performance

Program year 2013 was the first year of implementation for the 2013 – 2015 Demand Side Management (DSM) portfolio. Cumulative energy and demand impacts from program activity, starting on January 1, 2013, will be reported in future annual reports for program years 2014 and 2015. The previous implementation cycle (2010-2012) consisted of different program designs than the current portfolio. While the number of programs and their specific design differ, the portfolios for the two implementation cycles share similar goals and energy efficiency/demand response measures. PSO has previously submitted three annual reports, one each for program years 2010, 2011, and 2012. These previous annual reports document projected, reported, and verified energy and demand impacts for each program year, with the 2012 annual report including cumulative impacts for the entire implementation cycle. Table 1-9 summarizes the cumulative impacts of the 2010 – 2012 DSM portfolio.

Table 1-9: 2010 – 2012 Cumulative Portfolio Performance – Verified Energy and Peak Demand Impacts

Program Year	Verified Gross Annual Energy Savings (GWh)	Verified Net Annual Energy Savings (GWh)	Verified Gross Peak Demand Reduction (MW)	Verified Net Peak Demand Reduction (MW)
Energy Efficiency Programs				
2010	45.96	30.88	9.49	6.86
2011	30.69	21.5	6.29	4.5
2012	64.79	49.59	15.65	12.35
Cumulative EE Totals	141.44	101.97	31.43	23.71
Demand Response Programs				
2010	0.59	0.59	27.4	27.4
2011	0.66	0.66	18.84	18.84
2012	1.04	1.04	32.59	32.59
Cumulative DR Totals	2.29	2.29	NA[10]	NA[10]
Cumulative Portfolio Totals	***143.73***	***104.26***	***64.02***	***56.30***

Table 1-10 provides a similar summary of program impacts for PY2013. Rows for program year 2014 and program year 2015 will be added to the table in future annual reports to display cumulative performance over the three year implementation cycle.

[10] Cumulative demand reduction for DR programs is not reported, as the load reductions are only expected to occur during event days. The cumulative portfolio total represents the cumulative EE demand reduction and the 2012 DR demand reduction.

Table 1-10: 2013 Portfolio Performance – Verified Energy and Peak Demand Impacts

Program Year	Verified Gross Annual Energy Savings (GWh)	Verified Net Annual Energy Savings (GWh)	Verified Gross Peak Demand Reduction (MW)	Verified Net Peak Demand Reduction (MW)
Energy Efficiency Programs				
2013	96.49	71.25	15.28	11.53
Demand Response Programs				
2013	0.63	0.63	40.66	40.66

1.7 Summary of Process Evaluation Findings

This section presents the high level findings and recommendations developed through process evaluation activities for the PY2013 portfolio. The results of the process evaluation research are largely positive. Program participants, service providers and program staff were mostly satisfied with the first year of implementation of the new program designs. Some of the programs had a slow start to PY2013, but program staff members expressed that there have been operational improvements in late 2013 and the early part of 2014. Key process related findings and recommendations from the PY2013 evaluation are summarized below:

- **High customer satisfaction with programs:** For PSO's portfolio of energy efficiency and demand response programs, participants were largely satisfied with their experience. Overall, 84% of customer survey responses indicated being satisfied or very satisfied with the High Performance Business (HPB) program. Survey respondents expressed similar satisfaction levels of 96% for the Home Weatherization program, 95% for the Energy Savings Products and Services program, 93% for the High Performance Homes program, and 97% for the Business Demand Response program.
- **High customer satisfaction with rebate levels:** Participants were also highly satisfied with the rebate amounts they received. Seventy-eight percent of customer survey responses indicated that the rebate amount met or exceeded their expectations (or indicated that they were satisfied or highly satisfied) for the High Performance Business program; similarly, 90% of respondents for the Energy Savings and Services program, 85% for the High Performance Homes program (Whole House Approach), and 73% for the Business Demand Response program.
- **Initial customer awareness of program:** Surveyed participants reported becoming aware of the PSO programs and rebates through a variety of different channels, with PSO and implementation representatives playing an important

role. For example, 66% of customer survey responses indicated they became aware of rebates for the High Performance Business program through a program representative or by an equipment vendor or building contractor; for the Home Weatherization program, 79% became aware through a program representative or by receiving direct mail brochures; 64% of Energy Saving Products and Services (ESPS) Individual Project Approach (IPA) survey respondents became aware through word-of-mouth, or by an equipment vendor or contractor; Business Demand Response customers reported learning of the program from PSO representatives for 67% of respondents.

- **Customer outreach:** For the High Performance Business program, few participants were aware of incentives for retro-commissioning projects and few of the prescriptive participants were aware that incentives for custom projects were available. Opportunities to cross-promote program components and to inform customers about these additional offerings include: call center engagement with customers, application approval letters and emails, and site inspections performed by program staff that allow for discussion of other HPB opportunities.

  The Home Weatherization program has started sponsoring community events and a referral process to increase participation in communities with low response rates. This has the potential to create cost-efficiencies by expanding participation in close geographic proximity. For the New Homes component of the High Performance Homes program, builders indicated that the program adds credibility to their building designs, but they would also like to see television commercials which highlight the builders that are participating in the program. For the Whole House Approach component of the High Performance Homes program, staff reported that unifying PSO's energy efficiency portfolio of programs under a single brand identity has greatly improved the portfolio's market appeal and customer awareness of the program. Anecdotal evidence from customer surveys suggests the same.

- **Continued focus on relationships with service providers**: For the High Performance Business program, vendors, contractors, and PSO staff were key influences. Because relatively few of the participants (25%) reported that their organizations initiated the decision to participate in the program, program activity is likely being sustained by the promotional efforts of program staff, contractors, and vendors. Continued development of service provider relationships is a likely path to increased program participation. For New Homes, the Home Builders Association (HBA) engagement is a core aspect of builder recruiting. The Tulsa area HBA is one of the most well attended HBA's in the country, which benefits the program by providing access to a large number of potential participants. For the Whole House Approach, program staff is focused on recruiting and retaining active service providers. Program guidelines currently limit participants to using enrolled service providers in order to maintain measure and service quality, as

well as to ensure that all service providers are sufficiently familiar with program requirements. As such, building on existing service provider relationships and establishing new ones is a key aspect of the program. Service providers that bundle their promotional materials with PSO marketing can be eligible to receive a reimbursement for half of their expenses, up to $1,500.

- **Program branding is now unified in order to increase market appeal:** Program staff reported that unifying PSO's energy efficiency portfolio of programs under a single brand identity has greatly improved the portfolio's market appeal and customer awareness of programs. Information about all of PSO's incentive offerings and other energy efficiency services are centrally located on a single website (www.powerforwardwithpso.com), and all program marketing materials contain the "Power Forward" branding. The website not only contains descriptive information about program structures, but also provides a list of eligible service providers and links to the PSO Online Energy Check-up tool and HPB Application Center. This unifying approach is a primary aspect of the transition to the 2013-2015 program cycle, which focuses on a simplified set of program offerings that is more approachable than previous iterations. Evidence of the success of this approach is shown in a recent J.D. Power's *Electric Utility Residential Customer Study*. J.D. Power's study shows that the percentage of PSO customers reporting being "very familiar" or "somewhat familiar" with energy efficiency has increased from 36% in a July 2012 – May 2013 survey to 46% in a July 2013 – February 2014 survey.
- **ESPS (Individual Project Approach) - More comfortable homes**: The majority of Individual Project Approach survey respondents (81%) reported that their home is now more comfortable to live in as a result of the energy efficiency improvements they have received through the incentive program. Only one percent of respondents indicated that their home is now less comfortable, which positively reflects on the qualitative value that the program has provided to customers.
- **Home Weatherization – Participant recruitment methods are working well:** For the second year in a row PSO has fully subscribed the weatherization program to utilize nearly all allocated funding. Staff members report that the program marketing efforts have been effective at identifying and enrolling eligible households. Targeted marketing and word-of-mouth within neighborhoods that have a higher ratio of eligible households has helped increase the efficiency of program delivery by allowing contractors to service several homes in one area during the same time period. Program staff mentioned there is room for improvement in marketing the program to eligible households in rural communities that are sometimes harder to reach.

- **High Performance Homes Program (New Homes) - Barriers to builder participation:** When asked whether there are persisting barriers to participation for some new home builders, program staff explained that some builders resist working with the Home Energy Rating System (HERS) raters that are required to evaluate the home's energy efficiency and code compliance. Staff noted that some HERS raters may not be actively providing builders with the energy models used to evaluate homes, which causes builders to feel somewhat uninformed throughout the assessment process. There may be opportunities for program staff to encourage better collaboration between HERS raters and potential builders to increase market saturation of the program.
- **High Performance Business program - Develop consistent technical review processes and coincident peak demand definitions for eligible measure types**: During the review of project documentation for High Performance Business sample rebates, there were certain areas identified where improvements can be made. In some cases, energy and demand savings submitted to the program by a service provider became the basis of reported project savings without sufficient technical review. In other cases, inconsistent peak demand definitions were used to calculate kW reductions. ADM recommends developing consistent review protocols for submitted projects.
- **High Performance Business program - Specify project inspection requirements to balance mitigating risk with efficient utilization of program resources:** Most of the projects implemented through the program in 2013 received pre- and/or post-inspections by implementation staff. Although pre- and post-inspections for most projects may effectively minimize evaluation risk, it is also resource intensive and can slow the project application and approval process. Program staff should consider a strategy that balances the minimization or evaluation risk with efficient use of program resources by setting criteria for when a project requires pre- and/or post-inspection.
- **Business Demand Response program - Low awareness of program software portal:** Beginning in the 2013 program year, participants of the Peak Performers Program were able to access a software portal that contained information about their hourly load profile and demand reduction achievements. However, nearly three-quarters of respondents reported that they were not aware of the ability to monitor their load reduction levels. ADM recommends increased marketing of the software portal to in 2014, as participants in previous years have expressed a desire for more feedback regarding program performance.

Additional detail regarding these and other process evaluation findings and recommendations can be found in the body of this report.

2. Introduction

This report presents an evaluation of the performance of the energy efficiency and demand response programs offered by Public Service Company of Oklahoma (PSO) in 2013. PSO is submitting this report to fulfill the requirements outlined in Title 165: Oklahoma Corporation Commission Chapter 35. Electric Utility Rules Subchapter 41. Demand Programs 165:35-41-7.

2.1 Annual Utility Growth in Metered Energy and Peak Demand

Table 2-1 shows weather normalized energy sales, peak demand, and associated growth rates for PSO over the past three years. The average annual energy and demand growth rates over that same period are also provided. Over the three year period, energy usage and peak demand have been stable.

Table 2-1: Utility Growth 2010 - 2013

Year	Metered Energy (GWh)	Energy Growth	Peak Demand (MW)	Demand Growth
2011	17,394	-0.2%	4,117	-1.6%
2012	17,588	1.1%	4,115	0.0%
2013	17,593	0.0%	4,114	0.0%
	Average Energy Growth Rate	0.30%	Average Demand Growth Rate	-0.53%

2.2 History of PSO's Energy Efficiency and Demand Response Programs

In August of 2008, as a result of the OCC's final order in Cause No. PUD 200600285, PSO implemented a portfolio of seven Demand Side Management (DSM) Quick Start programs. Those seven programs were the starting point for many of the programs PSO implemented through 2012. The first year of implementation of the Quick Start Programs provided PSO with valuable information and lessons learned. This led to the development of a more robust DSM portfolio in 2009. The OCC ultimately approved a DSM portfolio of 17 programs through the final order in Cause No. PUD 200900196 on January 14th, 2010. This approved DSM portfolio remained in effect through December 31, 2012. PSO closely monitored the performance of the DSM portfolio through annual program evaluations in 2010, 2011, and 2012. Results from these evaluations were used as inputs to program design for a new set of six streamlined DSM programs for the 2013-2015 implementation cycle. The reduction in number of programs from 17 to six does not reflect a reduction in DSM investment, but rather a consolidation of programs that were previously competing for similar customers and the discontinuation of some

efficiency measures that did not prove cost-effective. The 2013-2015 portfolio of programs was approved by the OCC through the final order in Cause No. PUD201200128 on November 15, 2012.

2.3 2013 Program Descriptions

2.3.1 Energy Efficiency Programs

High Performance Business: PSO's High Performance Business program seeks to generate energy and demand savings for large and small commercial and industrial customers through promotion of high efficiency electric end use products including (but not limited to) lighting, HVAC, and motors. The program provides PSO's C&I customers with flexibility in choosing how to participate, by either self-sponsoring or by working through a third party service provider to leverage technical expertise. In addition to standard rebates available through the program, municipalities, local governments, K-12 schools, technical schools, and accredited higher education facilities are exclusively eligible for Master Energy Planning Services. In 2013, the High Performance Business program offered cash inducements for 308 projects completed by customers representing 248 unique account numbers.

Home Weatherization: PSO's Home Weatherization program seeks to generate energy and demand savings for limited income residential customers through the installation of a wide range of cost effective weatherization and other measures in eligible dwellings. The purpose of the Home Weatherization Program is to provide PSO's limited income residential customers the financial assistance they need to make their homes more energy efficient, increase comfort levels, and reduce their utility bills. The Home Weatherization Program reported energy and demand impacts for a total of 1,652 projects completed in 2013.

Energy Saving Products and Services: PSO's Energy Saving Products and Services program seeks to generate energy and demand savings for residential customers through the promotion of ENERGY STAR® cooling equipment, CFLs, LEDs, window/glass door replacements, advanced power strips, and attic insulation. The purpose of this program is to provide PSO residential customers inducements for purchasing products that meet high efficiency standards.

The Energy Saving Products and Services Program reported energy and demand impacts for a total of 1,269 participants who received downstream rebates in 2013. Additionally, 319,353 packages of CFLs/LEDs (1,409,971 individual bulbs) and 28 room air conditioners were discounted upstream.

High Performance Homes: PSO's High Performance Homes program seeks to generate energy and demand savings for residential customers through the promotion

of comprehensive efficiency upgrades to building envelope measures and HVAC equipment for both ENERGY STAR® new homes and retrofits. The purpose of the High Performance Homes Program is to provide PSO residential customers with inducements for increasing building envelope efficiencies and installing items such as high efficiency appliances and HVAC equipment.

In 2013, the program had a total of 792 participants who received rebates through the whole house retrofit component of the program. Additionally, participating builders completed 697 new homes for which they received a rebate.

Education: PSO's Education program seeks to generate energy and demand savings for residential customers by providing elementary school students with easy self-install energy efficiency measures, such as LED light bulbs and advanced power strips. The purpose of the Education program is to provide PSO residential customers with an educational experience on how to make their homes more efficient. A lesson plan is provided to the classroom teacher, which engages the students in learning about energy efficiency while also practicing mathematics and science. The students are then provided the take-home energy efficiency kit. Energy savings are achieved when these measures are installed in homes, however PSO does not claim any kW or kWh savings associated with these kits. An estimate of the energy savings attributable to the program is provided in Section 3.5 of this report.

2.3.2 Demand Response Programs

Business Demand Response: The Business Demand Response program is designed to incentivize commercial and industrial facilities to curtail their energy usage during periods of high electrical demand. Non-residential PSO customers enroll in the program and are notified when a load reduction event is initiated. Participants have the option of participating in each event individually, and are paid incentives based on average reduction over the course of all events. Incentives are set at $32 per kW reduction, and participants receive a 5% payment bonus if they opt to participate in all reduction events throughout the year. There is no direct penalty for opting out of specific event days. The program is active during summer months, when average demand typically approaches designated capacity thresholds. A total of 61 companies participated in 2013, representing 250 account numbers. Fewer than expected days of high demand resulted in just three load reduction events being initiated.

2.4 Milestones Achieved in Market Transformation Programs

While all five of PSO's programs are designed primarily as energy efficiency resource acquisition programs, there are some market transformation characteristics, summarized below.

Energy Saving Products and Services (ESPS) Program: The main component of the ESPS program in 2013 was retail mark downs of certain CFL and LED light bulbs. The goal of the mark downs is to increase sales to customers who would have otherwise purchased less efficient options in the absence of the price discount. These programs have long been considered to have market transformation effects in terms of retailer stocking decisions and manufacturer shipment decisions. Much research has been conducted on these effects in different regions across the country. In 2012, the PSO program was active in 144 store locations across seven retailers. A total of 320,061 CFL bulbs were marked down through the program in 2012. In 2013, the program was expanded considerably by adding retail locations, additional bulbs eligible for mark down, and additional mark down funding. Over 1.4 million bulbs were marked down through the program at 177 retail locations during PY2013. Over 5,000 of the marked down bulbs were LEDs.

High Performance Homes – New Homes: PSO's New Homes component of the High Performance Homes program, a 2011 ENERGY STAR® Partner of the Year Award winning program, continues to expand its influence in the market for new homes. PSO was recognized again by ENERGY STAR® in 2012 and 2013, receiving Sustained Excellence Awards each year. Thirty-five builders and 8 HERS raters participated in the New Homes component of the program during 2013. This represents approximately the same number of builders and HERS raters from 2012. All fifteen of the surveyed builders from the 2013 program plan to participate during 2014. The program was successful in educating sales agents, homeowners, and builders about efficient building practices. PSO continues to offer tiered incentive levels to encourage builders to build well beyond current code requirements.

Service Provider Training: PSO's High Performance Business and High Performance Homes programs include service provider training opportunities that focus on increasing awareness and knowledge of building science approaches to energy efficiency. This aspect of the programs has potential market transformation effects beyond the energy savings induced through the program. For a complete list of service provider training events refer to Appendix D.

2.5 High-Volume Electricity User Opt Out

The Oklahoma Title 165:35-41-4 rules allow for High-Volume Electricity Users "to opt out of some or all energy efficiency or demand response programs by submitting notice of such decision to the director of the Public Utility Division and to the electric utility." A High-Volume Electricity User is defined as any single customer that consumes more than 15 million kWh of electricity per year, regardless of the number of meters or service locations.

The number of customers eligible for High-Volume Electricity User opt out, their aggregate load as a percentage of total sales, the number of such customers that opted

out for PY2013, and the percentage of total energy sales that they comprise are listed in Table 2-2 below. The number of opt out customers listed includes customers who chose to opt out of either demand response or energy efficiency programs (or both).

Table 2-2: High Volume Electricity User Opt Out

Metric	2013	
	Opt out eligible	Chose to opt out
Number of accounts	4,733	2,469
2013 Electric Sales (GWh)	6,538,797	4,410,323
Aggregate load as a percentage of total sales	33.99%	22.92%

2.6 Fuel Switching Impacts

PSO did not provide any inducement for installation of electric heating or electric water heating where a natural gas main was available during PY2013.

2.7 Research and Development Activities

PSO uses deemed or partially deemed energy, demand, and gas savings estimates for various measures included in their portfolio. The assumptions, algorithms, and sources for these deemed and partially deemed savings estimates are contained in the Oklahoma Deemed Savings, Installation, and Efficiency Standards (Oklahoma Deemed Savings Documents or OKDSDs). During 2013, PSO hired Frontier Associates, Inc. to update the OKDSDs. The update was completed in October of 2013 and includes a number of new residential and commercial measures. Certain existing residential measures were also updated, including residential insulation, duct sealing, and ENERGY STAR® standard CFLs.

2.8 Program Implementation & Strategic Alliances

PSO had eight fulltime employees dedicated to the implementation of energy efficiency and demand response programs in 2013. Additionally, PSO entered contracts with a number of energy services companies (ESCOs) and contractors to aid in program implementation.

ICF International (ICF) was contracted to implement the High Performance Business, High Performance Homes, and Energy Saving Products and Services programs. ICF subcontracted the upstream CFL and LED portion of the Energy Saving Products and Services program to Applied Proactive Technologies, Inc. The Home Weatherization program was largely implemented by Titan ES, LLC, with some program participation also coming through Rebuilding Together Tulsa, a volunteer organization working to preserve and revitalize low-income homes and communities. PSO contracted with Resource Action Programs to provide energy efficiency kits distributed to students through the Education program. Finally, the Business Demand Response program was

implemented “in-house” by PSO, with database support provided by ICF. Additional marketing materials and services for the entire portfolio of programs were provided by VI Marketing and Branding. Examples of marketing materials used during 2013 to promote PSO’s energy efficiency and demand response programs are provided in Appendix E.

For the majority of programs in the 2013 portfolio, service providers were recruited to participate by submitting rebate applications on behalf of customers implementing qualifying energy efficiency measures. PSO’s website contains lists of service providers and the associated products/services they provide. As of April 2014, the list of service providers for the High Performance Business program includes 47 companies with various specialties including lighting, HVAC, variable frequency drives (VFDs), building automation, and retrocommissioning services. The list of service providers for the residential sector includes 87 companies in total. Specialties listed include HVAC, geothermal work, insulation, and window/door installation.

A complete list of implementation contractors, including contact name, title, business address, phone number, email address, and program associations, is provided in Appendix C.

2.9 Training and Customer Outreach

PSO regularly conducts various service provider training and customer outreach events, which are summarized in Appendix D. During 2013, PSO’s energy efficiency and demand response programs sponsored:

- 71 in-store residential lighting promotional events (many attendees)
- 14 service provider recruitment events (many attendees)
- 47 customer outreach events (>1,500 attendees)
- 4 stakeholder presentations (42 attendees)
- 20 service provider training events (>100 attendees)

2.10 Evaluation Measurement and Verification

PSO contracted with ADM Associates, Inc. (ADM) to perform comprehensive program evaluation, measurement, and verification (EM&V) for PY2013.

ADM’s evaluation findings for each 2013 energy efficiency program are provided in Chapter 3 of this report. Similarly, evaluation findings for each demand response program are provided in Chapter 4.

3. Energy Efficiency Programs

PSO's energy efficiency portfolio in 2013 consisted of five programs, one commercial/industrial and four residential (including the Education program). As shown in Table 3-1, reported gross annual energy savings of 97,809 MWh exceed the projected portfolio savings of 54,582 MWh. The higher than expected energy savings are almost entirely attributable to increased focus on upstream sales of CFL and LED bulbs in the Energy Saving Products and Services program. Program evaluation findings resulted in gross verified savings of 96,488 MWh, a 99% realization rate as compared to reported energy savings. The program evaluations also estimated program level net-to-gross ratios, resulting in verified net savings of 71,245 MWh.

Table 3-1: Annual Energy Savings – Energy Efficiency Programs

Program	Gross Peak Annual Energy Savings (MWh)				Net Impacts	
	Projected	Reported	Verified	Gross Realization Rate	NTG Ratio	Net Annual Energy Savings (MW)
Energy Efficiency Programs						
High Performance Business	37,919	25,413	24,739	97%	0.78	19,188
Home Weatherization	2,119	5,095	5,113	100%	1.00	5,113
Energy Saving Products and Services	10,569	63,502	62,688	99%	0.70	43,823
High Performance Homes	3,973	3,799	3,949	104%	0.79	3,121
Energy Efficiency Totals	**54,582**	**97,809**	**96,488**	**99%**	**0.74**	**71,245**
Education Programs[11]						
Education	0.00	2,785	NA	NA	NA	NA

Reported peak demand reduction of 19.49 MW also exceeded projections of 14.36 MW. The EM&V study resulted in gross verified peak demand reduction of 15.28 MW. Applying the evaluation estimated program level net-to-gross ratios results in total verified net peak demand reduction of 11.53 MW, as shown below in Table 3-2.

[11] Energy savings attributable to the Education program are not claimed by PSO, and therefore are not included in portfolio totals. Reported energy savings for the Education program in this table represent calculations based on the number of energy efficiency kits distributed and estimated installation rates. EM&V was not performed for the Education program.

Table 3-2: Peak Demand Reduction – Energy Efficiency Programs

Program	Gross Peak Demand Reduction (MW)				Net Impacts	
	Projected	Reported	Verified	Gross Realization Rate	NTG Ratio	Net Peak Demand Reduction (MW)
Energy Efficiency Programs						
High Performance Business	8.22	7.07	3.37	48%	0.78	2.61
Home Weatherization	1.3	1.33	1.41	106%	1.00	1.41
Energy Saving Products and Services	2.29	9.61	9.04	94%	0.70	6.36
High Performance Homes	2.55	1.48	1.46	99%	0.79	1.16
Energy Efficiency Totals	**14.36**	**19.49**	**15.28**	**78%**	**0.76**	**11.53**
Education Programs[12]						
Education	0	0.65	NA	NA	NA	NA

In the sections that follow, evaluation findings for each of the PY2013 PSO energy efficiency programs are provided. Program performance metrics, evaluation methodologies, energy and demand impacts, and process related findings for each program are detailed.

[12] Peak demand reduction attributable to the Education program is not claimed by PSO, and therefore is not included in portfolio totals. Reported peak demand reduction for the Education program in this table represents calculations based on the number of energy efficiency kits distributed and estimated installation rates. EM&V was not performed for the Education program.

3.1 High Performance Business Program

3.1.1 Program Overview

PSO's High Performance Business (HPB) program provided rebates for a total of 308 projects completed by 255 unique participants in 2013. The program seeks to generate energy and demand savings for small and large commercial and industrial customers, schools, and municipalities through promotion of high efficiency electric end use products including (but not limited to) lighting, HVAC, and Variable Frequency Drives (VFDs) for motors. The program provides PSO's C&I customers with flexibility in choosing how to participate, by either self-sponsoring or by working through a program service provider to leverage technical expertise. In 2013, lighting system retrofits continued to be the main source of program impacts, representing over 70% of program reported kWh savings.

Reported expenditures, energy savings, and demand reduction for the HPB program fell short of projections. Much of this is explained by a slower-than-expected program ramp-up period. The changes in program design between PY2012 and PY2013 resulted in hiring of additional program staff, new technical requirements/ marketing materials, and converting pending projects to the new program paradigm – all of which are common challenges during the early months of program start up that can lead to a slow build-up before expected participation levels are reached.

Table 3-3 provides projected, reported, and verified energy and demand impacts as well as other program performance metrics for the High Performance Business program.

Table 3-3: Performance Metrics – High Performance Business Program

Metric	PY2013
Number of Customers	248
Budgeted Expenditures	$9,797,638
Actual Expenditures	$6,352,105
Energy Impacts (kWh)	
Projected Energy Savings	37,919,306
Reported Energy Savings	25,412,714
Gross Verified Energy Savings	24,738,603
Net Verified Energy Savings	19,188,275
Peak Demand Impacts (kW)	
Projected Peak Demand Savings	8,219
Reported Peak Demand Savings	7,071
Gross Verified Peak Demand Savings	3,367
Net Verified Peak Demand Savings	2,612
Benefit / Cost Ratios	
Total Resource Cost Test Ratio	1.29
Utility Cost Test Ratio	2.20

3.1.2 EM&V Methodologies

This section provides a brief overview of the data collection activities, gross and net impact calculation methodologies, and process evaluation activities that ADM employed in the evaluation of the High Performance Business program.

3.1.2.1 Data Collection

Data for the study were collected through review of program materials, on-site inspections, end-use metering, and interviews with participating customers and service providers. Based on program tracking data provided by PSO through the VisionDSM database and SSRS reporting system, a sample design was developed for on-site data collection. The VisionDSM system is a central database where program activities are tracked and project documentation is stored. The SSRS reporting system pulls data from VisionDSM and presents the information in useful summary reports that can be designed to meet specific program tracking needs. The on-site verification and data collection samples were drawn from EM&V specific SSRS reports to provide gross impact estimates with ±10% precision or better at the 90% confidence level for the program.

On-site visits were used to collect data for gross impact calculations, to verify measure installation, and to determine measure operating parameters. Facility staff members were interviewed to determine the operating hours of the installed systems and provide

any additional operation characteristics relevant to calculating energy savings. For a subset of sampled projects, lighting equipment, HVAC equipment, or motors/Variable Frequency Drives (VFDs) were monitored in order to obtain accurate operation profiles. Table 3-4 below shows the sample design that was used. The 50 projects that were sampled for on-site measurement and verification account for approximately 59% of reported program kWh savings.

Table 3-4: Sample Design for the High Performance Business Program

Stratum Name	Reported kWh Savings	Strata Boundaries (kWh)	Population of Projects	Assumed ER[13]	Design Sample Size
Light 0	2,567,740	< 50,000	157	0.4	8
Light 1	8,685,389	50,000 – 500,000	61	0.4	13
Light 2	6,856,806	> 500,000	8	0.4	8
Custom0	1,599,730	< 400,000	19	1.2	4
Custom1	4,013,145	≥ 400,000	3	1.2	3
NC Light	1,355,130	All	24	0.4	6
HVAC	112,996	All	17	0.4	3
NC HVAC	146,530	All	12	0.4	3
Kitchen Equip.	75,249	All	7	0.4	2
Total	**25,412,714**	**N/A**	**308**	**N/A**	**50**

In addition to the on-site data collection effort, customer surveys provided self-report data for the net-to-gross analysis and process evaluation. A total of 52 customer decision makers completed the survey. The response rate for the decision maker surveys was lower than expected, despite advance notice of the survey from PSO and three reminder emails encouraging study participation. A larger sample size would have been preferable because the net-to-gross estimation was based on the customer survey responses. As a result of the relatively small sample size, there is a higher than desired sampling uncertainty associated with the net-to-gross estimates. This is in addition to other uncertainties associated with net-to-gross estimation that are not quantified (customer recall, social desirability bias, free ridership and spillover scoring algorithms, etc.). The final net-to-gross ratio estimation for the program should be viewed with these potential uncertainties in mind.

[13] The ER (Error Ratio) is a measure of the uncertainty in the relationship between verified savings and the reported savings estimates. Because the actual error ratios for the HPB program strata are unknown prior to evaluation, error ratios based on the 2012 PSO Standard Offer Program evaluation were used. Sampled projects from 2012 were divided into three categories: lighting, non-lighting, and custom non-lighting. The error ratios for these categories were then applied to the 2013 sample design, with a floor of 0.40. Both lighting and non-lighting projects in 2012 had relatively small error ratios, below 0.40. Custom non-lighting projects sampled in 2012 had a relatively large error ratio of 1.2.

In-depth interviews with PSO and implementation staff members were conducted to provide additional perspectives for the process evaluation. Finally, six service providers were interviewed and provided additional insight regarding program processes in 2013.

Table 3-5 shows the achieved sample sizes for the different types of data collection employed for this study.

Table 3-5: Sample Sizes for Data Collection Efforts – Standard Offer Programs

Data Collection Activity	Achieved Sample Size
Large C&I Solutions: On-Site M&V	50
Customer Decision Maker Survey	52
Service Provider Survey	6
In-depth Interviews with Program Staff	2

3.1.2.2 Gross Impact Estimation

The evaluation of gross energy savings and peak demand reduction from projects rebated through the High Performance Business program can be broken down into the following steps:

- First, the program tracking database was reviewed to determine the scope of the program and to ensure there were no duplicate project entries. The tracking database was used to define a discrete set of rebated projects that made up the PY2013 program population. A sample of projects was then drawn from the population established in the tracking system review.
- Next, a detailed desk review was conducted for each project sampled for on-site verification and data collection. The desk review process includes a thorough examination of all project materials including: invoices, equipment cut sheets, pre- and post-inspection reports, and estimated savings calculators. This review process informed ADM's fieldwork by identifying potential uncertainties, missing data, and sites where monitoring equipment was needed to verify key inputs to the reported savings calculations. Additionally, the review process involved assessing the reasonableness of deemed savings values and calculation input assumptions.
- After reviewing the project materials, on-site verification and data collection visits were scheduled for each sampled project. The visits were used to collect data for savings calculations, to verify measure installation, and to determine measure operating parameters.
- Next, the data collected during the on-site verification visits was used to revise savings calculations as necessary. For example, if the reported savings calculations relied on certain measure operating hours that were determined to

be inaccurate based on the facilities actual schedule, changes were made to more accurately reflect actual operating conditions.

- Finally, after determining the verified savings impacts for each sampled project, results were extrapolated to the program population using project specific sampling weights. This allows for the estimation of program level gross verified savings with a given amount of sampling precision and confidence. For the High Performance Business program, the sample was designed to ensure ±10% or better relative precision at the 90% confidence level.

3.1.2.3 Net-to-Gross Estimation

The purpose of net savings analysis is to determine what portion of gross savings achieved by PSO customers is the direct result of the program. The savings directly attributable to the program are the “net” savings attributable to the program.

Net savings may be less than gross savings because of free ridership impacts, which arise to the extent that participants in a program would have adopted energy efficiency measures and achieved the observed energy usage changes even in the absence of the program. Free riders for a program are defined as those participants that would have installed the same energy efficiency measures without the program. Conversely, net savings may be greater than gross savings due to energy savings spillovers attributable to the program. Participants or non-participants may implement energy efficiency measures due to the influence of the program, without receiving program inducements for implemented measures.

Information collected from a sample of program participants through a customer decision maker survey was used for the net-to-gross analysis. Based on review of this information, the preponderance of evidence regarding free ridership inclinations was used to attribute a customer’s savings to free ridership.

Several criteria were used for determining what portion of a customer’s savings for a particular project should be attributed to free ridership. The first criterion was based on the response to the question: “Would you have been financially able to install the equipment or measures without the rebates provided through the High Performance Business program?” If a customer answered “No” to this question, a free ridership score of 0 was assigned to the project. That is, if a customer required financial assistance from the High Performance Business program to undertake a project, then that customer was not deemed a free rider.

For decision makers that indicated that they were able to undertake energy efficiency projects without financial assistance from the program, three additional factors were analyzed to determine what percentage of savings may be attributed to free ridership. The three factors are:

- Plans and intentions of the firm to install a measure even without support from the program,
- Influence that the program had on the decision to install a measure, and
- A firm's previous experience with a measure installed under the program.

For each of these factors, rules were applied to develop binary variables indicating whether a participant showed free ridership behavior. The first required step was to determine if a participant stated that his or her intention was to install an energy efficiency measure without the help of the program inducements. Two binary variables were constructed to account for customer plans and intentions: one, based on a more restrictive set of criteria that may describe a high likelihood of free ridership, and a second, based on a less restrictive set of criteria that may describe a relatively lower likelihood of free ridership.

The first, more restrictive criteria indicating customer plans and intentions that likely signify free ridership are as follows:

- The respondent answered "yes" to the following two questions: "Did you have plans to install the [Equipment/Measure] before participating in the High Performance Business program?" and "Would you have gone ahead with this planned installation of the measure even if you had not participated in the High Performance Business program?"
- The respondent answered "definitely would have installed" to the following question: "If the rebates from the High Performance Business program had not been available, how likely is it that you would have installed [Equipment/Measure] anyway?"
- The respondent answered "did not affect timing of purchase and installation" to the following question: "We would like to know whether the availability of information and rebates through the High Performance Business program affected the timing of your purchase and installation of [Equipment/Measure]. Did you purchase and install [Equipment/Measure] earlier than you otherwise would have without the program?"
- The respondent answered "no, the program did not affect level of efficiency that we chose for equipment" in response to the following question: "We would like to know whether the availability of information and rebates through the High Performance Business program affected the level of energy efficiency you chose for [Equipment/Measure]. Did you choose equipment that was more energy efficient than you would have chosen had you not participated in the program?"
- The respondent answered "no, the program did not affect the quantity of equipment we chose" in response to the following question: "We would like to know whether the availability of information and rebates through the High

Performance Business program affected the quantity (or number of units) of energy efficient [Equipment/Measure] that you purchased and installed at your facility. Did you purchase and install more [Equipment/Measure] than you otherwise would have without the program?"

The second, less restrictive criteria indicating customer plans and intentions that likely signify free ridership are as follows:

- The respondent answered "yes" to the following two questions: "Did you have plans to install the [Equipment/Measure] before participating in the High Performance Business program?" and "Would you have gone ahead with this planned installation of the measure even if you had not participated in the High Performance Business program?"
- Either the respondent answered "definitely would have installed" or "probably would have installed" to the following question: "If the rebates from the High Performance Business program had not been available, how likely is it that you would have installed [Equipment/Measure] anyway?"
- Either the respondent answered "did not affect timing of purchase and installation" to the following question: "Did you purchase and install [Equipment/Measure] earlier than you otherwise would have without the program?" or the respondent indicated that while program information and rebates did affect the timing of equipment purchase and installation, in the absence of the program they would have purchased and installed the equipment within the next year.
- The respondent indicated that "no, the program did not affect level of efficiency that we chose for equipment" and "no, the program did not affect the quantity of equipment we chose."

The second factor is determining if a customer reported that a recommendation from a program representative or past experience with the program was influential in the decision to install a particular piece of equipment or measure. This criterion indicates that the program's influence may lower the likelihood of free ridership when either of the following conditions is true:

- The respondent answered "critical affect – could not have made decision without it" to the following question: "How did a PSO or ICF staff member affect your decision to install the efficient equipment?"
- The respondent answered "through past experience with the program" to the following question: "How did you learn about PSO's rebates for efficient equipment or upgrades?"

The third factor is determining if a participant in the program indicated that he or she had previously installed an energy efficiency measure similar to one that they installed under the program without an energy efficiency program incentive during the last three years. A participant indicating that he or she had installed a similar measure is considered to have a higher likelihood of free ridership, due to the potential influence of the prior experience. The criteria indicating that previous experience may signify a higher likelihood of free ridership are as follows:

- The respondent answered "yes" to the following question: "Before participating in the High Performance Business program, had you installed any equipment or measure similar to [Equipment/Measure] at your facility?"
- The respondent answered "yes, purchased energy efficient equipment but did not apply for financial incentive." to the following question: "Has your organization purchased any energy efficient equipment in the last three years for which you did not apply for a rebate through the High Performance Business program?"

The four sets of rules just described were used to construct four different indicator variables that address free ridership behavior. For each customer, a free ridership value was assigned based on the combination of variables. With the four indicator variables, there were 11 applicable combinations for assigning free ridership scores for each respondent, depending on the combination of answers to the questions creating the indicator variables. Table 3-6 shows these values.

Table 3-6: Free Ridership Scores for Combinations of Indicator Variable Responses

Indicator Variables				Free Ridership Score
Had Plans and Intentions to Install Measure without HPB Program? (Definition 1)	**Had Plans and Intentions to Install Measure without HPB Program? (Definition 2)**	**HPB Program had influence on Decision to Install Measure?**	**Had Previous Experience with Measure?**	
Y	N/A	Y	Y	100%
Y	N/A	N	N	100%
Y	N/A	N	Y	100%
Y	N/A	Y	N	67%
N	Y	N	Y	67%
N	N	N	Y	33%
N	Y	N	N	33%
N	Y	Y	N	0%
N	N	N	N	0%
N	N	Y	N	0%
N	N	Y	Y	0%
Required program incentive to implement measures				0%

The customer decision maker survey also included a series of questions used to analyze whether there were potential spillover effects associated with non-rebated purchases by HPB program participants.[14] Specifically, survey respondents were asked:

- Since participating in the High Performance Business program, have you bought, or are you likely to soon buy, additional energy efficient equipment for your facility?

Customers who indicated “yes, have already purchased additional equipment” or “yes, likely to buy efficiency equipment” were identified as potential spillover candidates. These respondents were then asked whether or not they received any rebates for the additional equipment. Potential spillover candidates were additionally asked to identify the type of additional equipment installed using an open ended question. Finally, these respondents were asked to rank the importance of HPB program participation in choosing to install the additional items.

Survey timing is an important consideration when estimating participant spillover effects. The customer decision maker surveys were conducted between February and April of 2014, which may not have given participating customers the necessary time to implement additional energy efficiency measures that may be influenced by their past participation in the HPB program. As a result, the participant spillover estimates developed in this evaluation may be an underrepresentation, depending on the extent to which future energy efficiency choices are made because of past HPB program influences.

3.1.2.4 Process Evaluation Activities

The process evaluation of the 2013 HPB program was designed to answer the following research questions:

- How effective were the marketing efforts for the program? Which marketing methods were most effective? How aware of the program are eligible PSO customers? Are participants accessing the program website to learn more about the program?
- How well did PSO staff, implementation staff, service providers and participant customers work together? Are there rebate processing, data tracking, and/or communication efficiencies that can be gained?
- Were the program participants satisfied with their experience? What was the level of satisfaction with the rebate amount, the scheduling/application process, the installed measures, and other aspects of program participation?

[14] The spillover analysis is limited to participant spillover. Non-participant spillover effects may exist for the program, but they are not estimated and therefore assumed to be zero.

- What are service provider perspectives on the program? Reactions to program changes since 2012 (if any)?
- What do service providers like about the program? Why? What would they like to change about the program? Why?
- What customer barriers to participation do service providers see? How can these be mitigated?
- Were there any significant changes or new obstacles during the 2013 program year?
- Are there any changes to the program in 2014 and moving forward?

To address these questions, ADM's process evaluation activities included a review of program materials, customer decision maker surveys, service provider interviews, and in-depth program manager interviews with staff at PSO and implementation contractor ICF.

3.1.3 Impact Evaluation Findings

To estimate kWh savings and peak kW reductions for the program, data were collected and analyzed for samples of rebated projects. The data were analyzed using the methods described in Section 3.1.2 to estimate project energy savings and peak kW reductions and to determine realization rates for both program components. The results of that analysis are reported in this section.

3.1.3.1 Verified Gross Energy Savings (kWh)

The verified gross kWh savings for each of the PY2013 Standard Offer Programs are summarized by sampling stratum in Table 3-7. Overall, the verified gross savings of 24,738,603 kWh are equal to 97% of the reported savings for the High Performance Business program.

Table 3-7: Reported and Verified Gross kWh Savings by Sampling Stratum

Stratum	Reported kWh Savings	Verified Gross kWh Savings	Gross kWh Realization Rate
Light0	2,567,740	2,304,665	90%
Light1	8,685,389	8,126,709	94%
Light2	6,856,806	6,009,764	88%
Custom0	1,599,730	2,464,633	154%
Custom1	4,013,145	4,045,952	101%
NC Light	1,355,130	1,400,814	103%
HVAC	112,996	183,554	162%
NC HVAC	146,530	121,655	83%
Kitchen Equip.	75,249	80,857	107%
Total	**25,412,714**	**24,738,603**	**97.3%**

The achieved sample design resulted in verified gross kWh estimates with ±8.1% relative precision at the 90% confidence interval.[15] Verified gross energy savings were very close to the original reported values at the program level. There was however a wide range of kWh realization rates at the sample project level.

Lighting Projects

The overall kWh realization rate for lighting projects was 92%. Much of the discrepancy between reported and verified energy savings is explained by measure operation schedule assumptions that differed from on-site verification findings. When estimating energy savings for rebate calculation purposes, it is often convenient and advisable to use participant estimated hours of operation for measures such as lighting. Requiring more detailed schedules or monitoring data can often impede program performance by increasing barriers to participation. While there is some level of inherent uncertainty in the use of these estimated annual operating hours, the uncertainty is usually outweighed by the additional program participation encouraged by an easy application process. ADM installed monitoring equipment to capture the hours of operation for a majority of the sampled lighting projects. For smaller lighting projects where monitoring was not performed, ADM used lighting schedules from detailed interviews with facility staff. The 92% kWh realization rate points to the fact that for many of the sample projects the reported hours of use were fairly accurate, while slightly overestimated on average. Of the 29 sample projects that were lighting retrofits, 19 had kWh realization rates between 80% and 120%, again pointing to the overall accuracy of reported annual operating hours for lighting systems.

[15] That is, we are 90% confident that the true verified gross savings are between 22,738,538 and 26,738,667 kWh based on the uncertainty introduced by sampling.

The reported energy savings (and peak demand reduction) for lighting projects did not include any adjustment for heating and cooling interactive factors. The installation of efficient lighting means less waste heat, requiring less cooling in the summer, and more heating in the winter. In instances where retrofit lighting was installed in a location that was space conditioned, ADM applied Heating and Cooling Interactive Factors (HCIF) from the Arkansas TRM (1.05 for energy savings and 1.10 for peak demand reduction). ADM recommends that HCIF adjustments are made for future lighting projects in conditioned space.

Aside from annual operating hours and HCIF, there were some instances where claimed fixture installation counts or types varied from on-site findings. However, these discrepancies were generally minor, likely reflecting the fact that most of the projects received pre- and/or post- inspection from the implementation team. The program requires detailed project invoices for lighting rebates, which also contributed to the high level of accuracy in reporting installed fixtures types. The pre-inspections performed by ICF for many sample sites were associated with high levels of accuracy in describing baseline fixture types and quantities.

Non-Lighting Projects

The reasons for differences between reported and verified savings for sampled non-lighting projects are more varied. In one instance, a simple calculation error for a prescriptive HVAC project resulted in a kWh realization rate of 1100%. This was because the reported savings were based on a single roof top unit retrofit, when the project really involved nine units total. The provided savings calculator showed that for the purpose of calculating the rebate amount, the per-unit rebate was multiplied by nine correctly. However, the calculations for energy savings and peak demand reduction were not multiplied by quantity as they should have been.

In other cases, annual energy savings for heat pump projects were systematically underestimated because only cooling energy savings were calculated, while heating savings were unintentionally omitted. For all sampled heat pump projects, ADM included heating energy savings in addition to cooling savings. ADM recommends that the HVAC savings calculation tool be updated to include heating savings for heat pumps. One other area of discrepancy for HVAC projects involved the conversion from tons to BTU/h. For reported savings, the HVAC calculator used the rule of thumb conversion of 1 Ton = 12,000 BTU/h. ADM instead used the rated BTU/h from the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) directory. Generally, these changes had minor effects on verified savings.

Custom projects also had a wide range of realization rates. For example, of the four sampled projects in stratum Custom0, there was a realization rate of 35% on the low side, and 739% on the high side. The low realization rate project was a pump system retrofit where the reported energy savings calculations assumed full load motor efficiencies (pre-retrofit) considerably lower than verified savings. Additionally, the

reported savings assumed that one of the baseline pumps had an annual run time considerably higher than actuality. For the project with the 739% kWh realization rate, a full explanation for why reported energy savings were underestimated to such a degree is hindered by a lack of full project documentation. However, it is clear that the savings for the project (a chiller retrofit) were calculated using a prescriptive approach, despite the large chiller size and complexity. ADM used a DOE2 simulation model calibrated to monthly billing data to estimate final project savings.

There were also sampled non-lighting projects for which reported kWh and verified kWh did not differ significantly. Prescriptive kitchen equipment rebates and two of the three largest kWh saving custom projects present good examples of this. The largest energy saving projects likely had the most technical review when developing reported savings, which may account for the near 100% kWh realization rate for these projects overall.

Overall, the program level realization rate for annual kWh is high. Still, there were some sampled non-lighting projects for which verified savings varied considerably from reported values, as mentioned above. ADM recommends that the HVAC savings calculation tool be updated as suggested. Additionally, ADM recommends additional technical review for all custom projects where budget and implementation resources allow.

3.1.3.1 Verified Peak Demand Reduction (kW)

The verified gross kW reduction for the PY2013 High Performance Business program is summarized by sampling stratum in Table 3-8. Overall, the verified gross reduction of 3,367 kW is equal to 48% of the reported reduction for the program.

Table 3-8: Reported and Verified Gross kW Reduction by Sampling Stratum

Stratum	Reported Peak kW Reduction	Verified Gross Peak kW Reduction	Gross kW Realization Rate
Light0	568.01	363.91	64%
Light1	1,428.09	1,223.81	86%
Light2	3,757.47	895.85	24%
Custom0	396.57	369.80	93%
Custom1	335.05	161.83	48%
NC Light	291.36	182.24	63%
HVAC	103.40	68.18	66%
NC HVAC	167.92	84.64	50%
Kitchen Equip.	22.74	16.78	74%
Total	**7,070.60**	**3,367.05**	**47.6%**

The achieved sample design resulted in verified gross kW estimates with ±7.1% relative precision at the 90% confidence interval.[16] Overall, the realization rates for coincident peak demand reduction are fairly low. Much of this difference between reported and verified demand reduction is explained by either 1) calculation error in reported demand reduction, 2) use of stipulated coincidence factors (CF) that did not align well with actual equipment schedules or 3) calculating peak demand reduction without considering the PSO defined peak period of 2 – 9 PM, weekday non holidays, June through September.

Lighting Projects

Results from the analysis of sample lighting projects had the largest effect on the realization rate for peak demand reduction. In particular, there was one sampled project in the Light2 stratum that contained a calculation error that multiplied estimated peak demand reduction by 12 (presumably, months in the year). This error was part of the energy use analysis submitted by a program service provider, and was not caught through the technical review process before impacts were reported for the program. Had the reported savings for this project not been multiplied by 12, the overall peak demand realization rate for the program would have been 77% as opposed to 48%. Since this project was rebated, the program has implemented a standard lighting project calculator that prevents a calculation error of this magnitude from occurring. Technical review of submitted lighting calculators is still important, but a twelvefold overestimation of peak demand is unlikely to occur in the future given the standardized lighting calculator requirements.

In addition to this one influential project, verified peak demand reduction was lower than reported for a number of other sampled lighting projects, though the magnitude of the differences is much smaller. This resulted from the fact that the lighting calculator used to estimate reported savings uses stipulated coincident factors (CFs) by building type to assign peak demand reduction. Coincidence factors are used as an estimate of the percentage of total connected load reduction that occurs during high-use hours. Annual operating hours used to develop reported energy savings are not stipulated; rather, they are based on participant estimates of lighting hours of use for their facilities. For the most part, ADM's monitoring and verification efforts found that the estimated annual operating hours were fairly accurate, but the underlying operational schedules of the facilities did not always match up well with the stipulated CFs.

ADM adjusted the CFs based on monitoring data or site contact interview data regarding hours of lighting operation. For example, if monitoring data or site contact interviews revealed that the facility operated on a 24/7 schedule, a CF of near 1.0 might be appropriate because the full connected load reduction would be expected during peak hours. If, on the other hand, a project included dusk-to-dawn lighting retrofits, a

[16] That is, we are 90% confident that the true verified gross peak demand reduction is between 3,127 and 3,607 kW based on the uncertainty introduced by sampling.

much lower CF would be appropriate given that the lights are unlikely to turn on before 7 PM during the peak summer months.

Excluding the one influential project, the average peak demand realization rate for retrofit lighting projects was 84%. This shows that even though stipulated CFs were used for reported savings purposes, the real driver of the low kW realization rate for lighting projects was mostly specific to the one high impact project already mentioned.

ADM recommends that for future projects, attempts are made to verify that the stipulated CFs are in-line with the estimated annual operating hours and underlying daily usage profile provided by participants. If the stipulated CFs do not match the lighting operation schedule of the facility, adjustments should be made. Adjustments already in place with the standardized program lighting calculator should be sufficient to avoid a similarly low kW realization rate for any one project in the future.

Non-Lighting Projects

Verified peak demand reduction for sampled non-lighting projects also differed from reported values significantly. In some cases, this was again the result of a simple calculation error. For example, one prescriptive HVAC project received a peak demand realization rate of 533% because the reported savings were based on a single roof top unit, when the project involved nine units total (this is the same project that had a high kWh realization rate mentioned earlier, not a separate project). Another example comes from a custom project that included a lighting retrofit, HVAC system improvements, and an Energy Management System (EMS) installation. For this project, reported savings were based on a collection of savings estimates from multiple service providers. While the kWh savings for all of the different measures were included in reported savings, peak demand reduction was only counted for the lighting retrofit and part of the HVAC upgrades. ADM's verified peak demand reduction included estimates of peak demand reduction from all measures.

In other cases, the difference between reported and verified peak demand reduction was the result of a more systematic error. For example, the savings calculator for prescriptive HVAC projects includes a coincidence factor labeled the "summer system peak" CF. This CF is a stipulated factor that comes from the Mid-Atlantic Technical Reference Manual. While the calculations in the Mid-Atlantic TRM are applicable, the summer system peak CF is not, because it is an estimated CF based on the hour ending 5 PM on the hottest summer weekday. This is not consistent with PSO's defined coincident peak period of 2 PM – 9 PM, June – September, non-holiday weekdays. As a result, the use of this CF over estimates peak demand reduction. ADM recommends that the existing HVAC savings calculator be updated to reflect CFs that matches PSO's peak period.

Finally, there were some instances where the difference in verified peak demand reduction cannot be fully explained, because of gaps in the documentation available for

reported savings. One such project was an air compressor retrofit, for which detailed savings calculations were not provided. The reported peak demand reduction for this project was -3.3 kW, which is inconsistent with the installation of a VFD on an air compressor. ADM installed monitoring equipment on the compressor for a period of three weeks, and extrapolated the monitored energy use to annual usage. Peak demand reduction was calculated under the PSO defined peak period, and resulted in a kW reduction estimate of 30 kW.

Overall, the M&V results for the sampled projects suggest there are a number of areas where peak demand savings were previously being calculated inconsistently, or with incomplete technical review of service provider documentation. Some of these issues have largely been resolved with the introduction of standardized calculation tools required for submitted applications. Still, ADM recommends reviewing savings calculation tools and technical review protocols to ensure consistent peak demand calculations across measure types.

3.1.4 Net-to-Gross Estimation Results

The data used to assign free ridership scores were collected through a survey of customer decision makers for projects rebated through the HPB program during PY2013.

Free ridership was estimated using the methodology described in Section 3.1.2.3. Table 3-9 shows percentages of total survey respondents that are associated with different combinations of free ridership indicator variable values. Twenty three percent of the respondents indicated that they were financially unable to implement the project in the absence of the program inducements. These respondents were assigned a free ridership score of 0%. Their responses to other free ridership indication questions were checked for consistency, and showed that they did not have plans or intentions to install the energy efficient equipment before learning about the HPB program.

Table 3-9: Estimated Free-ridership for PY2013 HPB Program[17]

Had Plans and Intentions to Install Measure without HPB Program? (Definition 1)	Had Plans and Intentions to Install Measure without HPB Program? (Definition 2)	HPB Program had influence on Decision to Install Measure?	Had Previous Experience with Measure?	Percentage of Total Respondents	Free Ridership Score
N	N	N	N	6%	0%
N	N	Y	N	23%	0%
N	N	Y	Y	6%	0%
N	Y	Y	N	6%	0%
N	N	N	Y	2%	33%
N	Y	N	N	4%	33%
N	Y	Y	Y	2%	33%
N	Y	N	Y	4%	67%
Y	Y	Y	N	0%	67%
Y	Y	N	N	12%	100%
Y	Y	N	Y	10%	100%
Y	Y	Y	Y	4%	100%
Required program incentive to implement measures.				23%	0%
Total				**100%**	**30%**

Overall, the estimated percentage of program free ridership is 30%. This is approximately 10% higher than the free ridership estimate from the 2012 PSO Standard Offer Program, despite using the same response scoring methodology. Most of this 10% increase from 2012 is explained by a higher number of respondents strongly indicating plans and intentions to install the measures even in the absence of the program. Considering the survey sample sizes and uncertainties associated with self-report free ridership estimation, it is possible that both the 2012 and 2013 estimates point to similar free ridership levels. However, given that both estimates were calculated using the same response scoring, it may be that some change in program activities has allowed for increased free ridership. This issue is worth monitoring closely in program year 2014.

Customer decision maker survey responses were also analyzed to estimate participant spillover effects. Overall, four of the 52 survey respondents indicated that they have either installed additional energy efficiency measures or are likely to soon install additional energy efficiency measures. None of the four potential spillover respondents

[17] The achieved sample size of 52 respondents resulted in the following error bounds at the 90% confidence interval for the mean FR score: 0.295 ±0.098 = 0.197 – 0.393.

were associated with any level of free ridership. One customer indicated that they had purchased additional HVAC equipment, while the other three respondents did not provide measure details. All four respondents indicated that their experience with the program was “important” or “very important” to their decision to install additional measures. Based on these responses, a participant spillover estimate of 7.7% (4/52) is estimated. This spillover estimate is simplistic and associated with potential uncertainty based on limited measure details from respondents, the short time period between program participation and customer surveying, and subjectivity of the methodology used. Despite these uncertainties, the participant spillover estimate is included in the final net-to-gross ratio estimate because:

- There is anecdotal evidence of participant spillover based on project documentation reviews that show certain energy efficient light fixtures were not rebated because they are not listed on either the DesignLights Consortium or the Consortium for Energy Efficiency (CEE) approved product lists. There is not enough documentation to quantify energy savings for these fixtures or determine whether these savings are attributable to the program.
- There was no attempt to identify non-participant spillover for the 2013 program. This likely underestimates program benefits to some extent. There may be future EM&V efforts to estimate these effects in future years, but the costs and uncertainty associated with such estimates was a deterrent in 2013.
- Finally, the 7.7% participant spillover estimate is in line with the percentage of 2012 Standard Offer Program survey respondents who were identified as potential spillover customers.

The final net-to-gross ratio for the program is calculated as 1 – free-ridership + participant spillover. This results in a NTGR of 78%. The gross and net verified energy savings and peak demand reduction of the HPB program during PY2013 are summarized by program in Table 3-10.

Table 3-10: Summary of Verified Gross and Net Impacts

Program	Verified Gross kWh Savings	Verified Gross kW Reduction	Net-to-Gross Ratio	Verified Net kWh Savings	Verified Net kW Reduction
High Performance Business	24,738,603	3,367.05	0.78	19,188,275	2,611.62

3.1.5 Process Evaluation Findings

This section presents the key process related findings derived from analyzing program materials, customer decision maker surveys, service provider surveys, and in-depth interviews with PSO program staff.

Key process evaluation findings and recommendations are summarized below:

- **High customer satisfaction:** High Performance Business participants were generally satisfied with their program experience. Eighty-four percent of customer survey respondents indicated being at least "somewhat satisfied" with the program overall. Customer satisfaction levels with equipment performance and installation quality were even higher. High levels of satisfaction with the application process and interactions with program staff were also reported.
- **Few problems with participation process noted by participants:** Survey respondents were asked several questions about their experience with the program participation process. These questions covered topics such as who was involved in completing the application, participants' assessments of the application materials, the equipment installation process, the rebate amount, and post-installation verifications. Few participants noted problems with the participation process in their responses to these questions.
- **New program design start-up period:** The PSO HPB program design differs from the prior PSO C&I programs that were in place. HPB is a consolidated program, offered to all qualified non-residential customers. The program targets a wide band of C&I customers, as opposed to a sector-specific approach. ICF, PSO's implementation contractor, is responsible for many facets of the program, including program design, staffing, management, incentive processing, and tracking/reporting. These tasks require substantial time and resources and generally occur concurrently, and often over a period of time. ICF leveraged internal resources for design and start-up, but ran into some difficulty in locating qualified staff to perform account management and incentive processing tasks at the local level. This necessitated the use of the start-up staff for a longer period than expected. However, the program was fully staffed, from an operational perspective, by fall 2013.

  ICF placed a temporary program manager in place in June 2013, with a permanent selection appointed in December 2013. While the permanent program manager was an internal candidate, the selection process still took a number of months.

  Programs such as HPB often remain somewhat dynamic during the first year of implementation as the utility and third party staff members work to ascertain the market conditions and program potential for certain measures and incentive levels. Program staff report that all of the necessary components are now in place for PY2014, and the program has moved into a growth mode as compared to a start-up mode in early 2013.
- **Vendors, contractors, and PSO staff were key influencers:** Survey respondents reported that participation in the program and decisions about equipment installations were most influenced by vendors, contractors, and PSO staff. A relatively low percentage of survey respondents (25%) reported that their

organizations initiated the decision to participate in the program. This indicates that a large portion program activity is being driven and sustained by the promotional efforts of program staff, contractors, and vendors.

- **Rebates met most participants' expectations:** Last year's evaluation noted that some participants did not understand the incentive structure. No participants made similar comments this year and the majority indicated that the rebate they received met or exceeded their expectations.
- **Opportunity to cross-promote program components:** Few participants were aware of the incentives for retro-commissioning projects and few of the prescriptive participants were aware that incentives for custom projects were available. These findings suggest that there may be an opportunity to cross-promote program components more effectively to drive additional activity. Opportunities to inform customers about these additional incentives include during calls made to the call center, when application approvals are given, and during site verification visits performed by program staff.
- **Develop consistent technical review processes and coincident peak demand definitions for eligible measure types:** During the review of project documentation for the on-site verification sample, there were a few issues identified. In some cases, energy and demand savings submitted to the program by a service provider became the basis of reported project savings without sufficient technical review. In other cases there were inconsistent applications of the coincident peak demand period. Reviewing standard program savings calculators and technical review processes is recommended.
- **Finalize a detailed program manual:** PSO staff indicated that there is currently no finalized program manual, only a draft version. ICF staff noted that the draft version is near completion. This manual is important to formalize program implantation procedures and to ensure that there is a mutual understanding between PSO and ICF regarding how the program will be implemented and how certain project types will be handled.
- **Consider program staff promotion of retro-commissioning:** Although the service providers should ultimately drive activity in the retro-commissioning component of the program, initial promotion by program staff may be required. To date no projects have been completed through the program. Program staff members did however indicate that there are some projects in the pipeline for 2014. A common barrier to completing retro-commissioning projects that was noted by program staff is that customers are typically unfamiliar with what retro-commissioning is and how it can result in financial savings. Because of the lack of understanding about retro-commissioning, customers may be distrustful of the program marketing provided by service providers. Program representatives who

are not selling their services may be a more credible messenger for these customers.

- **Specify project inspection requirements to balance mitigating risk with efficient utilization of program resources:** A review of project documentation, as well as PSO staff comments, revealed that most of the projects implemented through the program in 2013 received pre- and/or post-inspections by implementation staff. Although pre- and post-inspections for most projects may effectively minimize evaluation risk, it is also resource intensive and can slow the project application and approval process. Program staff should consider a strategy that balances the minimization or evaluation risk with efficient use of program resources by setting criteria for when a project requires pre- and/or post-inspection. For example consider limiting pre-inspection to projects of greater than 50,000 kWh for which other methods cannot be used to document energy usage or other baseline conditions. Additionally, consider limiting post-verifications to a random sample of projects below a certain energy savings threshold (e.g., a sample of 10% of projects below 200,000 kWh in expected savings), while verifying installation and post-retrofit conditions for all projects above that threshold. Invoices, equipment cut-sheets, and other customer provided documentation may prove sufficient for many prescriptive projects.

3.1.5.1 Program Staff Feedback

This section summarizes the core findings of interviews with key program staff members. These interviews provide information regarding the structure of the program and the procedures that take place during program operation. For the 2013 High Performance Business program evaluation, the evaluators conducted in-depth interviews with two PSO program management staff members.

- **New program design launched:** In 2013, PSO launched the newly designed High Performance Business program that incorporated several changes form offerings in 2012. Most notably, PSO consolidated all of their C&I energy efficiency offerings into one cohesive customer facing program. Additional changes included the addition of prescriptive incentives for HVAC equipment, lighting equipment, and hotel and kitchen equipment. The program also began offering services that provide customers with facility and project assessments to assist customers with identifying energy saving opportunities. These services include Full Retro-Commissioning, Enhanced Operations and Maintenance Services (HVAC tune-ups), and Capital Improvement Consultations.

  PSO staff also reported that the changes included quality control enhancements. One of the new quality control changes is the requirement that lighting products are listed on either the DesignLights Consortium or the Consortium for Energy Efficiency (CEE) approved product lists. The purpose of this requirement is to

insure that the incentivized lighting meets specific performance and product quality standards. However, program staff noted that LED lighting in particular is rapidly changing, and that the list of approved products is not always current. Consequently, some of the distinctions between listed and unlisted products appear arbitrary. To address this issue, program staff will consider unlisted products for approval on a on a case-by-case basis. Another significant change is that the program is performing more onsite inspections and staff indicated that nearly all projects receive a pre- and/or post-inspection. Staff noted that the downside of the additional quality control measures is that they add to the program administration costs and the challenge is finding the balance between effective program delivery and efficient program operations.

Other more recent changes include the launching of an online application and a redesigned website.

- **New implementation contractor:** PSO contracted with ICF International to implement the HPB program beginning in 2013 instead of implementing the program in-house, as was done with previous C&I offerings. Program staff noted that key program implementation roles fulfilled by ICF are the analysis of energy and demand savings for proposed projects and QA/QC of completed projects. ICF also manages the service provider network, operates a call center for applicants, and has provided input on the content needed for the program application materials. Although program marketing is not a primary component of ICFs role, ICF's implementation activities do include direct customer outreach and customer outreach done in coordination with PSO staff.

  Program staff reported some challenges early in the 2013 program year during the transition from in-house to third-party implementation. One of the challenges noted by program staff was that they felt the implementer did not have the program fully staffed until the third quarter of 2013. PSO staff indicated that the insufficient staffing during much of the program year likely limited the promotion of the program at a time when effort was needed to sell the program and the substantial changes from PY2012. An additional concern raised was the lack of a completed program implementation manual. Without a program manual that clearly spells out program design and policies, PSO staff felt there were too many areas of ambiguity relating to project submissions. Lastly, PSO staff indicated that there was not a clearly defined program manager at ICF during much of the program year and that this sometimes limited the implementer's responsiveness to PSO inquiries. ICF staff reported that the program manual is nearly finalized.

  That said, PSO staff indicated that these structural and communication problems have largely been resolved since ICF hired a dedicated program manager in

December of 2013. As a result, PSO staff feels the program is now operating much more smoothly, and customer participation and awareness is increasing.

- **Initial resistance from service providers to program changes:** Given the significant program changes, it is not surprising that service providers expressed some resistance to the new program design. The addition of the prescriptive incentives was of particular concern to service providers because in some cases the incentive levels were lower than the custom, performance based incentives previously offered. However, program staff reported that service providers appear to have acclimated to the program changes and expressed fewer concerns with the new program design later in the program year.
- **Program fell short of 2013 goals:** The program fell short of its energy and demand savings goals for 2013 and did not fully utilize its allocated budget. Program staff indicated that this was likely due to the slow implementation of the program that resulted in a loss of program momentum and a slow ramp-up of activity during the program year. Staff report that the program is on track to meet its 2014 goal.
- **No activity in retro-commissioning components:** PSO offers two retro-commissioning tracks through the program. One track, the Enhanced Operations and Maintenance Services, primarily focuses on HVAC tune-up projects and covers projects at buildings of less than 75,000 square feet. The other component, for which buildings of more than 75,000 square feet qualify, is Full Retro-Commissioning. In 2013, no projects were rebated through either track. However, both PSO and ICF staff indicated that some projects are in the pipeline for 2014 or are being discussed with customers.

  These retro-commissioning tracks are largely promoted by four approved service providers in addition to ICF and PSO staff members. Program staff noted that a key barrier to program participation may be a lack of understanding of what retro-commissioning is and that that the best way to address this barrier is through greater promotion of the program by program staff.
- **Weekly progress meetings between PSO and ICF initiated in the fall of 2013:** Weekly meetings between PSO staff and program implementer staff to review project/goal progress began in the fall of 2013. These meeting often occur in person as the ICF program manager is located near PSO's offices. These meetings cover the status of projects in the program pipeline, the program marketing needs such as the need for brochures and technical tip sheets, and implementer outreach efforts. Additionally, PSO staff indicated that overall their needs are being addressed and there are not any gaps in the types of reporting provided by ICF or the accuracy and quality of reporting.

3.1.5.2 Participant Feedback

A total of 52 customer decision makers completed surveys relating to their experience with the High Performance Business program in 2013. As shown in Table 3-11, survey respondents worked for a variety of different types of organizations, but industrial/manufacturing (23%), office (15%), and retail (15%) were the most common.

Table 3-11: Survey Respondent Organization Types

	Response	Percent of Respondents(n=52)
Which of the following best describes the type of work that your firm or organization does?	Industrial/Manufacturing	23%
	Office	15%
	Retail	15%
	School	8%
	Lodging	6%
	Restaurant (not fast food)	4%
	Warehouse	2%
	Grocery and convenience	-
	Fast food restaurant	-
	Other (please specify)	27%
	Not sure	-

Source of Program Awareness

To gauge the effectiveness of various approaches to promoting the program, survey respondents were asked how they learned of the High Performance Business program. Survey respondents found out about PSO's incentives from a wide variety of sources. The most commonly mentioned sources included from an equipment vendor or building contractor (38%) and from a PSO account representative (28%). Fewer respondents, only 9%, learned of the program through the program's website. However, this may increase during the 2014 program year because program staff reported that website was redesigned and there has been a recent increase in website traffic. Additionally, 11% of the respondents indicated that they learned of the incentives from an ICF program representative.

Table 3-12: Sources of Awareness for the PSO Equipment Incentives

	Response	Percent of Respondents* (n=52)
How did you learn about PSO's rebates for efficient equipment or upgrades?	From an equipment vendor or building contractor	38%
	From a PSO Account Representative	28%
	From an architect, engineer or energy consultant	17%
	Friends or colleagues	15%
	From an ICF program representative	11%
	Through past experience with the program	11%
	From PSO's website	9%
	Received an informational brochure or newsletter	6%
	TV / radio ads sponsored by PSO	6%
	Don't know	-
	Other	8%

*Since respondents were able to select more than one response, the sum of the percentages in the table above can exceed 100%.

In order to gauge awareness of incentive types offered by PSO for energy savings, survey respondents who received prescriptive incentives were asked whether or not they were aware of the custom incentives offered and all participants were asked if they were aware of the incentives for retro-commissioning. Their responses are shown in Table 3-13. As shown, relatively few participants who received prescriptive incentives were aware of the custom incentives. Prescriptive participants who were aware of the custom incentives were asked why they did not complete a custom project. Few of these respondents noted any program barriers to participating. Specifically, only one respondent indicated interested in a custom project but that they did not want to complete two applications and none said the custom application was too complicated.

Participants' awareness of the incentives offered for retro-commissioning is also shown in Table 3-13. Less than one-quarter of the participants were aware of the incentives for retro-commissioning.

Table 3-13: Awareness of Incentives for Custom Equipment and Retro-Commissioning

Response	Aware of Custom Incentives (n=44)	Aware of Retro-Commissioning Program (n=51)
Yes	39%	24%
No	50%	71%
Don't know	11%	6%

These findings suggest that there may be potential to increase activity in the custom incentives and retro-commissioning components of the High Performance Business program through increased cross-promotion to participants applying for prescriptive rebates.

Influences on Participation and Projects

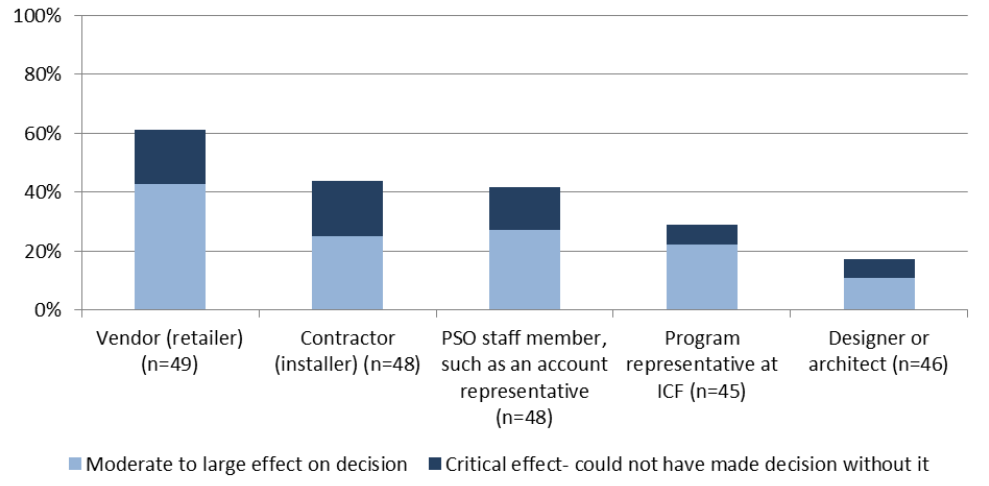
Survey respondents reported on who initiated the decision to participate in the High Performance Business program. The findings suggest that vendors, contractors, and PSO representatives were key drivers of program activity during 2013: 31% reported that a vendor or contractor initiated it, 27% said that a representative from PSO initiated the discussion, and 2% indicated that someone from ICF initiated the discussion. Another 10% of respondents indicated that the decision to participate arose in discussion between their organization and their vendor or contractor. These responses indicate that a majority of the projects were initiated by someone outside of the organization that implemented the equipment and emphasize the importance of program staff and service providers for promoting the incentives.

Table 3-14: Who Initiated Decision to Participate

	Response	Percent of Respondents (n=52)
Regarding your organization's decision to participate in the High Performance Business Program, who initiated the discussion about the rebate opportunity? Would you say…	Your organization initiated it	25%
	Your vendor or contractor initiated it	31%
	A representative from PSO initiated the discussion	27%
	The idea arose in discussion between your organization and your vendor or contractor	10%
	A representative from ICF initiated the discussion	2%
	Some other way	4%
	Don't Know	2%

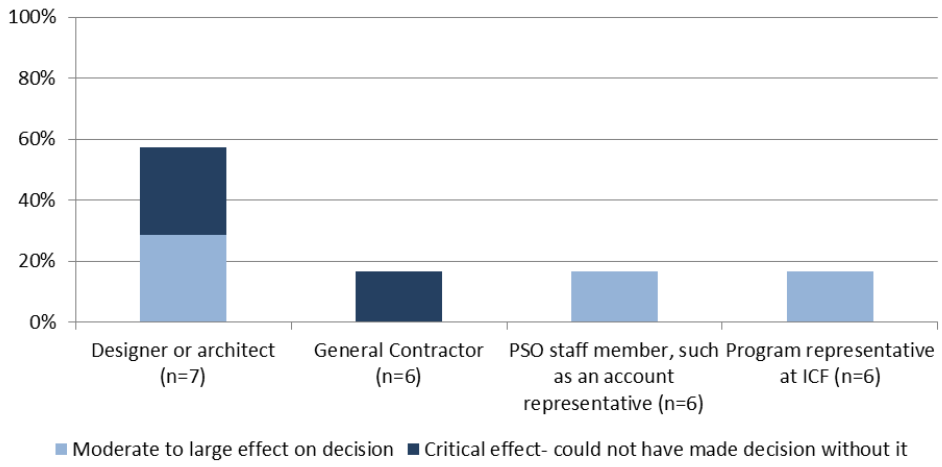
Various types of people can influence program participants' decisions to install energy efficient equipment. Figure 3-1 displays the share of potential influencers of equipment decisions that had a moderate to large or a critical effect on participants' decisions to retrofit their equipment with energy efficient options. The largest share of participants (61%) reported that vendors and retailers had an important influence on the decision to install energy efficient equipment. Contractors and PSO staff members were also influential for a large share of respondents.

Figure 3-1: Share of Project Influencers who had Moderate to Critical Effect on Decision to Install Efficient Equipment



Among participants that installed energy efficient equipment as part of a new construction project, designers and architects were most frequently noted as playing an important role in the decision to install energy efficient equipment.

Figure 3-2: Share of New Construction Project Influencers who had Moderate to Critical Effect on Decision to Install Efficient Equipment



Participation Process

Survey respondents were asked several questions about their experience with the program participation process. These questions covered topics such as who was involved in completing the application, participants' assessments of the application materials, the equipment installation process, the rebate amount, and post-installation verifications.

Nearly three-quarters of survey respondents indicated that they worked on completing the application materials to receive the program rebates. Several also reported that contractors (32%) and equipment vendors (28%) assisted with completing the applications.

Survey respondents who worked on completing the application materials were asked to provide their assessment of these materials. Their assessments are summarized below.

- Of the eight respondents that recalled completing the MS Excel-based lighting calculator, only one reported that it was difficult to use. This respondent indicated that previously an engineering firm would complete the calculator for them, but did not specify what made it difficult to use.
- Only one respondent indicated that the information on how to complete the forms was unclear. This respondent did not indicate what information could be further clarified.
- Eighty-four percent of respondents reported that they had a clear sense of whom to go to for assistance with the application process.
- Most participants reported that the ease of finding the forms, the time it took for PSO to approve the application, the effort required to provide supporting

documentation, and the overall application process was acceptable (see Table 3-15). Very few reported that any of these aspects of the process were unacceptable.

Table 3-15: Acceptability of Elements of Application Process

How acceptable was…	1 - Completely unacceptable	2	3	4	5 - Completely acceptable	Don't know	N/A
The ease of finding forms on PSO's website (n=37)	-	5%	5%	16%	62%	5%	5%
The time it took for PSO to approve the application (n=37)	3%	-	11%	24%	62%	-	-
The effort required to provide required invoices or other supporting documentation (n=37)	3%	5%	5%	24%	59%	3%	-
The overall application process (n=37)	3%	-	5%	30%	59%	3%	-

Survey respondents were asked who installed the equipment that they received incentives for. The majority (73%) reported that someone other than their own staff installed the equipment. Respondents most frequently reported that a contactor they had previously worked with. The tendency of participants to work with a contractor they had previously worked with underscores the importance of insuring that a large number of contractors who work in the service territory are aware of the PSO incentives. Relatively few of the respondents (6%) indicated that they worked with a program registered service provider. However, it is possible that respondents were not aware that the contractor they worked with was a registered service provider and that consequently the number of projects installed by registered service providers was underreported.

Table 3-16: Who Installed the Energy Efficient Equipment

	Response	Percent of Respondents*(n=52)
Who installed your program-qualified equipment or efficiency upgrades?	Your own staff	27%
	A contractor you've worked with before	56%
	A contractor approved by your PSO High Performance Business program (registered service provider)	6%
	A new contractor that someone else recommended	6%
	Other	6%
	Don't know	-

As shown in Table 3-17, a large majority of survey respondents reported that they were satisfied with the equipment installed, the quality of the installation, and their experience with the service provider.

Table 3-17: Satisfaction with Equipment Installation

Please rate your satisfaction with	1 - Very Dissatisfied	2	3	4	5 - Very Satisfied	Not sure	No equipment, N/A
The equipment that was installed (n=52)	2%	2%	4%	10%	81%	2%	-
The quality of the installation (n=51)	2%	2%	2%	10%	82%	-	2%
Your experience with the /service provider (n=49)	4%	-	4%	10%	76%	4%	2%

Approximately, one-half of survey respondents indicated that a post-inspection of the work done through the program was performed. None of these respondents reported that they were dissatisfied with the inspection process and 70% reported that they were completely satisfied with the inspection. The relatively high levels of satisfaction with the inspection process are important from the perspective that not over burdening participants likely increases willingness to participate with future efficiency upgrades and word-of-mouth advertising.

Table 3-18: Satisfaction with Post-Project Inspection

	Response	Percent of Respondents*(n=27)
How satisfied were you with the inspection process?	1 - Not at all satisfied	-
	2	-
	3	4%
	4	22%
	5 - Completely satisfied	70%
	Don't know	4%

Fifty four percent of the respondents reported that the rebates were about what they expected. Roughly equal shares reported that the rebate was somewhat more (16%) or somewhat less (16%) than what they were expecting. Very few (2%) reporting being disappointed by a rebate that was much less than what they were expecting. Eight percent reported that the rebate was more than they had expected. These findings suggest that the various parties involved in the participants projects such as PSO staff, ICF staff, service providers, and vendors, are providing reasonable expectations for project rebates.

Table 3-19: Amount of Rebate Compared to Expectations

	Response	Percent of Respondents (n=50)
How did the rebate amount(s) compare to what you expected?	It was much less	2%
	It was somewhat less	16%
	It was about the amount expected	54%
	It was somewhat more	16%
	It was much more	8%
	Don't know	4%

Sixty-three percent of respondents indicated that they had interactions with PSO program staff during the course of the project. All of these respondents reported that the staff was either knowledgeable (30%) or very knowledgeable (70%). Table 3-20 displays respondents' level of satisfaction with their PSO program staff interactions. Most respondents reported that they were satisfied with how long it took staff to address their questions or concerns (94%) and how thoroughly these were addressed (97%).

Table 3-20: Satisfaction with Staff Interactions

Please rate your satisfaction with…	1 - Very Dissatisfied	2	3	4	5 - Very Satisfied	Not sure
How long it took PSO program staff to address your questions or concerns (n=33)	-	3%	3%	15%	79%	-
How thoroughly PSO program staff addressed your questions or concerns (n=32)	3%	-	-	16%	81%	-

Overall Satisfaction

Eighty-four percent of participants were satisfied with the program overall and only 4% expressed a level of dissatisfaction, as shown Table 3-21. This share of respondents who were satisfied with the program represents an increase from the 72% who reported they were satisfied with the program in 2012. Additionally, most respondents indicated satisfaction with the various elements of the program. The increased level of satisfaction may point to the effectiveness of the cohesive single program approach of the High Performance Business program. Prior to 2013, C&I customers had five different programs they could potentially participate in depending on their type of business and measures installed. This often meant different program materials and rules needed to be reviewed.

Only one of the respondents elaborated on his or her level of satisfaction with the program. This respondent reported dissatisfaction with each element of the program and seemed to indicate that the rebate they received was less than what was expected and that there was difficulty in scheduling a post-inspection.

Table 3-21: Satisfaction with Program Elements

Please rate your satisfaction with…	1 - Very Dissatisfied	2	3	4	5 - Very Satisfied	Not sure
The steps you had to take to get through the program (n=52)	-	4%	10%	29%	54%	4%
The amount of time before the rebate check arrived after the project and application was completed (n=51)	2%	6%	12%	24%	55%	2%
The range of equipment that qualifies for rebates (n=49)	2%	6%	4%	35%	49%	4%
The program, overall (n=50)	2%	2%	8%	22%	62%	4%

Respondents were provided an opportunity to provide additional comments about their experience with the High Performance Business program. Most of the comments made by the respondents indicated satisfaction with the program. A lot of these comments were fairly general in nature and did not refer to any specific aspect of the program. Some examples of comments that typify this kind of response are:

> *"Good program."*
>
> *"Easy to work with."*

> *"Very good experience."*

A few of the participants noted satisfaction in working with program staff. Some examples of these comments include:

> *"Every staff member from PSO was fantastic to work with and very helpful. PSO should be thankful for great employees like [PSO Staff Member] and [PSO Staff Member], they are friendly, helpful, and great at their jobs."*

> *"[ICF Staff Member] with ICF was instrumental in my decision. Very knowledgeable about all the lighting options. Couldn't have done it without him."*

Four of the survey respondents suggested that the program or its delivery should be modified in some way. These suggestions included promoting the program more, extending the program to buildings indirectly supplied, including commodity fixtures in delamping, and making the paperwork less time consuming.

Two participants noted an issue with program. One noted that they had not received their incentive check at the time of the survey and the other felt that the program was misleading (this was the same participant who expressed dissatisfaction with the program discussed earlier). However, these comments were in the minority with most participants expressing positive program experiences.

3.1.5.3 Service Provider Feedback

ADM conducted interviews with six program registered service providers. Key points expressed by the service providers are summarized below:

- **Past program participation:** Three of the six service providers interviewed said they have been involved with PSO's program offerings before 2013 (one said for the past five years, another the past three years). Two other respondents indicated that they heard about the program from a customer which led to their involvement in 2013.
- **Involvement with the High Performance Business program in 2013**: When asked to describe their involvement with the program in 2013, five of the six service providers indicated that they are involved with submitting rebate applications for their customers. Other commonly reported activities were incentive management, equipment selection and equipment installation. One service provider mentioned that they were also involved in radio advertisement spots for the program. Another service provider indicated that they mostly "spec jobs to fit with LED and fluorescent rebates" and fill out all necessary paperwork to complete the rebate applications.
- **Rebate application process:** When asked how they felt about the program rebate application process and whether it was reasonable, five of the six service

providers were generally positive. Their comments included “straight forward and easy,” and “at the beginning the process seemed a little slow and then seemed more streamlined.” When asked if there were any ways in which the application process could be improved, two customers said yes, but then offered suggestions that are more rebate related. One said he/she would prefer that the rebates were based on custom incentives like they were in 2012, rather than the prescriptive offerings in 2013. The other said “higher rebates and less focus on ENERGY STAR products” would be an improvement.

- **Program training:** Four of the six service providers said they participated in training events for the High Performance Business program. Three indicated that they had attended “all” or “several” of the training events. The other respondent indicated only attending the “basic training.” All four described the training events as either “very useful” or “somewhat useful.” Only one respondent offered a suggestion for making the training more useful. This respondent felt the application process was rushed through during the training events, which could be improved upon in the future. The same respondent also indicated that the training provided contacts within the program to help when questions or issues arise.
- **Interaction with program staff:** When asked about communication with PSO and ICF staff members, four of the six service providers used the opportunity to express that they felt program staff were helpful. Response include “they are always there to help” and “extremely helpful.” The other two respondents focused more on what the interactions consisted of, such as checking equipment eligibility or discussing the application process. None of the service providers expressed any dissatisfaction with program staff interactions.
- **Marketing strategy and effects on business:** Five of the six respondents said the program helps them sell their products and services. All five indicated that the rebate helped lower customer costs or increase return on investment. Three respondents also said the program has affected the types of products or services they offer either by offering more program qualified equipment or focusing more on project energy savings. All six of the respondents said that they actively market the High Performance Business program to their customers. Marketing methods that they mentioned include word of mouth, directing customers to PSO’s website, radio spots, and including PSO rebates in their cost proposals.
- **PSO’s marketing efforts:** Two respondents offered suggestions for improving marketing of the program. One suggested that he hasn’t notice much marketing in rural OK, suggesting that might be an area of increased efforts. The other thought that a monthly email or newsletter would be a useful marketing method.
- **Eligible program measures and rebate structure:** Service providers were asked whether there were any measures they think should qualify for the

program that currently do not. Two respondents thought the eligible measures were sufficient, while the other four all indicated that they thought non ENERGY STAR or DesignLights Consortium qualified LED products should be eligible, and not require a special exception. This sentiment was strongly expressed by three of the four service providers. Three of six respondents felt that the rebate amounts are sufficient to encourage customers to select energy efficient equipment options. However, four of six thought that LED fixtures should receive higher rebates, claiming the current levels might not be sufficient to get customers past the upfront cost barrier. One respondent again expressed a preference for the 2012 performance based rebates as opposed to the 2013 prescriptive offerings.

- **Plans to participate in future years:** Six of the seven service providers interviewed said they planned to be more active or similarly active in PSO's energy efficiency programs in futures years. Only one respondent indicated that his/her firm would be "less active" in the future, citing a key employee moving out of Oklahoma.
- **Overall program satisfaction and other comments:** When asked to rate their level of satisfaction with the program, two of six respondents stated "very satisfied," while three more were "somewhat satisfied." One respondent expressed neither satisfaction nor dissatisfaction. The last question of the interview allowed service providers to express anything else about their experience with the program they thought was relevant. One customer indicated they thought the pre-inspection process took too long and wasn't necessary. Another said there were too many repetitive steps in uploading project documentation to the program website, and that the website was slow. The new online application tool was not introduced until 2014, so this respondent may be referring to an older system that was used in 2012, but not 2013. The same respondent again expressed dissatisfaction with needing exceptions for certain lighting products. However, the same respondent also said "each year the program is getting better and I am more satisfied." Finally, one respondent said the program needed to "hire more people who know lighting."

3.1.6 Planned Program Changes

There are no major changes planned for the High Performance Business program in 2014. There was been an effort early in the year to finalize program materials and outreach for the HVAC tune-up component to the program (Enhanced Operations and Maintenance Service). There have also been adjustments and additions made to the program website, application forms, online application tool, and savings calculation tools. Program staff members indicate there is a focus on identifying remaining T12 lighting retrofit opportunities in 2014. Additional marketing channels have also been added in 2014 including a door-to-door campaign for small businesses; engaging more

manufactures, distributors, and energy service companies; facility specific marketing materials; and co-branding materials with registered service providers.

In early 2014 the program has also developed “technical tip sheets” for LED lighting, high bay lighting, total building tune-ups (RCx), and HVAC VFDs. Industry specific tip sheets have been developed for schools, government facilities, small businesses, industrial customers, grocery stores, and restaurants.

Incentive levels, eligible measures, and general program structure will remain largely unchanged. One exception is an increased incentive for replacing 1000W metal halide fixtures with LED fixtures.

3.2 Home Weatherization

3.2.1 Program Overview

The Home Weatherization program - also referred to as Efficiency Outreach[18] - targets limited income residential customers with total annual household income at or below 200% of federal poverty level. The federal poverty level as defined by the Federal Register increases as family size increases. However, households with annual income of less than $35,000 are eligible for the program regardless of family size. Only single-family homes are serviced through the program.

Qualifying homeowners are eligible for a free energy assessment through the program. Once the energy assessment is complete, PSO provides contractor recommended improvements at no cost to the participant. Measures installed through the program include:

- Infiltration reduction measures,
- Attic insulation
- Duct sealing
- Water heater jackets
- Pipe insulation
- Health and safety measures

PSO worked with Titan ES and Rebuilding Tulsa Together to implement the Home Weatherization program. Overall, 1,652 households were serviced in 2013. The vast majority of these households were serviced by Titan ES (1,576).

Actual program spending in 2013 was nearly identical to projected spending, reflecting the fact that the program was ramped down toward the end of the year as the allocated budget was expended. Reported energy savings were more than double projections. PY2013 performance metrics are summarized in Table 3-22.

[18] While the program name as filed is Home Weatherization, it is marketed to customers under the name Efficiency Outreach. Both names are used interchangeably in this report.

Table 3-22: Performance Metrics – Home Weatherization Program

Metric	PY2013
Number of Customers	1,652
Budgeted Expenditures	$3,140,824
Actual Expenditures	$3,138,669
Energy Impacts (kWh)	
Projected Energy Savings	2,119,479
Reported Energy Savings	5,095,260
Gross Verified Energy Savings	5,113,144
Net Verified Energy Savings	5,113,144
Peak Demand Impacts (kW)	
Projected Peak Demand Savings	1,301
Reported Peak Demand Savings	1,331
Gross Verified Peak Demand Savings	1,408
Net Verified Peak Demand Savings	1,408
Benefit / Cost Ratios	
Total Resource Cost Test Ratio	2.14
Utility Cost Test Ratio	1.55

3.2.2 EM&V Methodologies

This section provides a brief overview of the data collection activities, gross and net impact calculation methodologies, and process evaluation activities that ADM employed in the evaluation of the Home Weatherization program.

3.2.2.1 Data Collection

The primary data collection for the evaluation consisted of a participant telephone survey to verify program participation and in-home inspections to verify installation of the claimed energy efficiency measures. ADM staff also participated in contractor “ride-alongs” for four premises in order to observe and verify installation and performance testing methods. An additional 28 homes were visited independently to verify all measures were installed to program standards. In total, 150 participants were surveyed by telephone and an additional 32 homes were visited for installation verification. In-depth interviews with PSO program staff were also conducted to gain insight for the process evaluation.

Table 3-23 below summarizes the data collection activities and sample sizes.

Table 3-23: Sample Sizes for Data Collection Efforts

Data Collection Activity	Achieved Sample Size
On-site Verification Visits	32
Customer Survey	150
In-Depth Interviews with Program Staff	2

In addition to the primary data collection efforts, ADM reviewed detailed program tracking data and documentation maintained in the VisionDSM database and accompanying SSRS reporting system. The tracking data was reviewed and screened for duplicate entries, correct climate zone characterization, and potential inconsistencies.

3.2.2.2 Gross Impact Methodologies

The methodology used to calculate energy and demand impacts consisted of verifying measure installation for a sample of program participants, reviewing deemed savings estimates for each measure as described in the Oklahoma Deemed Savings Documents, and reviewing the program tracking data to assure that deemed savings were applied appropriately. The application of deemed savings in the tracking data was reviewed for a census of homes and measures.

Verification of measure installation was conducted through telephone interviews with program participants and on-site visits to participating homes. The telephone survey included questions to verify:

- Whether the participant indeed had their home serviced through the program,
- The measures claimed to be installed in the tracking database matched participant responses, and
- The heating and cooling systems for respondents matched records in the tracking database.

During the site visits, ADM field staff verified that the claimed energy efficiency measures were installed, and recorded key inputs to savings calculations such as R-value and square footage of installed insulation. Data collected through these activities was used to develop measure level verification rates, which were then used to make adjustments to the deemed savings estimates where necessary.

3.2.2.3 Net-to-Gross Estimation

The Home Weatherization program specifically targets customers with limited income, providing all services at no cost to the customer. It is likely that participating customers

would not have funded the installed energy efficiency measures on their own. As a result, ADM assumed a net-to-gross ratio of 100%.

3.2.2.4 Process Evaluation Activities

The process evaluation component was designed to answer the following research questions regarding the Home Weatherization program:

- How well did PSO staff, implementation staff, and participating customers work together? Are there data tracking and/or communication efficiencies that can be gained?
- How do participants hear about the program? What percentage is contacted directly by PSO or implementation staff? What percentage hears about the program through another avenue and then contacts PSO?
- Were the program participants satisfied with their experience? What was the level of satisfaction with the work performed, the scheduling/application process, and other aspects of program participation? What are the perceived energy and non-energy benefits associated with the program?
- How did the 2013 changes in qualifying income levels and dwelling types affect participation? Are participation goals still being reached? Are there changes that should be considered in future years?
- Were there any significant changes or new obstacles during the 2013 program year?
- Looking forward, what are key barriers and drivers to program success within PSO's market?

To address these questions, ADM's process evaluation activities included a review of program documentation, participant customer surveys, and in-depth interviews with PSO program staff.

3.2.3 Impact Evaluation Findings

As described in Section 3.2.2.2, the gross impact analysis consisted of verifying measure installation and checking the program tracking data to ensure that deemed savings algorithms were appropriately applied. In-Service Rates (ISR) for each measure type were developed based on the findings from the participant telephone survey and on-site visits. Findings from these activities are summarized below for each measure type.

Infiltration Reduction: The Oklahoma Deemed Savings Documents specify the following formula for use in calculating energy and demand impacts for infiltration

reduction measures. The air infiltration reduction estimate in CFM is obtained through blower door testing performed by the program contractor for each home serviced. Only homes with electric cooling systems are eligible for the measure (central AC or room AC).

$$\textit{Deemed Savings (kWh)} = CFM_{50} \times V$$

Where:

CFM_{50} = Air infiltration reduction in cubic feet per minute at 50 Pascal
V = the value in the following table that corresponds to the climate zone and heating and cooling type.

Table 3-24: Deemed Savings Table – Infiltration Reduction kWh Savings

Zone	Impact per CFM50 Reduction					
	AC/Gas Heat kWh	Gas Heat (no AC) kWh	Gas Heat (no AC) Therms	AC/Electric Resistance kWh	Heat Pump kWh	AC Peak Savings kW
Zone 9	0.1870	0.0000	0.1220	2.4696	1.5368	0.0001
Zone 8A	0.4324	0.0562	0.0835	2.0884	1.3721	0.0003
Zone 8B	0.4587	0.0536	0.0799	2.0442	1.3854	0.0002
Zone 7	0.4030	0.0407	0.0612	1.6236	1.066	0.0002
Zone 6	0.2730	0.0000	0.0600	1.3830	0.8404	0.0002

Of the 150 respondents to the participant survey, 149 represented homes where infiltration reduction measures were claimed. All 149 of these respondents indicated that they had indeed had air sealing measures installed. Additionally, ADM's on-site verification work found evidence of air sealing in all visited homes. For 147 of the respondents, the cooling system type reported matched the cooling system type in the program tracking database (room AC or central AC). One respondent said they didn't know, while another said they did not have space cooling equipment. No adjustments were made based on these findings.

There was however a number of discrepancies identified in the participant survey regarding heating system fuel source. For 121 of the 149 respondents, the heating system reported by respondents matched records in the program tracking database. For the remaining 28 respondents, they either reported gas heating when the tracking database reported electric resistance, or vice versa. No adjustments were made based on these findings because the mismatch was approximately equal (gas vs. electric, electric vs. gas). Additionally, no heating or cooling system type mismatches were identified during on-site verification visits. It is possible that survey respondents

incorrectly reported their heating system type, but it is an issue worth monitoring closely in 2014. Based on these findings, an ISR of 100% was applied.

ADM reviewed the deemed savings values used for each home and determined they were applied correctly for the majority of homes, based on the reported infiltration reduction. For a few homes (28), there were incorrect climate zone assumptions in the tracking system. Correcting the climate zone entries led to verified savings estimates slightly higher than reported values.

Duct Sealing: The algorithms used for estimating reported savings for duct sealing measures come from the 2013 update to the Oklahoma Deemed Savings Documents. These algorithms are shown below for heating and cooling kWh savings.

Cooling Savings:

$$kWh_{savings,C} = \frac{(DL_{pre} - DL_{post}) \times EFLH_C \times (h_{out}\rho_{out} - h_{in}\rho_{in}) \times 60}{1{,}000 \times SEER}$$

Where:

DL_{pre} =	Pre-improvement duct leakage at 25 Pa (ft3/min)
DL_{post} =	Post-improvement duct leakage at 25 Pa (ft3/min)
$EFLH_c$ =	Equivalent full load cooling hours, from table
h =	Outdoor/Indoor seasonal specific enthalpy (Btu/lb), from table
ρ_{out} =	Density of outdoor air (lb/ft3), from table Savings
ρ_{in} =	Density of conditioned air at 75°F = 0.0756 (lb/ft3) (default)
60 =	Constant to convert from minutes to hours
1,000 =	Constant to convert from W to kW
SEER =	Seasonal Energy Efficiency Ratio of existing system (Btu/W·hr) = 13 (default)

Heating Savings (Heat Pump):

$$kWh_{savings,H} = \frac{(DL_{pre} - DL_{post}) \times 60 \times 0.77 \times HDD \times 24 \times 0.018}{1{,}000 \times HSPF}$$

Where:

DL_{pre} =	Pre-improvement duct leakage at 25 Pa (ft3/min); assume 35% of fan flow if duct system cannot be pressurized
DL_{post} =	Post-improvement duct leakage at 25 Pa (ft3/min)
60 =	Constant to convert from minutes to hours
0.77=	Factor to correlate design load hours to EFLH under actual working conditions (to account for the fact that people do not always

	operate their heating system when the outside temperature is less than 65°F)
HDD=	Heating Degree Days, from table in Deemed Savings Document
1,000 =	Constant to convert from W to kW
HSPF =	Heating Seasonal Performance Factor of existing system (Btu/W·hr) = 7.7 (default)

Heating Savings (Electric Resistance):

$$kWh_{savings,H} = \frac{(DL_{pre} - DL_{post}) \times 60 \times 0.77 \times HDD \times 24 \times 0.018}{3{,}412}$$

Where:

DL_{pre} =	Pre-improvement duct leakage at 25 Pa (ft3/min); assume 35% of fan flow if duct system cannot be pressurized
DL_{post} =	Post-improvement duct leakage at 25 Pa (ft3/min)
60 =	Constant to convert from minutes to hours
0.77=	Factor to correlate design load hours to EFLH under actual working conditions (to account for the fact that people do not always operate their heating system when the outside temperature is less than 65°F)
HDD=	Heating Degree Days, from table in Deemed Savings Document
24 =	Constant to convert from days to hours
0.018 =	Volumetric heat capacity of air (Btu/ft3°F)
3.412 =	Constant to convert from Btu to kWh

A total of 77 of the participants interviewed represented homes where duct sealing savings were claimed. All of these respondents verified duct sealing measures. Similarly, ADM found evidence of duct sealing at all sites that received on-site verification. All 77 of the duct sealing respondents indicated they have electrically cooled homes. As with infiltration reduction, there were some discrepancies in reported heating system type. Twelve of the 77 respondents reported having electric heating systems, while the tracking data suggested they were heated using gas. Interestingly, there were no instances where gas heating was reported in conflict with tracking system data. These additional electric heating systems would mean additional energy savings. However, because no heating system mismatches were identified during on-site inspections, ADM made no adjustment to verified savings based on these findings. An ISR of 100% was applied for duct sealing. Again, it is recommended that close attention is paid to the issue of heating system fuel source in 2014.

The review of the program tracking date revealed an incorrect climate zone designation for just one home. Otherwise, the algorithms for energy savings and peak demand were applied correctly based on the improvements in duct leakage reported for each home.

As a result, verified savings for duct sealing measures were almost identical to reported savings.

Insulation: Reported energy and demand impacts from attic insulation are based on deemed savings values per square foot installed. The deemed savings are also dependent on climate zone, heating and cooling equipment and existing level of insulation. In order to qualify for the deemed savings, the home must have existing insulation with an R-22 or less, and must be brought up to the level of R-38 or greater. The Oklahoma Deemed Savings Documents provides tables for each climate zone that present the kW and kWh savings per square foot of insulation improved. Table 3-25 below is an example for climate zone 8B.

Table 3-25: Example Deemed Savings Table - Attic Insulation

Zone 8B Ceiling Insulation Deemed Savings						
Ceiling Insulation Base R-value	AC/Gas Heat kWh	Gas Heat (no AC) kWh	Gas Heat Therms	AC/Electric Resistance kWh	Heat Pump kWh	Summer Peak kW Savings
	(per sq. ft.)	(per sq. ft.)	(per sq. ft.)	(per sq. ft.)	(per sq. ft.)	(per sq. ft.)
R-0 to R-4	1.3653	0.1226	0.1433	4.1846	2.8426	0.0002
R-5 to R-8	0.7444	0.0621	0.0769	2.2625	1.5611	0.0002
R-9 to R-14	0.422	0.0345	0.0439	1.2851	0.8913	0.0002
R-15 to R-22	0.213	0.0175	0.0226	0.6593	0.4565	0.0001

Respondents to the participant survey represented 127 homes where attic insulation was installed. Again, all respondents verified insulation was installed. Similarly, evidence of additional attic insulation was verified for all projects where on-site verification took place. During the on-site verification visits, the pre-existing and new insulation levels along with sqft installed were measured, where possible. There were no instances where the insulation measurements did not meet the pre- and post-R-value requirements of the Deemed Savings Documents. Approximate square footage measurements also closely matched reported values. There were 21 survey respondents who reported having a different heating system than listed in the tracking database. Similar to infiltration reduction, these answers essentially canceled each other out (10 said they had gas heating when the tracking database said they had electric heating, 11 vice versa). On-site verification found no heating system type discrepancies, and no adjustments were made based on these findings. An ISR of 100% was applied for attic insulation.

The tracking database review showed that for the vast majority of homes deemed savings values for insulation were applied correctly, given the sqft installed. For a small number of participating homes, the wrong weather zone was assumed, which caused verified savings to vary slightly from the reported savings.

Pipe Insulation and Water Heater Jackets: Installation of pipe insulation and/or water heater jackets required electric water heating in serviced homes. As such, the number of recipients was significantly smaller than other program measures. ADM completed surveys with 37 customers who had one or both of the measures installed in their homes. All 37 respondents indicated that the measures were indeed installed. However, three of the 37 respondents indicated that they did not have electric water heating, but rather gas (8.1%). While no such discrepancies were found during ADM's on-site verification visits, the sample size for homes with water heating measures was very small. This resulted in ADM applying an electric ISR of 89.9% for pipe insulation and water heater jackets.

A review of the tracking system showed that deemed savings were applied correctly for pipe insulation measures (44 kWh and 0.014 kW per home). For water heater jackets, a review of the tracking system showed that conservative assumptions were used to inform the use of the deemed savings. Savings values corresponding to 2" thick jackets on 40 gallon tanks were used for all sites. The deemed saving for this measure depend on 1) water heating fuel source, 2) insulation thickness and 3) water heater tank size. There could be additional savings for homes that had larger water heaters, but this information is not recorded during installation. Table 3-26 below shows the deemed savings for water heater jackets installed on electric water heaters.

Table 3-26: Deemed Savings – Electric Water Heater Jacket

Approximate Tank Size	Electric					
	Energy Savings (kWh)			Peak Savings (kW)		
	40	52	80	40	52	80
2" WHJ savings kWh	68	76	101	0.005	0.006	0.008
3" WHJ savings kWh	94	104	139	0.007	0.008	0.011

Program Level Findings

Applying the adjustments detailed by measure type above results in a small increase in estimated energy savings and peak demand reductions overall, as shown in Table 3-27.

Table 3-27: Reported and Verified kWh and Peak kW

Measure	Reported Energy Savings (kWh)	Reported Peak Demand Savings (kW)	Verified Gross Energy Savings (kWh)	Verified Gross Peak Demand Savings (kW)
Air Infiltration	2,288,386	548.11	2,270,958	553.12
Duct Sealing	1,132,236	413.21	1,132,476	413.21
Attic Insulation	1,644,558	363.8	1,682,909	436.93
Water Heater Jacket	15,164	1.12	13,511	0.99
Pipe Insulation	14,916	4.75	13,290	4.23
Total	**5,095,260**	**1,331**	**5,113,144**	**1,408**

The savings estimates in the above table result in a kWh realization rate of 100% and a kW realization rate of 106%. The verified gross savings estimates reflect confidence that the energy and demand impacts reported for the program were largely consistent with the deemed savings values for each measure type. The deemed savings algorithms are designed to reflect average energy savings for installed measures, and may not reflect actual savings at any given participant meter. For homes where multiple measures affecting the same end use are installed, the deemed savings may not capture the interactive effects between the measures.

3.2.4 Process Evaluation Findings

This section presents the findings of the process evaluation activities described in Section 3.2.2.4 of this report. Findings are derived from interviews with program staff and feedback from 150 program participants who responded to a telephone survey.

3.2.4.1 Participant Feedback

A telephone survey was conducted to collect data about participant decision-making, preferences, and opinions of the Home Weatherization program. The surveys were conducted in November and December of 2013. Through November 1, 2013, 1,288 PSO customers had participated in the program and received low-cost energy efficient measures for their homes. In total, 150 of these participants responded to the telephone survey.

Overall, customers were very satisfied with their experience with the Efficiency Outreach program, and only a very small portion of participants were dissatisfied with any aspect of the program. The following sections discuss key issues that were discovered through an analysis of survey responses.

Participant Motivations and Awareness

This section details the survey findings related to participant preferences, program awareness, and prior energy efficiency behaviors. Participant respondents were first asked about how they learned of the PSO Efficiency Outreach program. As shown in Table 3-28, the majority of participants stated that they learned about the program through direct mail. Relatively few participants indicated that they had learned of the weatherization program through the PSO website. The results suggest that program awareness is being effectively distributed through direct mailings and customer contact, such as phone calls and community events. This is consistent with program staff feedback suggesting that the program is effectively marketed to low-income households through targeted mailing and direct contact. Responses in the "other" category included newspaper and magazine advertisements, and a TV advertisement.

ADM's interviews with PSO's program manager and ride alongs with Titan staff showed that, as the program attempts to reach rural communities, all approaches are used, but the greatest response comes once word-of-mouth spreads.

Table 3-28 How Participants Learned of the Program

	Response	Percentage of Respondents (N = 150)
How were you first informed about the Efficiency Outreach Program sponsored by PSO?	Received information brochure in the mail	46%
	Informed by a Program Representative	33%
	Heard about it from Friends and or Colleagues	13%
	Other	4%
	Utility website	3%

Participants were then asked why they decided to participate in the PSO Efficiency Outreach program. Table 3-29 displays the distribution of responses, where respondents were able to provide more than one response. Participants most commonly indicated that they participated in the program in order to reduce their gas or electric utility bills; all of the respondents selected at least one of these options. Only 33% of respondents reported that they participated because the measures and improvements were provided at no cost to the customer. These results suggest that participants were primarily concerned with the financial benefits of participating in the program, particularly the long-term effects of increasing residential energy efficiency. "Other" responses included: "my house needed insulation", "needed to get things fixed", "to keep warm".

As the program seeks to implement the most cost-effective energy saving measures in customer homes, it appears that participant interests and the interests of the utility are fairly aligned.

Table 3-29 Motivations for Participating in the Program

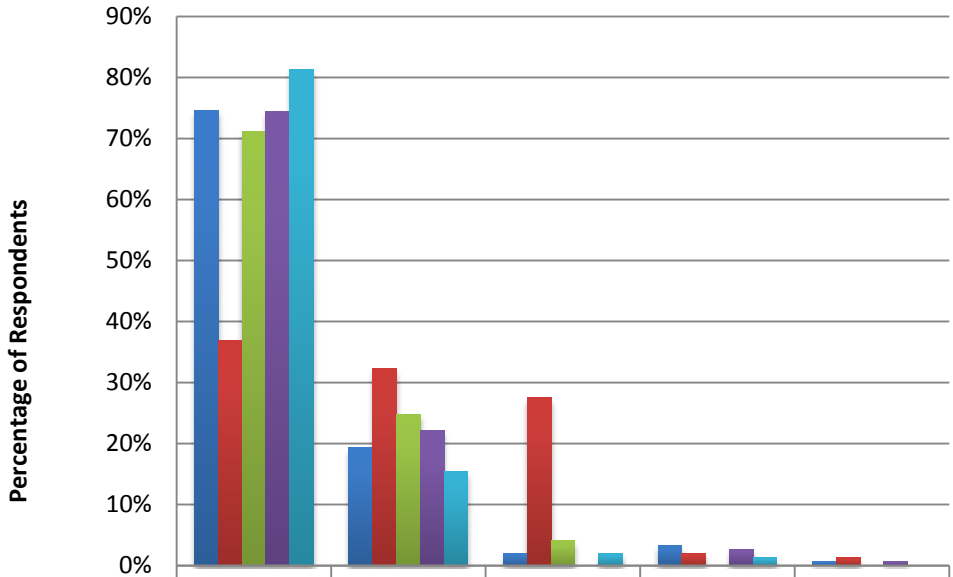
	Response	Percentage of Respondents (N = 150)
What motivated you to participate in this program?	To save money on your Electric Energy bill	84%
	Services are free	33%
	Environmental Concerns	21%
	Other	14%

*Respondents were able to provide multiple responses. The percentages shown are percentages of respondents rather than percentages of responses. Thus, the total exceeds 100%.

Participant Satisfaction

Survey respondents were asked about their levels of satisfaction with selected elements of their experience with the 2013 Efficiency Outreach program. Results were provided on a scale of *1* to *5*, with *1* representing “very dissatisfied” and *5* representing “very satisfied”. The distribution of participant satisfaction findings is displayed below in Figure 3-3.

Figure 3-3: Customer Satisfaction with Selected Program Elements



	Very Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
Performance of the measures installed (n=150)	75%	19%	2%	3%	1%
Savings on your monthly bill (n=149)	37%	32%	28%	2%	1%
Information provided by energy auditor (n=149)	71%	25%	4%	0%	0%
Quality of work conducted by the energy auditor (n=149)	74%	22%	0%	3%	1%
Overall program experience (n=150)	81%	15%	2%	1%	0%

Overall, 96% of respondents reported being satisfied or very satisfied with the program as a whole. Similarly, 94% were satisfied or very satisfied with the performance of energy efficiency measures installed in their home. Many of the satisfied respondents mentioned that it would be useful to receive a summary of exactly what measures were installed in their home. The following customer quotes represent the majority of responses:

> *"I think that it is a great program, and ultimately I end up using less energy."*
>
> *"We really appreciated so much, we are very grateful."*
>
> *"The workers that came out were very professional."*

There were a limited number of respondents who indicated some level of dissatisfaction with the program. Four customers reported that they had cracked windows that should

have been fixed. As it may not be always be cost effective to replace entire windows in a program of this nature, this should be explained to the customer, and these customers should be referred to other PSO energy efficiency programs that can help offset window replacement costs. This will ensure the customer that PSO is offering to help correct any and all issues.

Three of the 150 respondents reported that the contractor left behind a mess, and two respondents complained that their doors were hard to close. During ADM's ride-alongs with Titan, it was noted that the crews were very clean and explained to customers that doors would be harder to close during a "break-in" period for the weather stripping. There were also other respondent comments complimenting the professionalism and clean-up efforts of the program contractors.

Overall, the results from the satisfaction portion of the survey indicate that participants are very satisfied with their program experiences, and that they highly value the information and services offered by the program. As the incidents of dissatisfaction were sparse and fairly anecdotal, there do not appear to be any systematic issues related to participant satisfaction. Participant responses suggest that they primarily value a straightforward and low-effort participation process, as well as open communication and information from both utility staff members and the installation contractors. It appears that the Efficiency Outreach program is effectively addressing these values and maintaining positive relationships with participating customers.

Participant Characteristics and Demographics

This section presents the results of a series of survey questions related to participants' heating and water heating fuel, and characteristics of all homes that participated in the program. Figure 3-4 and Figure 3-5 are developed from the 150 survey respondents, while Table 3-30 and Table 3-31 are developed from data recorded in the program tracking database.

Figure 3-4: Survey Respondent Residence Heating Type

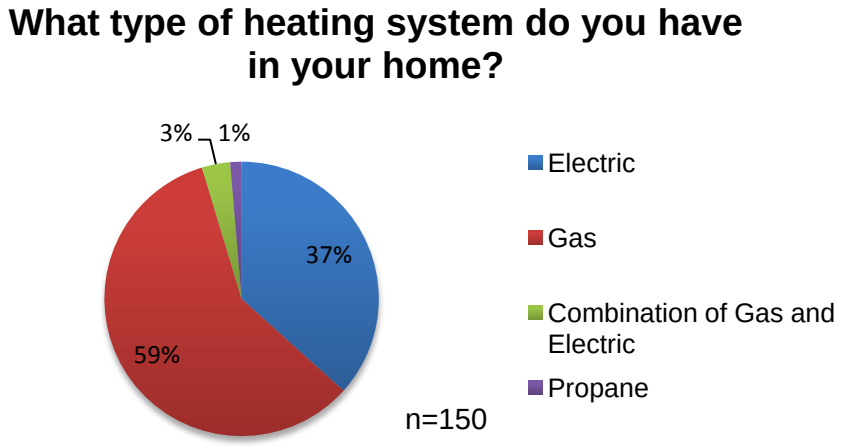


Figure 3-5: Survey Respondent Residence Water Heating Type

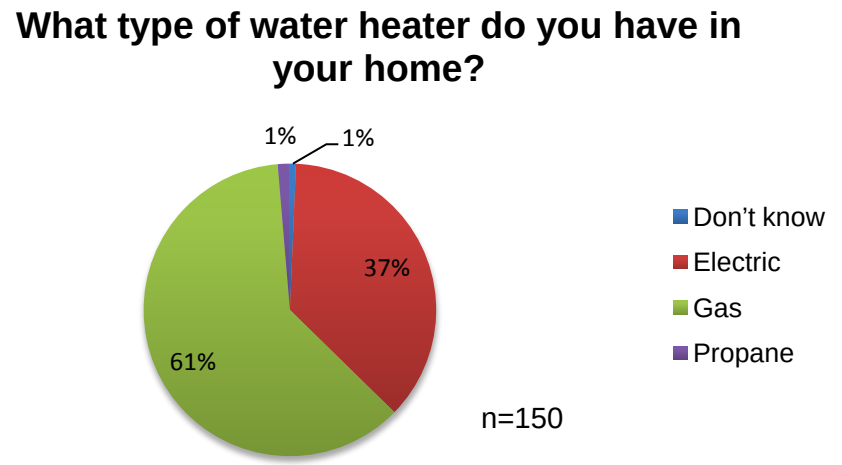


Table 3-30: Reported Age of All Participant Homes

Year Built	Percentage of Participants (N = 1,649)
Before 1950	22%
1950's	19%
1960's	19%
1970's	22%
1980's	10%
1990's	7%
2000's	0.1%

Table 3-31: Reported Square Footage of all Participant Homes

Approximate Square Footage of Home	Percentage of Program (N = 1,652)
Less Than 1,000	7%
1,000 - 1,499	56%
1,500 - 1,999	24%
2000+	13%

The following maps show a representative distribution of participant homes. The maps do not identify all homes, but rather the relative distribution of serviced homes throughout the PSO service territory.

Figure 3-6: Representative Distribution of All Participants

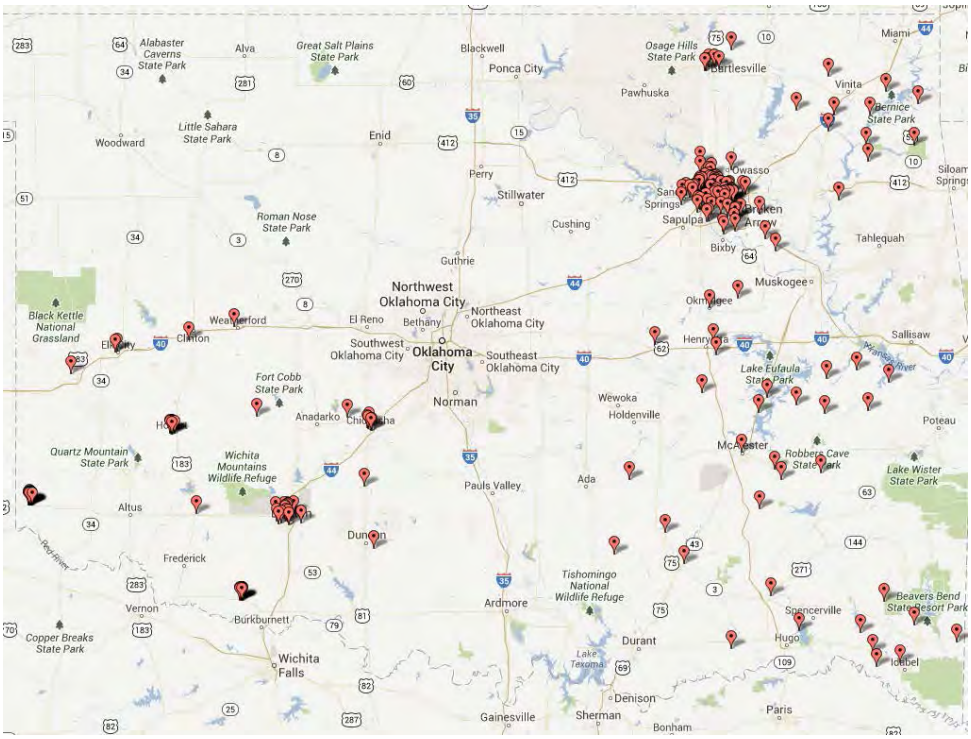
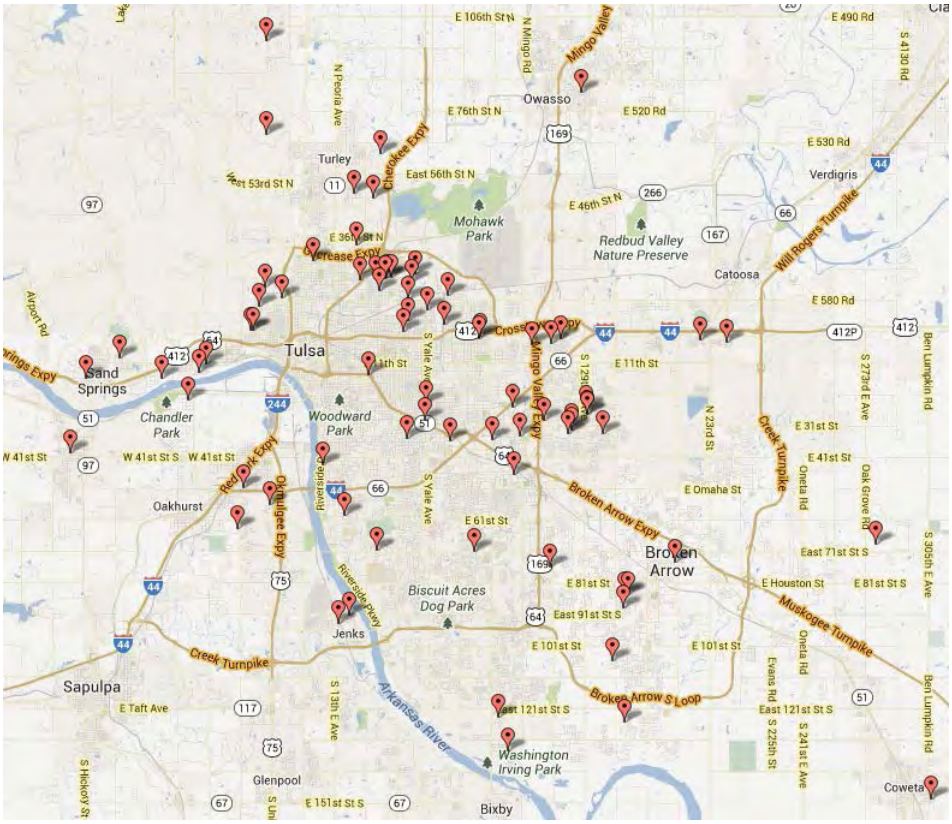


Figure 3-7: Representative Distribution of All Participants in the Tulsa Area



3.2.4.2 Program Staff Interview

As part of the evaluation of the 2013 Efficiency Outreach program, ADM conducted in-depth interviews with utility staff involved in managing and operating the program. This interview process was designed to explore various aspects of program performance, including overall design, operational efficiency, and opportunities for future improvement.

This section provides an overview of program structure and processes, and identifies any key areas that have been modified since prior program years.

Overall Program Status

Program year 2013 was a transitional year, with many changes to program design, but informal interviews with program staff indicate that the program operated fairly smoothly. The program eliminated the compact fluorescent lamp measure this year due to low installation rates and customer satisfaction. VisionDSM, a new tracking database, was also rolled out this year. Program staff reported that although there was a considerable learning curve, VisionDSM has helped to streamline processes for all stakeholders. Over the course of this year's evaluation an issue with the reporting of the duct sealing measure was discovered, discussed, and remedied.

Program Participation Potential

Program staff also indicated that after four years of program implementation there is still a significant pool of customers eligible for program participation in future years. The implementation team is developing new methods to recruit potential customers in order to reach markets that have not yet been served. Eligible customers are mostly identified using contact information provided by the federal Low Income Home Energy Assistance Program (LIHEAP), and 2010 US Census data showing counties where the average household income is below the participation threshold. Communities with significant low-income populations are often targeted at the same time to increase cost-effectiveness by reaching several homes in the same geographic location around the same time. The response rates in communities vary greatly from one to the next. To increase participation in communities with low response rates, Titan has started a referral program. At the end of the 2013 program year, Titan had distributed 76 gift cards, and had 15 current leads heading into 2014.

Program Contractors

In the PSO Efficiency Outreach program contractors conduct energy audits of customer homes and complete energy efficiency improvements for qualifying participants. In the 2013 program year, two contractors participated. All contractor staff members undergo regular training in order to stay current with industry techniques, safety protocols, and regulatory requirements. Interviewed utility staff indicated that adding additional contractors is fairly unlikely unless participation rates increase sharply. Interviewed utility staff reported that both contractors have been performing as expected, with few challenges in coordination, record-keeping, or installation work. Additionally, utility staff explained that if an error or issue is discovered during the quality assurance and verification process, the contractors are contacted and notified of any changes or improvements that need to be made. This serves to monitor the quality of work that is being conducted, and continually improve the accuracy and quality of services offered by the program over time.

Marketing and Community Outreach

As discussed above in the Participant Motivations and Awareness section, the marketing strategy for the program uses many channels. The installation contractor trucks display the name of the weatherization program, which serves as method of direct marketing. In ADM's ride-along with a program contractor, one customer claimed that she had seen the trucks all around town, but didn't know what they did. She proceeded to ask her neighbors and was then informed of the program. There is additional information on the utility websites and customers can inquire about the program via telephone. A large portion of participant recruiting is done by direct customer contact through phone calls and community outreach events.

Utility staff members explained that the PSO marketing structure has been very effective, with some room for improvement in the rural communities that are sometimes hard to reach.

3.2.5 Planned Program Changes

The Home Weatherization program will remain largely unchanged in 2014. Program staff members indicate that the current system for identifying and recruiting eligible households is working well, and there is still plenty of market potential for the program moving forward. During 2013 there was a review process to solidify the criteria used for program quality assurance protocols. The QA/QC protocol being used in 2014 is based on clearly defined criteria for each measure type developed through this review process. There are no other major changes planned for the 2014 program year.

3.3 Energy Saving Products and Services Program

3.3.1 Program Overview

PSO's Energy Saving Products and Services (ESPS) program seeks to generate energy and demand savings for residential customers through the promotion of ENERGY STAR® qualified cooling equipment, CFLs, LEDs, window/glass door replacements, advanced power strips, and attic insulation. The purpose of this program is to provide PSO residential customers inducements for purchasing products that meet high efficiency standards.

The program has two distinct channels through which customers receive rebates or discounts. The first participation channel for the ESPS program consists of retail price discounts for qualifying CFL and LED light bulbs, as well as room air conditioners. This component of the program uses a price mark down mechanism where participating retailers advertise and offer discounted pricing for program sponsored products. The retailers are then reimbursed by PSO for the difference between the discounted price and the normal retail price. Discounted CFL sales make up the vast majority (~96%) of the 2013 ESPS program reported energy savings.

The second channel is referred to as the Individual Project Approach (IPA)[19], where participating service providers submit rebate applications to PSO on customers' behalf once they have purchased and installed qualifying equipment. Eligible measures for the Individual Project Approach component of ESPS are listed below:

- Central air-conditioning systems (CAC) – SEER 16 or higher
- Air source heat pumps (ASHP) – SEER 16 or higher
- Ground source heat pumps (GSHP) – SEER 16 or higher
- Attic Insulation - 0-7 inches pre-existing
- ENERGY STAR® windows and glass doors
- Advanced power strips

The Energy Saving Products and Services program reported energy and demand impacts for a total of 1,269 participants who received rebates through the Individual Project Approach in 2013. Of these 1,269 participants, 387 had advanced power strips

[19] The Individual Project Approach component of the ESPS program is designed to accommodate single measure installations by PSO residential customers. If a customer installs three or more eligible measures, their project falls into the Whole House Approach component of the High Performance Homes program.

installed. Additionally, 319,353 packages of CFLs/LEDs (1,409,971 individual bulbs) and 28 room air conditioners were discounted through participating retailers.

Table 3-32 provides a summary of program metrics for the 2013 program year. Program costs were approximately $266,000 more than budgeted, while reported kWh savings significantly exceed program projections. The large difference between projected and reported impacts for the program is explained by much of the program funding being dedicated to the Lighting Discounts component of the program. This differs from the projected savings estimates, which were modeled under the assumption of retail lighting inducements representing a much smaller fraction of program funding. Funds were reallocated based on feedback from participating retailers and program staff, who believed there was more potential for CFL and LED sales through the program than was originally budgeted. Additionally, program participation in the Individual Project Approach started off slower than expected.

Gross verified energy savings developed through ADM's impact evaluation were slightly lower than reported savings, representing a gross realization rate of 98.7%. Verified peak demand reduction represents 94.1% of reported values.

Table 3-32: Performance Metrics – Energy Saving Products & Services Program

Metric	PY2013
Number of Customers	320,650[20]
Budgeted Expenditures	$4,151,699
Actual Expenditures	$4,418,045
Energy Impacts (kWh)	
Projected Energy Savings	10,569,444
Reported Energy Savings	63,502,307
Gross Verified Energy Savings	62,687,594
Net Verified Energy Savings	43,822,868
Peak Demand Impacts (kW)	
Projected Peak Demand Savings	2,290
Reported Peak Demand Savings	9,610
Gross Verified Peak Demand Savings	9,041
Net Verified Peak Demand Savings	6,357
Benefit / Cost Ratios	
Total Resource Cost Test Ratio	3.97
Utility Cost Test Ratio	3.11

[20]This program includes upstream sales of CFLs, LEDs, and room air conditioners for which the actual number of purchasing customers is not tracked. The "number of customers" in Table 3-32 represents 1,269 customers who participated in the Individual Project Approach component of the program, 387 customers who had advanced power strips installed in their homes, 319,353 packages of CFLs or LEDs marked down, and 28 room air conditioners marked down.

The remainder of this section details the EM&V methodologies and findings for the Energy Saving Products and Service program. The Lighting Discounts component is reported first in Section 3.3.2, with the Individual Projects Approach component following in Section 3.3.3.

3.3.2 Lighting Discounts Component

3.3.2.1 EM&V Methodologies

The following section details the methodologies that ADM used to verify retail sales, estimate energy and peak demand impacts, and assess the performance for the Lighting Discounts component of the Energy Saving Products and Services program.

Data Collection

A number of primary and secondary data sources were used for the evaluation. Tracking data and supporting documentation for the program was obtained from the VisionDSM database. This tracking data was used as the basis for quantifying participation and assessing program impacts. Additional documentation including retailer agreements, retailer invoices, promotional event documentation and general program materials were reviewed as part of the evaluation.

Primary data collection activities included a general population telephone survey effort, in-store intercept surveys, and interviews with program staff members. The final sampling size for each primary data collection activity is presented in Table 3-33 below.

Table 3-33: Lighting Discounts Data Collection Activities

Data Collection Activities	N
CFL/LED In-Store Intercept Survey	111
CFL/LED RDD Survey	331
Program Staff Interviews	2
Total	444

The first survey effort was conducted using a Random Digit Dialing (RDD) technique, where residential customers within Oklahoma were contacted and interviewed about recent CFL and/or LED purchases. The RDD procedure was organized by zip codes, separated by PSO service territory and non-PSO service territory. The goal of the survey was to interview a sufficient number of PSO and non-PSO customers to compare recent light bulb purchasing decisions. Because customer contact information is not tracked for the upstream CFL and LED mark downs, the RDD methodology provided a cost-effective way of reaching a large number of potential program participants or representative consumers. Interviewers used screening questions to determine whether respondents were (a) a PSO or other electric utility customer, (b)

recently purchased light bulbs and (c) that the respondent had a general understanding of different light bulb technologies.[21] In total, the RDD survey was completed by 165 PSO customers and 171 non-PSO customers. The non-PSO customers were identified as being located outside PSO's service territory where a utility sponsored upstream lighting discount program is not currently active. Of the RDD respondents, 224 felt they could correctly identify different light bulb technologies, and 159 had purchased light bulbs within the past six months.

Customer intercept surveys were also conducted in retail stores during PSO sponsored lighting promotions. ADM staff members interviewed customers at the point of purchase about the number and type of lamps they purchased, their plans for installing the lamps, purchasing decisions and general awareness of the program. In total, 111 intercept surveys were completed at CFL/LED mark down retail locations in the PSO service territory. The intercept surveys focused on large retailers, where the likelihood of encountering light bulb purchasers is higher than smaller retail stores. Table 3-34 below shows the number of intercept surveys completed by retailer.

Table 3-34: Intercept Surveys Completed by Retailer

Retailer	N
Walmart	40
Home Depot	28
Lowe's	22
Sam's Club	21
Total	111

In addition to the intercept surveys at large retailers, store visits at other, smaller participating retail outlets were conducted. Discounted pricing and point-of-sale (POS) marketing materials were confirmed at all visited stores.

To inform the process evaluation, ADM conducted in-depth interviews with program staff at PSO and implementation contractors ICF and APT.

Gross Impact Estimation Methodology

Reported energy and peak demand impacts for the program were calculated using deemed per-unit impacts from the Oklahoma Deemed Savings Documents. For CFLs and LEDs, the deemed savings algorithms came from the 2013 updated Deemed Savings Documents, which reflect baseline bulb wattage changes resulting from the Energy Independence and Security Act of 2007 (EISA). ADM's evaluation consisted of (1) verifying the quantity of program eligible measures that were rebated or discounted,

[21] Customers were asked if they felt they could correctly identify a typical incandescent bulb, a CFL, and an LED if all three were place in front of them.

(2) reviewing the assumptions and inputs associated with the deemed savings values, and (3) verifying that the deemed per-unit impacts were applied appropriately.

For CFL and LED markdowns, ADM reviewed the program tracking database consisting of retailer transaction data. Important fields included: item description, number and type of lamp sold, bulb lumens, bulb wattage, program and original retail pricing, retail location, and transaction period. This tracking data was compared to participating retailer/manufacturing invoices to verify the quantity of units sold and discounted through the program. The retailer/manufacture invoices submitted to the program rebate processing center are based on actual sales transaction data from each retailer.

Gross annual energy savings for discounted CFLs and LEDs were calculated using the algorithm from the Oklahoma Deemed Savings Documents shown below.

$$kWh_{savings} = \left(\left(W_{base} - W_{post}\right)/1000\right)\ x\ Hours\ x\ ISR\ x\ IEF_E$$

Where:

W_{base} = Baseline wattage equivalent for the lumen output of purchased bulb

W_{post} = Wattage of purchased bulb

Hours = Average hours of use per year (1,023)

ISR = In Service Rate, or percentage of discounted bulbs that get installed (97%)

IEF_E = Interactive Effects Factor to account for cooling energy savings and heating energy penalties (0.96 for unknown heating fuel type).

The baseline wattage is assumed to be that of an equivalent lumen incandescent bulb up until six months after EISA regulations dictate higher efficiency bulbs, at which point EISA compliant bulbs become the baseline. The six month lag suggested by the Oklahoma Deemed Savings Documents reflects consideration of existing stock sell through for non-EISA compliant incandescent light bulbs. Table 3-35 below shows the pre-EISA and EISA tier one and two baseline wattages as outlined in the Deemed Savings Document for standard CFL bulbs.

Table 3-35: Standard CFL Baseline Wattages

Lumen Output	Incand. Equiv. Pre-EISA 2007 (Wbase)	Incand. Equiv. 1st Tier EISA 2007 (Wbase)	Effective dates for 1st Tier EISA 2007 Baselines	Incand. Equiv. 2nd Tier EISA 2007 (Wbase)	Effective dates for 2nd Tier EISA 2007Baselines
Less than 309 lumens	25	25	July 2012 to June 2020	25	July 2020
310-749 lumens	40	29	July 2014 to June 2020	12	July 2020
750-1049 lumens	60	43	July 2014 to June 2020	20	July 2020
1050-1489 lumens	75	53	July 2013 to June 2020	28	July 2020
1490-2600 lumens	100	72	July 2012 to June 2020	45	July 2020

Based on the dates of EISA Tier 1 effective dates (and the six month sell through period suggested by the Deemed Savings Documents), standard CFLs in the 1050-1489 lumen range are assumed to have a baseline wattage of 53W if sold between July and December of PY2013. Standard CFLs in the 1050 – 1489 lumen range sold during March through June of 2013 are assumed to have a baseline wattage of 75W. Similarly, CFLs in the 1490-2600 lumen range are assumed to have an EISA compliant baseline wattage of 72W in PY2013. CFLs in the lumen range of 310-1049 are assumed to have standard incandescent baseline wattages for the purposes of calculating gross impacts. Similar baseline wattage tables were used for LEDs and specialty CFLs sold through the program based on the Deemed Savings Documents.

Summer peak demand savings for CFLs and LEDs discounted through the program were also calculated using the algorithm from the Deemed Savings Documents, shown below.

$$kW_{savings} = \left(\left(W_{base} - W_{post}\right)/1000\right)\ x\ CF\ x\ ISR\ x\ IEF_D$$

Where

CF= Summer Peak Coincidence Factor (9%)

IEF_D= Interactive Effects Factor (1.53)

The cost-effectiveness testing for the program requires calculating lifetime energy savings for purchased CFLs and LEDs. Less efficient incandescent and EISA compliant halogen bulbs typically have rated lifetimes lower than CFLs and especially LEDs. As a result, it is necessary to calculate lifetime energy savings with a moving baseline as EISA Tier 1 and Tier 2 regulations become effective. For this purpose, lifetime energy savings are calculated based on the pre-EISA baseline wattages for six months after

EISA effective dates for each lumen range (to account for existing inventory depletion as described in the Oklahoma Deemed Savings Documents). Additionally, calculating lifetime energy savings requires an estimate of when the newly purchased bulbs are installed. The Deemed Savings Documents stipulate an In-Service Rate (ISR) of 97%, but this reflects the percentage of bulbs estimated to be installed eventually. Previous studies have found that immediate or first-year installation rates are general lower, as some bulbs are shelved for later use.

To estimate a first-year ISR, ADM asked intercept survey respondents to estimate the number of purchased light bulbs they plan to install within one week, and within one year. It was then assumed that the full ISR of 97% is achieved within three years.[22] The second-year ISR is assumed to be the average of the first-year ISR and the full ISR, reflecting an assumed linear rate of installation.

Net-to-Gross Estimation Methodology

The price discounts for LEDs and especially CFLs were the largest contributors to reported energy savings for PY2013, making up approximately 63% of portfolio level reported savings. Determining the net effects of the lighting discounts requires estimating the percentage of energy savings from efficient lighting purchases that would have occurred without program intervention. Ideally, participating retailers could provide light bulb sales data for non-program time periods or from similar non-program retail locations. This data would provide adequate information from which to calculate the lift in CFL and LED sales attributable to the program price mark downs. However, retailers are reluctant to release sales data for this purpose because of the possibility that the data may be exposed to competitors or otherwise misused.

As a result, evaluating the net effects of the price discounts requires estimating free ridership without non-program sales data. A number of methodologies have been used in similar evaluations across the country. One such methodology is self-report surveys with a sample of customers aimed at determining light bulb purchasing decision making characteristics. The goal of these surveys is to elicit information from which to estimate the number of bulbs that the customer would have purchased in the counterfactual scenario where CFLs and/or LEDs were not discounted. Self-report survey methods for determining free ridership are generally recognized as susceptible to certain biases and error. This may be especially true for upstream price markdown programs, where the counterfactual scenario of regular retail prices may be difficult to explain or grasp. There have been some efforts to estimate free ridership using consumer demand modeling when there is sufficient price variation within program time periods and products. These models often also consider program promotional activity and other variables besides price that may influence bulb sales. For the PY2013 PSO program, there was

[22] This three year period for achieving the full ISR is recommended by the DOE Uniform Methods Project Residential Lighting Evaluation Protocol.

insufficient price variation within program discounted bulbs to estimate such models in a robust and reliable way.

Instead, this evaluation relies on self-report survey data from two surveying efforts:

- The first survey effort was conducted using in-store intercept methods. These surveys are conducted in-person with customers purchasing qualifying lighting products from participating retailers. The advantage of this methodology is it allows for discussion at the time of purchase, when customers are most likely to adequately describe their purchase making decision process. There are however drawbacks to this approach, including the fact that obtaining large sample sizes can be costly. Conducting surveys at retail locations with inconsistent customer traffic is usually cost-prohibitive. Conducting the surveys during program sponsored promotional events is usually most cost efficient, but may lead to certain biases associated with convenience sampling.
- The second effort was conducted using a Random Digit Dial (RDD) technique. The strength of this approach is the ability to obtain a relatively large sample size cost-effectively. It also allows for responses from customers within the PSO service territory and outside the service territory (where price discounts are not currently active). This allowed for a comparison of light bulb purchasers by PSO and non PSO respondents, which provides insight to the effects of the program. The biggest drawback to the approach is respondent recall. It may be difficult to get accurate responses to questions about the number of bulbs the respondent recently purchased, for example.

Both survey methodologies were used because of their relative strengths, while acknowledging their weaknesses. Survey respondents were asked a series of questions to elicit feedback regarding influences to their light bulb purchasing decisions. Each respondent was then assigned a free ridership score based on a consistent free ridership scoring algorithm. The free ridership scoring algorithm for the in-store intercept surveys is shown on the following page in Figure 3-8. The free ridership scoring algorithm for the RDD surveys is shown in Figure 3-9.

For the intercept surveys, respondent free ridership scores were weighted by kWh savings based on the bulbs they purchased at the time of interview. Scores were then averaged to estimate program level free ridership. For the RDD survey, responses were not weighted. That is, each response had equal weight in estimating the average free ridership level for the program. The result is two separate estimates of free ridership for comparison.

For both surveys, the “behavior without discount” scoring has the primary determinate of respondents’ free ridership scores. This section asked whether the respondent would have purchased the same light bulbs if they had cost the regular retail price. This may be a question that is particularly prone to social desirability bias – the tendency to

respond in a manner that might be viewed favorably by others. For this reason, a consistency check was performed. For the intercept surveys, the consistency check was an open-ended question asking the survey taker to describe what made them select the particular bulbs for purchase. If a respondent said anything other than “definitely would not” have purchased the bulbs at retail price, the open-ended question was checked. If a respondent mentioned “price,” “good deal,” or “program promotion” as a reason for his/her purchase, it was taken to mean he/she might have overestimated their likelihood of purchasing the same bulbs at retail price. In these instances the behavior without discount score was reduced by 50% to control for this potential bias. A similar consistency check was used for the RDD survey by asking each respondent to state light bulb characteristics that are important to them when choosing between available options. If a respondent listed price as the *most* important characteristic, but then went on to indicate that they would have still purchased efficient options at full retail price, the same 50% reduction to the behavior without discount score was applied.

It is worth noting that neither survey effort attempted to measure spillover or leakage effects. It is likely that some bulbs that were discounted were ultimately installed outside PSO’s service territory, perhaps especially because certain areas around the PSO service territory do not have active utility sponsored lighting discounts. Leakage is generally considered a gross savings parameter, since the electric savings occur outside the sponsoring utility’s service area. However, it is also likely that some level of spillover and market transformation effects exist. These effects are generally considered net effects. The program discounts could conceivably influence purchasing customers to invest in other related or unrelated energy efficiency measures that are not rebated by the program. Similarly, the price discounts at participating retailers may have a downward influence on prices at non-participating retailers, which would also generate program spillover. The cost associated with measuring these impacts in a reliable manner prohibited a full spillover study. As a result, the net-to-gross ratio for the Lighting Discounts component of the program considers only free ridership, while spillover and leakage effects are assumed to offset for simplicity.

Figure 3-8: Free Ridership Scoring for Intercept Survey Respondents

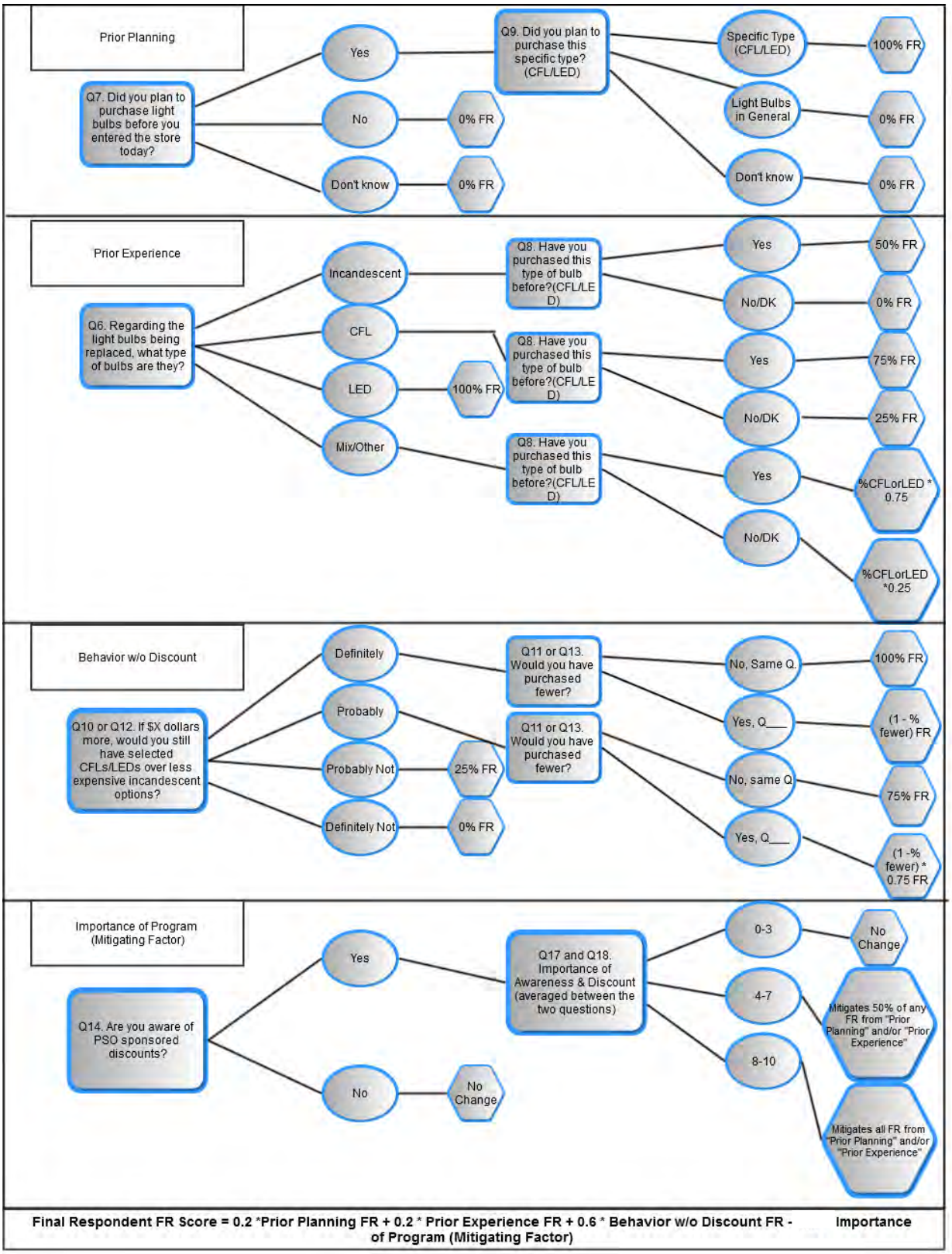
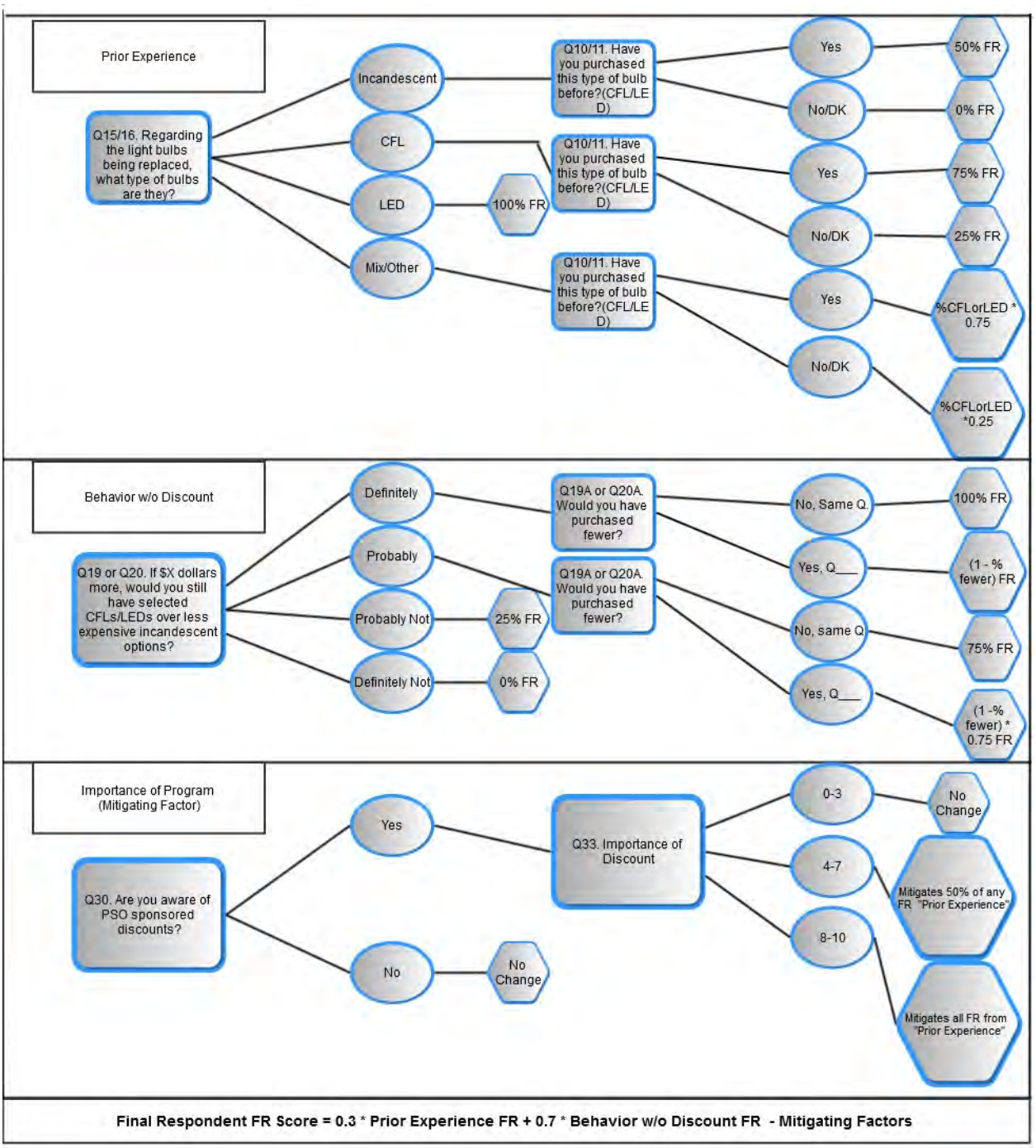


Figure 3-9: Free Ridership Scoring for RDD Survey Respondents



In addition to the two self-report survey methodologies, a third estimate of free ridership was developed based on a model that has recently been used in similar evaluations.

The model is referred to as the Revenue Neutral Sales Model,[23] which attempts to estimate a maximum free ridership value based on an assumed framework of retailer decision making. A simple explanation of the model is as follows:

- Retailers participate in the program only if their "top line" sales (revenues) will not decrease.
- In order for top line sales to not decrease, a retailer must sell a certain number *more* bulbs under program prices than they would without the buy-downs.
- Retailers take this into consideration when negotiating their agreement with the program sponsor in terms of mark down levels and quantity of bulbs to be discounted.
- By looking at the discount levels and quantities of bulbs the retailer agrees to, one can calculate the "revenue neutral" counterfactual number or bulbs that would have had to have been sold without the mark downs for revenues to remain equal.
- Subtracting the revenue neutral counterfactual sales from the actual program sales results in the net sales attributable to the program.

The model relies on at least two assumptions that must hold true in order for the model to produce meaningful results. Namely, the model is based on the following assumptions:

- Retailers will only participate in utility lighting programs if their participation is revenue neutral. This assumption implies that retailers are more interested in their "top-line" sales (within their lighting department specifically) than they are in overall profit.
- Retailers can accurately forecast lighting sales under program conditions and non-program conditions. This assumption is implied by the condition that retailers will only participate if they believe their top-line sales will be unaffected.

The Revenue Neutral Sales Model is attractive because of its simplicity, but these two assumptions might well be considered outside the normal understanding of retailer behavior. Additionally, anecdotal evidence suggests that retailer sales forecasts for lighting products might not be as accurate as the model requires for the participate/don't participate decision. The free ridership estimate developed through this model was used

[23] For a detailed explanation of the Revenue Neutral Sales Model, refer to: Tami Buhr and Stan Mertz, "The Revenue Neutral Sales Model: A New Approach to Estimating Lighting Program Free Ridership," Getting It Done! Evaluation Today, Better Programs Tomorrow, Chicago, IL: International Energy Program Evaluation Conference, August 2013.

only as an additional data point for comparison with the estimates developed through the customer self-report methodologies.

Finally, the RDD surveys included responses from customers outside the PSO service territory, where there is currently no utility sponsored lighting discount program active. This allowed for a comparison of CFL and LED sales per household as a final data point for consideration in determining a free ridership estimate.

Process Evaluation Activities

The purpose of the process evaluation for the Lighting Discounts component was to examine program operations and results, to assess how the program was designed under its new implementation contractor, and to identify any key areas that may need to be addressed in future program years.

Key research questions to be addressed by the process evaluation of the 2013 in-store lighting program include:

- How was the program promoted to retailers? Was retailer recruitment successful? What barriers to retailer participation continue to persist?
- How do customers learn about the program? Are they familiar with energy efficient lighting options and the various discounts available?
- How does the program control for savings leakage into other service territories? What other quality control procedures are in place?
- What communication between PSO, ICF, APT and customers exists? Do customers find that level of communication sufficient?
- Were there any significant obstacles during the 2013 program year? Are there any notable improvements or changes being implemented for the 2014 program year?

During the evaluation, data and information from several sources are analyzed to achieve the stated research objectives. Insight into the customer perspective on the program is developed from in-store intercept surveys and Random Digit Dialing (RDD) general population telephone surveys. The internal organization and operational efficiency of program delivery is examined through analysis of interviews conducted with PSO program staff, ICF staff, and APT staff.

3.3.2.2 Impact Evaluation Findings

Gross Energy and Peak Demand Impacts

ADM's review of retailer/manufacturer invoices for the CFL and LED lighting discounts verified that all bulbs claimed for reported savings were indeed sold and discounted through participating retailers. The invoice review process found only two discrepancies.

In one instance, 8,980 bulbs discounted through one retailer were reported as 16W CFLs, while the invoices showed that they were actually 14Ws. The other discrepancy involved 124 bulbs sold at a different retailer that were claimed as 12W standard CFLs, when they were in actuality specialty 3-way CFLs.

ADM reviewed the program tracking database and found that reported impacts were calculated in accordance with the algorithms in the Deemed Savings Documents for almost all bulbs. Each program eligible bulb was checked to determine lumen output and confirm the correct baseline wattage was applied. The two discrepancies identified through the invoice review required adjustment for baseline and actual wattages used in the calculation of energy and demand impacts. Additionally, there were 6,388 19W CFLs that were sold before July 2013 that used the EISA compliant baseline wattage of 53W. Because they were sold before July, the Deemed Savings Documents stipulates that they should be calculated with a baseline wattage of 75W to account for sell through of the remaining stock of 75W incandescent in the first half of 2013. These adjustments resulted in a small difference between reported and verified gross annual energy savings.

The Energy Saving Products and Services program also included a small number of room air conditioners that were discounted at the retail level. ADM verified that all incentivized model numbers were ENERGY STAR certified, and reviewed retailer invoices which confirmed the correct number of units was claimed. Reported savings values were reviewed and determined to be in accordance with the appropriate deemed savings. No adjustments were made to verified impacts for room air conditioners.

Based on these findings, verified gross annual energy savings for the Lighting Discounts component of the program were estimated to be 61,582,023 kWh. Verified peak demand savings were 8,638 kW. Table 3-36 compares reported and verified impact estimates for this program component.

Table 3-36: Lighting Discounts Component Impact Findings

Measure	Verified Quantity	Reported kWh	Verified kWh	Reported kW	Verified kW
CFLs	1,404,121	61,141,565	61,300,391	8,571	8,595
LEDs	5,850	277,374	277,374	39	39
RACs	28	4,258	4,258	4	4
Total	**1,409,999**	**61,423,197**	**61,582,023**	**8,613**	**8,638**

Net-to-Gross Estimation Results

The net-to gross analysis for the Lighting Discounts Component of the Energy Saving Products and Service program was conducted using the methodologies outlined in Section 3.3.2.1. The results of this analysis are summarized below.

Of the 111 intercept survey respondents, 101 purchased program discounted bulbs and completed all the questions necessary to assign a free ridership score (n=101). Each respondent's free ridership score was weighted by kWh savings based on the lighting purchases made on the day of the survey. The kWh weighted free ridership scores were then averaged to determine a program level free ridership percentage. The resulting estimate for the intercept surveys is a free ridership rate of 30.4%. Table 3-37 below shows the estimated free ridership level, by retailer.

Table 3-37: Intercept Survey Free Ridership by Retailer

Retailer	kWh Weighted Average FR Score	N	Program Bulb Purchases	kWh Savings
Home Depot	0.45	24	94	4,153
Lowe's	0.23	18	182	8,877
Sam's Club	0.32	21	160	7,147
Walmart	0.30	38	232	11,283
Total	**0.30**	**101**	**668**	**31,459**

The table above shows that Home Depot had considerably fewer bulbs purchased per survey respondent than the other three retailers. Lowe's had the highest bulbs purchased per survey respondent. The reason for this is unclear, and appears to simply be a product of the convenience sample design. There were insufficient sample sizes of LED and specialty CFL purchasers to develop separate free ridership estimates. For the few survey respondents who purchased these bulbs, free ridership scores were in line with the overall free ridership rate. Specialty CFL sales and LED sales make up less than 3% of the total Lighting Discount gross impacts.

The free ridership algorithm for the intercept surveys, as depicted in Figure 3-8 , is comprised of four components. Table 3-38 shows the average free ridership score for each component.

Table 3-38: Intercept Survey Free Ridership Component Scores

Component	Component Score
Prior Planning	0.26
Prior Experience	0.42
Behavior w/o Discount	0.36
Mitigating Factors	-0.03

One component of the intercept survey free ridership scoring algorithm that is somewhat subjective has to do with the "behavior without discount" category. Survey respondents were asked whether they would have still purchased the same program bulbs if they had been at regular retail price (the retail price was given to the respondent in the form of "$X more"). Those who responded "probably" were assigned a free ridership score of 0.75 for that category, unless they also said they would have

purchased fewer bulbs. Those who responded “probably not” were assigned a free ridership score of 0.25 for that category. The values of 0.75 and 0.25 were chosen for the purpose of symmetry, but it could be argued that 25% free ridership for those who said they probably would not have made the purchases is too high (one could also make the argument that a score of 75% for “probably” is too low). A sensitivity analysis was done to compare the free ridership under different scoring scenarios for this category. The results, shown in Table 3-39, show that the overall free ridership level is estimated between 28.7% and 32.3% depending on how the responses are scored.

Table 3-39: Sensitivity Analysis, Scoring for Behavior w/o Program

Survey Response	**N**	**Avg. FR Score, 90% for "probably"**	**Avg. FR Score, 85% for "probably"**	**Avg. FR Score, 15% for "probably not"**	**Avg. FR Score, 10% for "probably not"**	**Avg. FR Score, 15% for "probably not" and 85% for "probably"**	**Avg. FR Score, 10% for "probably not" and 90% for "probably "**
Definitely would have still purchased	20						
Would have purchased fewer	*7*						
Would have purchased the same Qty	*13*						
Probably would have still purchased	31						
Would have purchased fewer	*13*						
Would have purchased the same Qty	*18*						
Probably would not have still purchased	24						
Definitely would not have still purchased	26						
Program Free Ridership	101	32.3%	31.6%	29.2%	28.7%	31.6%	31.7%

The second self-report survey used to estimate free ridership was conducted using Random Digit Dialing (RDD) to reach the general population of Oklahoma residents (PSO and non-PSO service territory). A total of 331 respondents completed the survey, 162 of whom reported being PSO electric utility customers. A zip code lookup confirmed that reported utility company was largely accurate, though there were a small number of mismatches. No changes were made to respondent’s reported electric utility company.

Of the 162 PSO respondents, 109 reported purchasing light bulbs sometime in the preceding six months. Sixty-four of these respondents reported purchasing CFLs, LEDs or both during the preceding six months. This group of 64 respondents served as the sample for estimating free ridership according to the calculation shown in Figure 3-9. Table 3-40 below shows the results of this free ridership calculation by the type of bulbs respondents claimed to have recently purchased.

Table 3-40: RDD Survey Free Ridership Estimate

Respondent Type	N	Prior Experience Score	Behavior w/o Program Score	Mitigating Factor	Free Ridership Estimate
CFL Purchasers	33	0.49	0.44	-0.03	42.8%
LED Purchasers	20	0.32	0.37	-0.03	32.1%
Both Purchasers	11	0.31	0.22	-0.01	23.7%
Total	**64**	**0.42**	**0.38**	**-0.03**	**36.5%**

The average free ridership score for all 64 respondents was 36.5%. This is 6.1% higher than the free ridership level estimated through the intercept surveys. The RDD free ridership rate for LED purchasers is approximately 10 percentage points lower than CFL purchasers, consistent with expectations based on the higher price for LED bulbs.

Results from the RDD survey were also used to compare recent light bulb purchasing for PSO and non-PSO customers. Respondents outside of the PSO service territory were targeted in areas that currently do not have an active utility lighting discount program. Questions were asked regarding the number and types of light bulbs purchased during the preceding months. Nine survey responses were omitted for the PSO/non-PSO service area for one of the following two reasons:

- If the number of reported bulbs purchased during the preceding six months was unusually high. This was the case for five omitted responses (two PSO, three non-PSO). These respondents claimed to have purchased between 73 and 200 bulbs during analysis period. Including them in the analysis skewed the results, and did not reflect the purchasing habits of the typical household.
- If a respondent gave inconsistent responses regarding the number of bulbs purchased. This was the case for the remaining four omitted responses (two PSO, two non-PSO). The survey included two separate series of questions used to determine the number of bulbs purchased. Small discrepancies between responses were not omitted, but for these four respondents the answers to the two questions were significantly different (more than 10 bulbs).

With these nine responses omitted, the resulting sample included 158 PSO respondents and 164 non-PSO respondents. Table 3-41 below compares the findings for these two groups in terms of quantity and type of bulb purchases reported.

Table 3-41: Comparison of RDD Reported Bulb Purchases

Service Area	N	Total Bulbs Purchased	Bulbs per Respondent	Percent Incandescent	Percent CFL	Percent LED
PSO	158	1,003	6.35	60.9%	28.7%	10.4%
Non-PSO	164	1,156	7.05	65.1%	23.7%	11.2%

Both survey groups reported purchasing between six and seven bulbs on average during the preceding six months. There was a small but noticeable difference in the overall types of bulbs purchased. PSO respondents reported 4.2% fewer incandescent light bulb purchases and 5% more CFL purchases overall. LED purchases were similar across the two groups.

While the increase in CFL purchases (and corresponding decrease in incandescent purchases) is a promising sign that the program has had an effect, the overall magnitude of the difference may point to a higher free ridership level than the self-report scoring suggests. There are approximately 460,500 residential accounts serviced by PSO; if each of these households purchased 13 light bulbs during 2013 (twice the estimated bulbs per participant to account for the six month questioning timeframe), then PSO customer bulb purchases would be 5,526,000. This doesn't account for bulb purchases for new construction or non-residential purposes. A 5% increase in the percentage of CFLs purchased would mean an additional 266,300 CFLs sold, representing approximately 22% of the standard CFLs discounted through PSO's program in 2013.

Survey respondents were asked a series of demographic questions to determine how comparable the two groups are. Overall, both groups have similar characteristics in terms of housing type, household size, and household income. Table 3-54 contains a comparison of demographic information for the two groups in Section 3.3.2.3 of this report. The two groups also reported similar levels of familiarity with lighting technology and similar product characteristics that are important to their purchasing decisions. Without non-program sales data for both regions, it is difficult to tell whether the magnitude of the reported difference in CFL purchases between the two groups is biased by customer recall or other factors that may vary across the two comparison areas. As a result, the findings are not used for the final estimation of PY2013 free ridership. Monitoring the relative percentage of bulb type sales in absence of sales data may provide additional insight to the performance of the program over time.

The final free ridership estimate was developed using the Revenue Neutral Sales Model (RNSM). Allocated funding by bulb type was obtained from agreements between PSO and participating retailers/manufacturers. The number of bulbs allocated for each program eligible product was then multiplied by per-unit prices with program discounts. Table 3-42 below shows estimated total revenue for all retailers under the scenario of allocated bulb quantities being sold at program discounted prices.

Table 3-42: Revenue Neutral Sales Model – Allocated Scenario

Bulb Type	Allocated Bulbs	Average Price per Bulb with Program Mark Downs	Total Retailer Revenue (allocated quantities)
CFLs	1,498,158	$0.58	$872,337.31
LEDs	6,392	$17.30	$110,567.24
Total	**1,504,550**	**$0.65**	**$982,904.55**

According to the logic of the RNSM, retailers will not participate unless they feel they can do so without sacrificing revenue. The model relies on this assumption to calculate the number of bulbs sold under normal retail pricing required to meet the same level of revenues the retailers have implicitly agreed to by participating in the program. Table 3-43 below shows these quantities for CFLs and LEDs

Table 3-43: Revenue Neutral Sales Model – Counterfactual Non-Program Scenario

Bulb Type	Required Quantity for Revenue Neutrality	Average Retail Price per Bulb	Total Retailer Revenue (allocated quantities)
CFLs	433,946	$2.01	$872,337.31
LEDs	4,005	$27.61	$110,567.24
Total	**437,951**	**$2.24**	**$982,904.55**

This process sets the baseline for bulbs that would have been sold in the absence of the program. It relies heavily on the idea that retailers are concerned with top-line sales (perhaps more so than profit), and that they are able to accurately forecast sales under program and non-program conditions. The final step in calculating the RNSM free ridership level involves calculating the energy savings for the 437,951 bulbs that would have been sold under non-program conditions according the model. Using the same per-unit deemed savings values as used for the gross impact analysis, the counterfactual scenario would result in 18,718,794 kWh annual savings. This represents a free ridership rate of 30% of the verified gross savings (61,582,023 kWh). According to the RNSM, this is a maximum free-ridership level because retailers would not participate if it was any higher and the program discounts caused revenue to drop.

Final Net-to-Gross Ratio – Lighting Discounts

The discussion above outlines the results of three efforts to understand the level of attribution appropriate for the energy savings resulting from discounted upstream light bulb sales through the program. Both self-report survey methodologies resulted in similar estimates of free-ridership (30.4%, 35.6%); the RNSM suggested that maximum free ridership should be 30%. The comparison area analysis suggested that all three

methods may underestimate free ridership. Ultimately, the free ridership estimate developed through intercept surveying was chosen to calculate verified net savings for CFLs. The benefit of discussing the purchasing decision at the point of sale likely outweighs the drawback of an imperfectly random sample. For LEDs, the intercept surveys did not provide an adequate sample size to calculate a separate free ridership estimate. However, the RDD survey provides some evidence that the free ridership level is lower for LEDs as might be expected given the higher upfront costs. As a result, the free ridership level for LEDs was reduced by 11.2% (the difference between LED only and CFL only free ridership estimates from the RDD survey).

The measure level net-to-gross ratios are calculated as 1- estimated free ridership. The final net-to-gross ratios and associated net savings for each measure in the upstream sales component of the program are shown in Table 3-44. Room air conditioners are assumed to have a net-to-gross ratio of 1.0.

Table 3-44: Verified Gross and Net Impacts – Lighting Discounts

Measure	Verified Gross kWh	Verified Gross Peak kW	NTGR	Net kWh	Net Peak kW
CFLs	61,300,391	8,595	69.6%	42,665,072	5,982
LEDs	277,374	39	80.8%	224,118	32
RACs	4,258	4	100%	4,258	4
Total	**61,582,023**	**8,638**	**69.7%**	**42,893,448**	**6,018**

3.3.2.3 Process Evaluation Findings

This section presents the core process related findings derived from the following data collection activities:

- Intercept surveys with purchasing customers at participating retail locations,
- Random Digit Dial surveys conducted with Oklahoma residents, and
- In-depth interviews conducted with PSO and third party implementation staff members involved in the Lighting Discounts program component.

Intercept Survey Findings

ADM conducted interviews in-person with customers purchasing efficient lighting from participating retailers during late 2013 and early 2014. The interviews were conducted during PSO sponsored lighting promotions which allowed for access to the retail locations and browsing customers. Key findings from these interviews are summarized below.

- **Almost all purchased bulbs were reportedly going to be installed in a residential setting.** Intercept survey respondents were asked where they planned

to install the bulbs they were purchasing on the day of the survey. Only three respondents indicated that they were going to be installed in a business or non-residential setting. Five customers said they would be installed in an apartment or condominium, while the remaining 105 respondents said the bulbs would be installed in a single family detached home or duplex.

- **Most bulb purchases were for immediate installation.** Survey respondents were asked to describe when they plan to install the bulbs they were purchasing. As shown in Table 3-45, just over 50% planned to install all of the bulbs within one week of purchase.

Table 3-45: Installation Timing

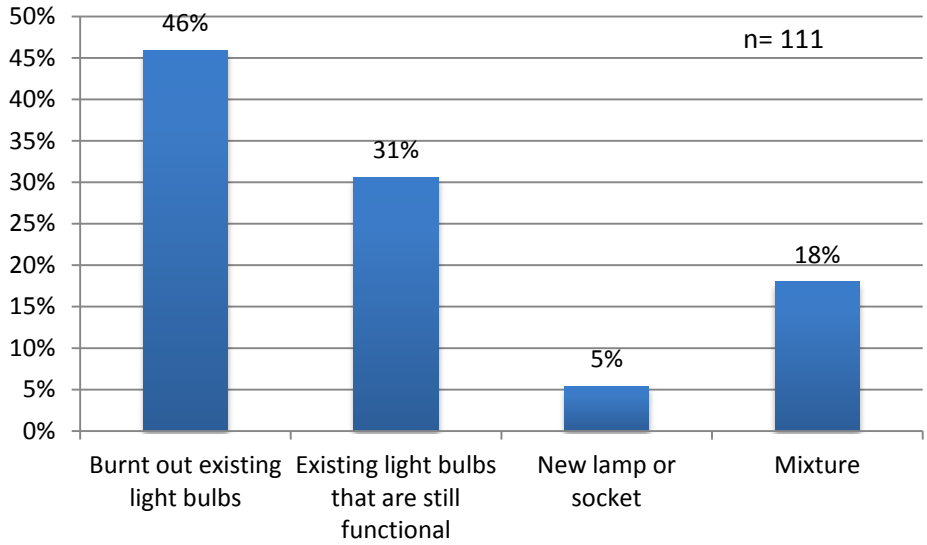
Response (n=111)	Q2: When do you plan to install the light bulbs you are purchasing?
Plan to install all within one week of purchase	52.25%
Plan to install some and shelve remainder for installation at later date	36.04%
Plan to shelve all for installation at later date	11.71%

Customers who indicated they planned to shelve some or all of the bulbs for a later installation date were asked how many bulbs they plan to install within one week and then within one year. Overall, survey respondents reported anticipating installing approximately 75% of purchased bulbs within one year of purchase. This is within the range of common first-year installation rates from evaluations of upstream lighting programs in other parts of the country. A first-year installation rate less than 100% is common because consumers often wait until an existing bulb burns out before installing a newly purchased bulb. For the purpose of estimating verified annual energy savings, ADM's impact evaluation used an in service rate of 97%, as suggested in the Oklahoma Deemed Savings Documents. This is consistent with recent evaluation protocols which suggest recognizing that purchasing customers tend to install virtually all bulbs eventually.[24]

- **Most bulbs were reportedly purchased to replace burnt out existing bulbs.** That said, a large portion was also reportedly going to replace existing bulbs that were still functional (Figure 3-10).

[24] As an example, the DOE Uniform Methods Project Residential Lighting Evaluation Protocol suggests assuming that 99% of bulbs are installed within three years. See: http://energy.gov/sites/prod/files/2013/05/f0/53827-6.pdf

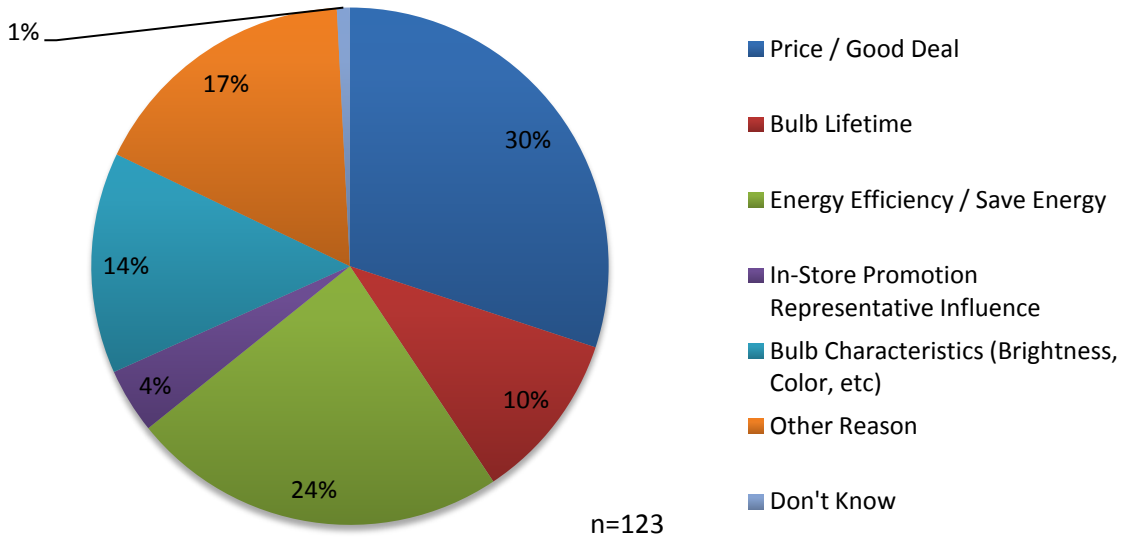
Figure 3-10: Bulb Replacements



Respondents who indicated a "mixture" replacement scenario most commonly reported the bulbs would replace 50% burnt out existing bulbs and 50% still functioning bulbs.

- **Customer awareness of program discounts is low.** Only eight of the 111 intercept survey respondents said they were aware that PSO is sponsoring discounts for energy efficient light bulbs sold in the store where the interview took place. Of the eight respondents who were aware, only three said they knew about the discounts before entering the store. One respondent said they became aware of the discounts through PSO's website, while the others cited in-store signage and marketing materials or an in-store promotional event representative.
- **Pricing and energy efficiency were the most commonly reported reasons for purchasing program discounted bulbs.** An open ended question at the end of the survey asked customers to describe in their own words what influenced them to pick the specific light bulbs they chose. For program discounted bulbs, the most commonly cited reason was "price" or "good deal" or a similar response. Energy efficiency was also highly cited. In Figure 3-11, responses are categorized into a few commonly reported areas. Some responses suggested that more than one category had an influence. These responses are included in more than one category where appropriate (thus, the number of reasons listed is 123, while the number of respondents to the question is 102).

Figure 3-11: Reasons for Specific Bulb Choices



Responses in the "Other Reason" category typically reflected situations unique to the respondent, such as "wanted a different shade of light and they fit in my fan" or "a friend suggested the bulb." Another reason that falls into the "other" category is any variation of "I needed a new light" or "light bulbs burned out." There were four respondents who only gave this simplified explanation.

Random Digit Dial (RDD) Survey Findings

In addition to the store intercept surveys, ADM conducted a general population survey with Oklahoma residents using random digit dialing. The numbers dialed were selected to be in one of two areas: PSO service territory and non-PSO service territory in an area known not to have an active utility sponsored lighting discount program. Overall, 322 respondents completed the survey. Responses were almost equally split between PSO and non-PSO customers. Findings from this comparison area survey effort are detailed below.

Awareness of available light bulb technologies is similar in both areas. Survey respondents were asked a series of questions to gauge their awareness of general light bulb technologies. When asked if they had ever heard of compact fluorescent light bulbs, over 70% of respondents in both areas answered affirmatively. PSO customers were slightly more likely to be aware of CFLs, as shown in Table 3-46.

Table 3-46: CFL Awareness

Before this call today, had you ever heard of compact fluorescent light bulbs, or CFLs?	*Utility*	*Responses*			*N*
		Yes	*No*	*Don't know*	
	PSO	73%	27%	1%	158
	Non-PSO	70%	29%	1%	164

Survey respondents were asked the same question regarding light emitting diode light bulbs, or LEDs. Again, responses were similar across the two areas. LED awareness was higher than CFLs, likely because of the numerous other technology areas that use LED technology and the more recent marketing campaigns for LED lighting.

Table 3-47: LED Awareness

Before this call today, had you ever heard of light emitting diode light bulbs, or LEDs?	*Utility*	*Responses*			*N*
		Yes	*No*	*Don't know*	
	PSO	80%	18%	2%	158
	Non-PSO	81%	17%	2%	164

The survey also asked respondents whether they felt they could accurately identify CFLs, LEDs, and incandescent bulbs if all three were placed in front of them. This question was designed to gauge how accurately survey respondents might be able to ask subsequent questions regarding recent light bulb purchases. Again, both areas had a similar distribution of responses, with PSO customers being slightly more likely to be able to identify the different bulb types. Table 3-48 shows the results for both comparison areas.

Table 3-48: Overall Light Bulb Type Recognition

Do you feel you could correctly identify a typical incandescent light bulb, CFL light bulb, and LED light bulb if all three were placed in front of you?	*Utility*	*Responses*			*N*
		Yes	*No*	*Don't know*	
	PSO	68%	23%	9%	158
	Non-PSO	65%	24%	11%	164

Finally, respondents were asked to rank their level of familiarity with household light bulb technologies. There was little difference between the two groups, with most respondents saying they were “somewhat familiar” or “very familiar” as shown in Table 3-49.

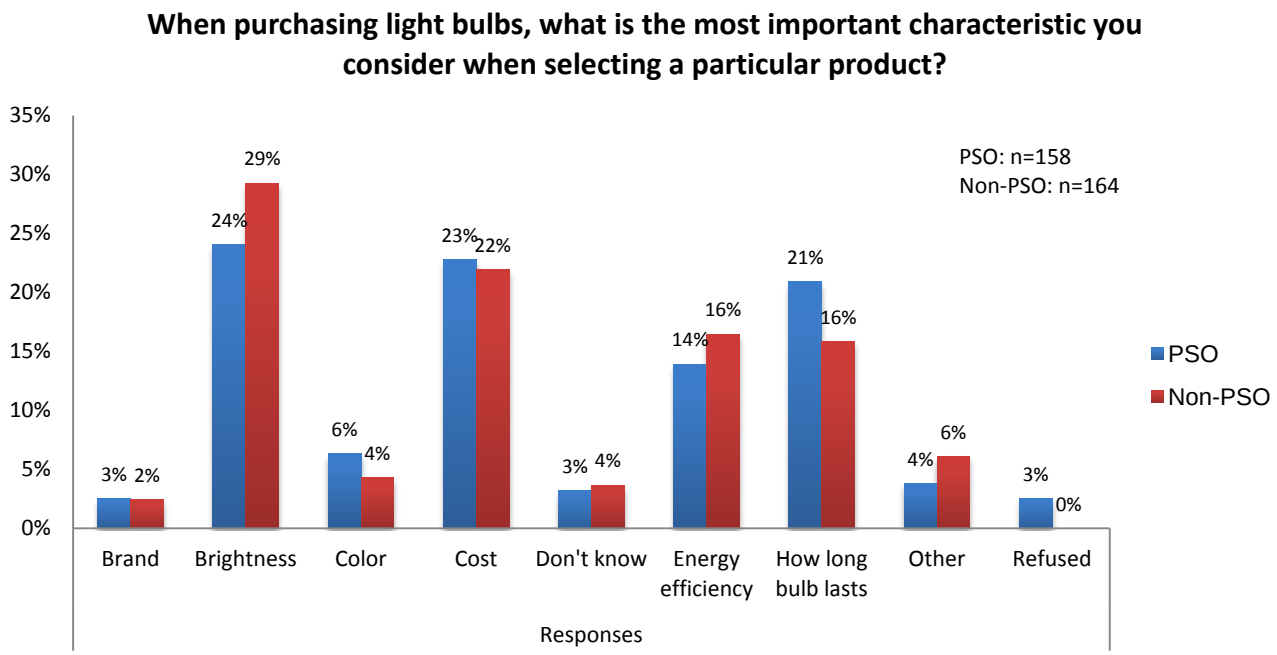
Table 3-49: Light Bulb Technology Familiarity

Would you say you are very familiar, somewhat familiar, not too familiar, or not at all familiar with currently available household light bulb technologies?	*Utility*	*Responses*					*N*
		Very familiar	*Somewhat familiar*	*Not too familiar*	*Not at all familiar*	*Don't know*	
	PSO	24%	39%	20%	16%	1%	158
	Non-PSO	24%	39%	16%	18%	2%	164

Energy efficiency is important, but customers are more likely to value price and bulb brightness. Respondents in both areas were asked to list important light bulb characteristics they consider when choosing between available products. They were then asked to choose the *most* important characteristic to their purchasing decision. As

one might expect, price of the bulb was highly cited by both groups (23% for PSO, 22% for non-PSO customers). This of course is the main barrier for energy efficient lighting technologies which the program discounts attempt to overcome. Bulb brightness, expected life, and energy efficiency were also highly cited. PSO customers were more likely to choose bulb expected life than they were energy efficiency, suggesting a possible marketing focus for the program.

Figure 3-12: Important Bulb Characteristics for Purchase Decision



Both comparison groups rated energy efficiency to be of similar importance to their purchasing decision making, as shown in Table 3-50. Using a scale of one to ten, with ten being "very important," both groups rated energy efficiency around a seven. Non-PSO respondents had a slightly higher ranking on average. The fact that respondents on average place a relatively high amount of importance on energy efficiency, yet rate cost and bulb brightness as "most important" more often, is an encouraging sign for the program. Customers may value energy efficiency, but it appears that without comparable up-front costs they may be inclined to purchase the cheapest and brightest available option.

Table 3-50: Importance of Energy Efficiency to Purchase Decision

	Utility	*Average Importance Rating*	*N*
On a scale of one to ten, where one is "not important at all" and ten is "very important," how important is energy efficiency to you when you select light bulbs for purchase?	PSO	6.9	158
	Non-PSO	7.1	164

Awareness of program discounts is low. Program design includes targeted marketing materials and point of sale signage in an attempt to educate customers of the benefits of choosing efficient lighting technology. PSO also sponsors periodic in-store promotional events to help educate customers shopping at participating retailers. Ultimately, the discounted pricing is the main mechanism for program influence, but customer education efforts are an important secondary focus. To gauge the effectiveness of these efforts, the survey included a series of questions about discount awareness.

All respondents who said they had purchased CFLs or LEDs in the past six months were asked whether they remember any products being discounted from their normal retail price. Both groups were almost equally likely to remember discounted pricing, suggesting the PSO discounts may not have stood out from other promotions.

Table 3-51: Awareness of Any Bulb Discounts

When purchasing CFL or LED light bulbs in the past six months, do you recall any of the products being discounted from their normal pricing?	*Utility*	*Responses*			*N*
		Yes	*No*	*Don't know*	
	PSO	20%	62%	18%	61
	Non-PSO	19%	64%	17%	58

Respondents who recalled discounted pricing were asked if they recall who the discounts were offered by. The responses overwhelmingly cited retailer discounts (e.g., “Walmart” or “Lowes.”). The retailers cited by PSO respondents in all instances were participating retailers (Walmart, Home Depot, and Sam’s Club were mentioned). Only one respondent mentioned PSO as the entity offering the discounts before prompting.

After being asked about discounts without prompting, all PSO customers were asked if they were aware that PSO offered in-store price discounts for efficient bulbs in 2013. Sixteen percent of PSO respondents said they were aware of the price mark downs, as shown in Table 3-52.

Table 3-52: Awareness of PSO Sponsored Discounts

In 2013, PSO discounted certain energy efficient light bulbs through participating retailers. Were you aware of these PSO lighting discounts?	*Utility*	*Responses*			*N*
		Yes	*No*	*Don't know*	
	PSO	16%	80%	3%	153

The 25 PSO customers who said they were aware of the lighting discounts were asked to identify how they learned of the discounts. In-store signage and the PSO website were highly cited. Only two customers mentioned hearing about the discounts from store employees. Nine respondents cited “other” means of awareness, which they went on to explain as either: 1) bill inserts, brochures, pamphlets, or 2) newspaper and radio advertisements. While the sample size of discount-aware respondents is small, the

results suggest that additional investment in retail salesperson training and outside-the-store advertising may be equally beneficial when compared to point-of-sale signage. Given the nature of retail workforce turnover, it might be hard to accomplish long lasting results through salesperson training. Still, where program resources allow, providing retail staff with sales strategies or incentives for promoting program eligible efficient lighting may produce additional customer awareness and sales.

Table 3-53: Source of Awareness for PSO Discounts

How did you become aware of the PSO lighting discounts?	*Utility*	*Responses*				*N*
		In-store signage/marketing materials	*Other*	*PSO website*	*Store salesperson*	
	PSO	32%	36%	24%	8%	25

Respondents from both comparison areas have a similar demographic distribution. The goal of the Oklahoma general population RDD survey was to assess whether the program had a notable influence on PSO customers as compared to a similar region known not to have utility sponsored lighting discounts. A battery of demographic questions was asked of both groups to assess the validity of the comparison. Table 3-54 shows the results for both groups. Overall, the respondent groups were highly comparable in terms of housing type, income levels, household size, and square footage of living space.

Table 3-54: PSO and Non-PSO Comparison Area Demographics

	PSO	*Non-PSO*
Type of home		
Single-family detached home	82.9%	85.3%
Single-family, factory manufactured/modular	7.0%	3.1%
Condominium	1.9%	0.6%
Single-family mobile home	1.9%	3.1%
Apartment	4.4%	6.1%
Other	1.9%	1.2%
Respondents (n)	158	163
Own or rent		
Own	85.8%	85.1%
Rent	14.2%	14.9%
Respondents (n)	155	161
Household Income		
Less than $10,000	17.1%	18.0%
$10,000 to $29,999	33.3%	34.4%

	PSO	*Non-PSO*
Household Income		
$30,000 to $49,999	16.2%	17.2%
$50,000 to $69,999	14.5%	13.1%
$70,000 to $89,999	6.8%	5.7%
$90,000 to $99,999	2.6%	3.3%
$100,000 or more	9.4%	8.2%
Respondents (n)	117	122
Estimate of above ground living space		
Mean	2,208	1,819
Respondents (n)	156	163
Household Size		
1	26.8%	31.4%
2	58.4%	45.3%
3	15.5%	10.1%
4	14.9%	8.8%
5	0.0%	3.1%
6-8	1.3%	1.3%
Respondents (n)	153	159

Overall, the RDD survey results suggest the program has had an effect, but the magnitude of the effect as compared to a non-program area is not clear. The RDD survey results showed that, on average, PSO respondents purchased approximately five percent more CFL bulbs than non-PSO respondents. A portion of survey respondents also identified program retailers as a source of discounts for efficient lighting purchased in the preceding months. Perhaps most importantly, respondents indicated that they care about energy efficiency when purchasing light bulbs, but it doesn't trump the importance of price and light bulb performance. This finding suggests that the program design is well suited to alleviate the upfront cost barrier for efficient lighting, allowing customers to then choose the energy efficient options they might prefer given equal pricing.

Still, the similarity in survey responses for the two comparison areas suggests that customers may already be inclined to purchases efficient options without program discounts. ADM recommends that PSO develop clear and measurable market transformation goals for the program. To the extent possible, market penetration of efficient bulb sales should be monitored in comparison to areas within Oklahoma that do not have utility sponsored lighting discounts.

Program Staff Interviews

ADM conducted interviews with program management staff from PSO as well as key staff members from ICF and APT, who subcontracts with ICF to implement the lighting

discounts program component. These interviews provide insight into various aspects of the program and its organization. PSO program staff members provide information regarding overall program structure and objectives, while ICF staff provides insight into additional program design considerations, retailer engagement, and other operational procedures.

The key findings from these interviews are as follows:

- **Program design was a collaborative effort between PSO and implementation staff.** APT staff reported that the program design is based both on their experience in implementing lighting programs in other regions, as well as analysis of the specific PSO customer market. Staff noted that one objective of the program is to offer products that are inclusive of the energy efficient choices that are currently available. APT attempts to appeal to the entire customer base by considering existing customer knowledge of energy efficiency and their willingness to adopt efficient lighting measures. APT staff noted that while lighting programs must be tailored to the specific service territory and are not a “one size fits all” type of offering, previous experience in similar territories has been useful in APT’s contributions to program design.
- **The available program budget affected program design.** Overall, APT staff noted that they have worked within the current program budgets to implement an effective program, but that additional features could be added with a larger budget. Specifically, staff explained that the available budget dictates the level of field service that will be available to each retail location. Thus, a larger program implementation budget allows for more quality assurance and promotional visits, which contributes to overall program success. Additionally, the available budget determines the volume of available incentives and influences the range of products that can be incentivized.

  An increased portion of the funding for the Energy Saving Products and Services Program was shifted to the Lighting Discounts component mid – 2013; this allowed APT to increase program field activity and to consider additional product discounts. APT staff reported that if this budget shift had not occurred, it may have been necessary to end discounts on some of the key products offered through the program. Based on this discussion, it appears that this program is able to effectively use additional funding towards specific operational improvements, which may be a worthwhile consideration in future program years.
- **The implementation contractor is well-suited to work with retailers.** When asked about engagement with retailers and specific retailer obligations, APT staff noted that each retailer must cooperate with program parameters in order to participate. Specifically, retailers must allow APT and PSO to place the point of purchase materials in store, and must allow the field service staff members to monitor and maintain these materials. Additionally, retailers must allow APT staff to

conduct in-store promotional demonstrations and interact directly with retail customers. Retailers must also allow APT to receive point of sale data for the discounted products in order to enable program tracking.

When asked about the relative success of working with retailers thus far, APT staff explained that APT has national agreements with many retailers at the corporate level. This mitigates most difficulties in recruiting retailers and approving APT requests. APT staff noted that although they have not created these agreements with all major retailers, they are continually involved in discussions to develop retailer relationships and further ease the implementation process.

- **Retailer distribution is designed to appeal to a wide range of customers.** When asked about the range of customers targeted by the lighting program, APT and PSO staff noted that the program seeks to offer discounts through a variety of retail types in order to appeal to several demographic areas. As different customers shop in different retail environments, the program seeks to recruit a variety of retailer types in order to cover the largest possible share of customers. For example, in some areas, one of the large do-it-yourself (DIY) stores generates a major portion of the program activity while a large “big box” retailer is used to cover a separate portion of the customer base. In order to fill additional gaps, APT has recruited dollar store retailers.

  Overall, program staff reported that the lighting program currently works with all major DIY stores and nearly all large retailers, as well as the major dollar store retailers. APT staff noted that they do not currently work with many retailers in the grocery or drug store sector, although this likely accounts for a small portion of market share. APT is working to address these sectors in order to more comprehensively target the full range of PSO customers.

- **There have been instances of non-compliant retailers.** APT noted that one of the dollar channel retailers has had difficulties in maintaining sufficient product stocking levels, which limits the retailer’s potential for generating energy savings. APT has provided this retailer with guidance, but decided to withdraw from the specific retailer after repeated attempts to bring the stores up to sufficient program compliance. This is a fairly uncommon occurrence, and APT noted that they plan to resume working with the retailer if the retailer’s ability to comply with program expectations improves.

  In terms of further retailer outreach, APT noted that one large retailer has been resistant to complying with program expectations such as allowing field staff to place signage and conduct promotional events. APT staff reported that this same retailer had presented difficulties in other service territories as well. Currently, there is no agreement with this retailer, but APT explained that ongoing conversations with the company may lead to a successful arrangement in the future.

- **The program considers high retail employee turnover rates.** When asked about the high employee turnover rates typical of retail stores, program staff noted that this

is a primary consideration within the program design. APT staff members explained that the field staff representatives visit the stores every week or every other week to provide staff with fundamental training and program awareness. Additionally, APT tracks the specific employees who receive training from field staff, and site visitations are varied throughout the daytime hours in order to reach different retail staff members.

- **The program addresses savings leakage.** Program staff explained that there are safeguards in place to minimize the potential for program savings to “leak” into other service territories. For example, the incentives are typically offered in all retail locations for a given retailer, except those that are located on the border of PSO’s service territory. APT reported that PSO reviews the list of suggested retail participants and provides feedback regarding any that should be removed due to leakage risk. This decreases the risk of a customer from the bordering service territory entering the program service territory and purchasing a discounted bulb. APT staff also noted that leakage might balance out, as it is also possible for PSO customers to enter a neighboring utility service territory, purchase a bulb, and install it back in PSO service territory.

  Additionally, implementation contractor staff explained that the limit of 12 CFLs per person is intended to both increase the number of customers who can take advantage of the program, as well as to limit the potential appeal of driving long distances (i.e. into a separate service territory) to purchase the discounted items. These aspects of program design are important for limiting savings leakage, which improves the reliability of program savings estimates.

- **Temporary pricing markdowns increase program appeal and drive sales.** APT staff noted that throughout the program year, some products will be marked down beyond the typical amounts in order to stimulate customer purchasing activity. These special markdowns are often coordinated with seasonal events such as daylight savings time or certain holidays. Program staff reported working with retailers in order to forecast sales levels and marketing seasonality, further informing the promotional schedule. This strategy can be used to increase the appeal of specific products, stimulate purchasing activity for a specific retailer type, or boost program activity in coordination with other retailer sales events.

- **Operational communications appear to be effective.** Program implementation staff and utility staff noted that communications between APT, ICF, and PSO were effective. Regular bi-weekly calls are held that serve to keep all parties updated on the current status of the program, changes to the program such as new or revised memorandums of understanding or other issues that arise. Ad hoc email exchanges and telephone calls also serve to ensure that communication between the parties is sufficient.

- **The upcoming food bank initiative addresses an important market segment.** A new component of the program for 2014 is the distribution of CFLs through food banks. The objective of this component is to distribute 75,000 CFLs at no charge to individuals receiving food from various food pantries across the service territory. APT staff noted that they have negotiated pricing with bulb manufacturers, who ship the bulbs directly to food banks. The food banks then distribute the bulbs to individual food pantries based on a list provided by APT. This list is limited to food pantries that serve PSO customers, and overall approximately 150 food pantries will be targeted.

  The bulbs are branded with PSO branding, and are shipped with informational materials to educate customers about energy usage and efficient lighting as well as inform them of the availability of the Efficiency Outreach program. Program implementation staff indicated that this is a valuable distribution channel because it is unlikely that these individuals would choose to purchase more expensive CFLs and because their greater need.

- **Program Performance exceeded expectations in 2013.** Program implementation staff and utility staff reported that the lighting program has performed as well or better than expected during the 2013 program year. APT staff noted that there had not been any specific, notable issues beyond what is expected during the first year of program operation. PSO staff reported that the program has successfully exceeded its savings goals and appears to be well-suited for meeting these goals in future operating years. As the program targets a wide variety of retail store types, it is likely that there are few gaps in terms of reaching the PSO customer base. This suggests that program awareness will continue to increase in the coming year, and that the program will continue to be well-received by the full spectrum of PSO customers.

ESPS Program Recommendations – Lighting Discounts

Based on the findings from the 2013 evaluation of the in-store lighting program, ADM makes the following recommendations:

- **Define market transformation goals.** Program staff reported that the lighting program seeks to provide discounts for a wide range of products, including both CFLs and LEDs. As LEDs have a higher price point than CFLs, the discount-to-kWh annual savings ratio is lower for LEDs. APT staff stated that the program could likely meet its goals by providing incentives only for CFLs, but that it is important to recognize the emerging technology of LEDs and encourage market transformation.

  However, as there do not appear to be specific market transformation goals for the program, the basis for paying higher incentives per kWh for LEDs is not clearly defined. If PSO, ICF, and/or APT are able to develop quantitative or qualitative

market transformation objectives for the program, this would more clearly demonstrate the value that is gained from incentivizing more costly products.

- **Add the bulb purchasing limit to all available materials.** APT staff noted that although there is technically a 12 bulb limit per customer, this rule is difficult to enforce and is not always clearly communicated to customers. For example, retailer point of sale (POS) systems will allow customers to purchase more than 12 bulbs, and the bulb limit was not listed on in-store materials for the majority of retailers. APT staff mentioned that allowing some customers to purchase more than 12 bulbs may not be a significant program issue, as customers who buy extra bulbs are likely to install them eventually.

  Program staff also noted that customers who purchase many CFLs or LEDs at once will have a steady supply of energy efficient lighting, and will not have to frequently decide between purchasing energy efficient lighting and standard efficiency lighting. However, enforcing a 12 bulb limit for customers does minimize the potential for savings leakage, and thus APT staff noted that they are currently working to add the bulb limit to in-store materials for some additional retailer chains. This should be pursued to the extent possible in order to remain consistent with program parameters.

3.3.3 Individual Project Approach (IPA) Component

3.3.3.1 EM&V Methodologies

The following section details the methodologies that ADM used to verify program participation, estimate energy and peak demand impacts, and assess program performance for the Individual Project Approach (IPA) component of the Energy Saving Products and Services program.

Data Collection

A number of primary and secondary data sources were used for the evaluation. Program tracking data and supporting documentation for the program was obtained from the VisionDSM database. This tracking data was used as the basis for quantifying participation and assessing program impacts. Additional documentation including project specific invoices, equipment cut sheets, and general program materials were reviewed as part of the evaluation.

Primary data collection used for the IPA program component included a participant telephone survey, interviews with program staff members at PSO and ICF, and interviews with participating service providers. Table 3-55 below summarizes the data collection activities for the IPA program component.

Table 3-55: Data Collection Activities – IPA Component

Data Collection Method	N
Individual Project Telephone Survey	150
Program Staff Interviews	2
Service Provider Interviews	10
Total	162

The telephone survey effort was focused on interviewing IPA participants who received rebates for installing efficient central air conditioners, heat pumps, ENERGY STAR® windows/doors and attic insulation. Program tracking data for the IPA component of the program included customer contact information and descriptions of the measures installed. Each IPA participant was assigned a random number, and the list of customers was sorted by the random number to create a prioritized call list. Ultimately, 150 surveys were completed. Table 3-56 lists the number of completed surveys by measure type.

Table 3-56: Completed Surveys by Rebate Measure

Measure	Surveys
AC/Heat Pump	85
Ground Source Heat Pump	1
Attic/Ceiling Insulation	44
ENERGY Star Windows	20
Total	150

ADM also conducted interviews with ten participating IPA service providers to elicit their feedback regarding various aspects of the program.[25] Finally, program staff members from PSO and implementation contractor ICF were conducted to elicit the program administrator perspective on program processes and operations.

Gross Impact Estimation Methodology

Projects rebated through the Individual Project Approach (IPA) component of the program make up a small percentage of program level reported impacts overall (3%). Verification activities included reviewing a census of projects and measures in the tracking system to ensure deemed savings values were calculated in accordance with the algorithms and assumptions in the Oklahoma Deemed Savings Documents. Additionally, telephone surveys with program participants were used to confirm measure

[25] These contractors were primarily interviewed as part of the process evaluation for the High Performance Homes Program. These same contractors also provide services and equipment to the Energy Efficient Products and Services Program, about which they were interviewed concurrently.

installation and develop in service rates. The program tracking data for central air conditioners and heat pumps included customer zip codes and AHRI certification numbers[26] for the rebated equipment. Tracking data for the insulation and windows included zip codes of customers and quantity of equipment installed. This allowed for verification of important deemed savings inputs including climate zone and unit efficiency levels. For more detail regarding the deemed savings algorithms for these measures, refer to Section 3.4.3.2 of this report, which details the calculations for the same measures rebated through the Whole House Approach component of the High Performance Homes program.

Net-to-Gross Estimation Methodology

Measures rebated through the program are also rebated through the High Performance Homes program whenever a customer decides to implement three or more measures at the same time (through the Whole House Approach). ADM conducted telephone surveys with 150 IPA participants in 2013. The methodology used to calculate a net-to-gross ratio is identical to that used for the Whole House Approach component of the High Performance Homes program. Refer to Section 3.4.3.1 of this report for the details of this calculation.

Process Evaluation Activities

The purpose of the process evaluation for the Individual Project Approach component was to examine program operations and results, to assess how the program has developed since the prior program cycle, and to identify any key areas that may need to be addressed in future program years.

Key research questions addressed by the process evaluation of the 2013 Individual Project Approach include:

- How was the program promoted to service providers? Was service provider recruitment successful? What barriers to service provider participation continue to persist?
- How do customers learn about the program? Are they familiar with program offerings, and the difference between the Individual Project Approach and Whole House Approach?
- What communication between PSO, ICF, and customers exists? Do customers find that level of communication sufficient?

[26] The Air-Conditioning, Heating, and Refrigeration Institute (AHRI) maintains an online database of all certified equipment at www.ahrinet.org.

- Were there any significant changes or new obstacles during the 2013 program year? Are there any notable improvements or changes being implemented for the 2014 program year?
- Looking forward, what are the key barriers and drivers to program success within PSO's market?

During the evaluation, data and information from multiple sources were analyzed to achieve the stated research objectives. Insight into the customer perspective on the program was developed from surveys with customers who participated through the IPA component in 2013. The internal organization and operational efficiency of program delivery was examined through analysis of interviews conducted with PSO program staff and ICF staff. The contractor perspective was developed from interviews conducted with participating service providers.

3.3.3.2 Impact Evaluation Findings

Gross Energy and Peak Demand Impacts

The gross impact analysis for the IPA component consisted of verifying measure installation and checking the program tracking data to ensure that deemed savings algorithms were appropriately applied. In-Service Rates (ISR) for each measure type were developed based on the findings from the participant telephone survey. Findings from these activities are summarized below for each measure type.

Central AC/Heat Pump Replacement: The Oklahoma Deemed Savings Documents specify cooling energy savings values based on climate zone, capacity, and SEER of the installed unit. The Deemed Savings Documents require that new units must have an AHRI listed SEER rating of 14.5 or higher (EER of 12 or higher). New units qualifying for deemed savings must also have a minimum cooling capacity of 1.5 tons and a maximum of 5 tons. For heat pumps, energy savings during the heating season are determined by climate zone, heating capacity, and HSPF (a minimum HSPF of 8.2 is required for the deemed savings to apply.

Eighty-five survey respondents received rebates for efficient central air conditioners or heat pumps through the IPA component in 2013. All of the surveyed respondents verified that the new systems were installed. As a result, an in service rate of 100% was applied.

ADM's review of the program tracking data found that for the most part the deemed savings were applied correctly. There was one instance where the heating energy savings for a rebated heat pump was not included in reported savings (only cooling savings were reported). There were also two instances where the reported cooling capacity did not match the model number for the rebated air conditioner. After correcting for these instances, verified savings varied only slightly from reported values.

Ground Source Heat Pumps: There were a total of four ground source heat pumps rebated through the IPA in 2013. One survey respondent installed one of the four, and verified doing so. The 2013 updated Deemed Savings Documents include algorithms for calculating heating and cooling energy savings and peak demand reduction for GSHPs. ADM reviewed the program tracking data and found that energy savings were systematically under reported. It is not clear exactly what the error in the calculation for reported savings, though it appears only heating or only cooling energy savings were claimed, rather than both. There may also be incorrect heating or cooling capacity inputs to the reported savings calculations. Peak demand reduction calculations were nearly identical to verified savings. ADM used AHRI reference numbers to verify heating and cooling capacity as well as EER and COP ratings. Overall, verified energy savings were 181% of reported values.

Electronically Commutated Furnace Fan Motors (ECMs): The program tracking listed energy savings for ECMs installed as part of 553 furnace upgrades. ECM motors are more efficient than typical permanent split capacitor motors, and produce energy savings during the winter heating season as well as during the cooling season if the fan is also the primary air mover for the cooling system. However, if the cooling system is replaced at the same time as the furnace, with incentives being paid for the cooling system upgrade, then cooling season fan energy savings should not be claimed. This is because the cooling savings are captured in the air conditioner upgraded SEER level.

ADM reviewed the tracking data for claimed ECM fan motor installations and found that for the majority of claimed installations a new program qualified central air conditioner was also installed at the same time. The reported savings included cooling energy savings in four instances, all of which included CAC replacements. For these four cases, verified energy savings were changed to only include heating savings. The rest of the claimed savings were verified to be calculated in accordance with the deemed savings documents. Overall, verified savings differed only slightly from reported values.

Attic Insulation*:* For insulation measures, deemed savings values per square foot installed are based on climate zone, heating and cooling equipment and existing level of insulation. The Residential Deemed Savings Document provides tables for each insulation type in each climate zone that present the kW and kWh savings that can be claimed per square foot of insulation improved.

Forty-four survey respondents had insulation measures installed in their homes, all of whom verified installation. ADM reviewed the savings claimed in the tracking data and did not identify any discrepancies. No adjustments were made to reported savings.

ENERGY STAR® Windows and Doors: The Oklahoma Deemed Savings Documents require climate zone designations, existing window type designations (single or double pane), HVAC system designations, and square footage of windows or doors installed in order to calculate savings.

Twenty survey respondents all verified installing windows or glass doors. A systematic error in the calculation of window and door energy and demand savings was identified through the tracking system review. The algorithm that populates the tracking system was inadvertently multiplying savings by the number of windows twice. That is, if a customer installed four windows, the tracking system multiplied by 16.

This error was detected by the program implementer early in 2014, and a fix is already in place moving forward. However, for PY2013 this error results in a realization rate of just 7.5% for both annual kWh and peak kW (windows and glass doors only).

Advanced Power Strips: The program rebated 387 advanced power strips in 2013. These strips were directly installed by program contractors on home entertainment systems. A review of the tracking system savings showed that the deemed savings for kWh and kW were appropriately applied. Given the small contribution to overall program savings, no verification efforts were performed. It is likely that some portion of the advanced power strips have been unplugged or overridden by customers, but this effect is not quantified. No adjustments to reported savings were made.

Verified Gross Impacts – Individual Project Approach

Table 3-57 compares reported and verified impacts estimated for the Individual Project Approach component of the program. Overall, the IPA component had a realization rate of 53% for annual kWh savings and 40% for peak kW reduction. The low realization rates are entirely driven by the calculation error for ENERGY STAR windows and glass doors, which has already been corrected by the program implementer for reporting future savings.

Table 3-57: Individual Project Approach – Gross Impacts

Measure	Verified Quantity	Reported kWh	Verified kWh	Reported kW	Verified kW
Central Air Conditioners / Heat Pumps	552	680,015	681,823	295	296
Ground Source Heat Pumps	4	13,613	24,665	6	6
ECM Fan Motors	553	159,594	157,985	1	0
Attic Insulation	210	106,740	106,740	45	45
ENERGY STAR Windows/Doors	1,217	1,065,208	80,418	643	49
Advanced Power Strips	387	53,940	53,940	7	7
Total	**2,370**	**2,079,110**	**1,105,571**	**997**	**403**

Net-to-Gross Estimation Results – Individual Project Approach

The net-to-gross analysis for the IPA component of the program is based on self-report survey data from 150 customers who participated in PY2013. Free ridership scores were assigned to each respondent based on their answers to a series of questions

relating to their measure installation decision making process. The scoring algorithm for the IPA survey is identical to that used for the Whole House Approach component of the High Performance Homes program, and can be found in Figure 3-15 later in this report.

The IPA participant survey also included a series of questions used to estimate participant spillover. Non-participant spillover was not quantified. The final net-to-gross ratio for the IPA component is calculated as 1 – estimated free ridership + estimated participant spillover. Responses to the participant survey resulted in estimated free ridership of 26% for the program, along with 10% participant spillover. The IPA component is thus estimated to be 84%. Table 3-58 below summarizes gross and net impacts for the IPA component.

Table 3-58: Verified Gross and Net Impacts – Individual Project Approach

Program Component	Verified Gross kWh	Verified Gross Peak kW	NTGR	Net kWh	Net Peak kW
IPA	1,105,571	403	84%	929,420	339

3.3.3.3 Process Evaluation Findings

This section presents the core findings derived from surveys conducted with participating customers, interviews conducted with participating service providers, and interviews conducted with key program operations staff members of the Individual Project Approach component within the Energy Saving Products and Services program.

A telephone survey was conducted in order to collect data about participant decision-making, preferences, and opinions of the Individual Project Approach. In total, 150 customers who had received one or more rebates through the program in 2013 responded to this survey.

Participant Awareness of the Program

When asked how they learned about PSO's energy efficiency incentives, respondents provided a wide range of responses as shown in Table 3-59. Respondents most commonly reported that they had learned of the incentives through word of mouth (36%), which suggests that program awareness is naturally developing throughout the customer market. Another 28% of respondents indicated that they had learned of the incentives through an equipment vendor or contractor, which suggests that the program's service providers are actively promoting program offerings. A smaller percentage of respondents cited other sources such as television (10%), bill inserts (7%), and other promotional channels.

Table 3-59 Sources of Initial Program Awareness

	Response	Percentage of Respondents (n = 150)
How did you hear about PSO's energy efficiency incentives?	Word-of-Mouth	36%
	Equipment vendor or contractor	28%
	TV	10%
	Bill Insert	7%
	Other	6%
	Direct Mail from electric company	5%
	Print Ad	4%
	Radio	3%
	Retail Store	1%
	PSO website	1%
	Recorded Phone Message	1%

Participant Perceptions of Program Benefits

In order to gain insight into how valuable the program has been to participants, the survey included questions focusing on the qualitative and quantitative benefits that customers may have experienced as a result of their program participation. As shown in Table 3-60, the majority of respondents (81%) reported that their home is now more comfortable to live in as a result of the energy efficiency improvements they have received through the incentive program. Only one percent of respondents indicated that their home is now less comfortable, which positively reflects on the qualitative value that the program has provided to customers.

Table 3-60 Participant Residence Comfort Level Following Participation

	Response	Percentage of Respondents (n = 150)
Would you say that the energy efficiency improvements made to your home have made it:	More comfortable to live in	81%
	Just as comfortable as before the improvements were made	16%
	Less comfortable to live in	1%
	Don't know	1%

Respondents were then asked to identify the specific benefits that they have observed in their home since participating in the Individual Project Approach. As shown in Table 3-61, respondents most commonly reiterated the fact that their home is now more comfortable. Approximately one-third of respondents reported that their appliances and heating systems are now more reliable, while 18% of respondents stated that their appliances are now quieter. Nearly one-quarter of respondents (23%) reported

benefitting from lower utility bills as a result of participating in the program. Overall, it appears that the Individual Project Approach has provided a wide range of benefits to participants, with many participants observing multiple benefits in their homes.

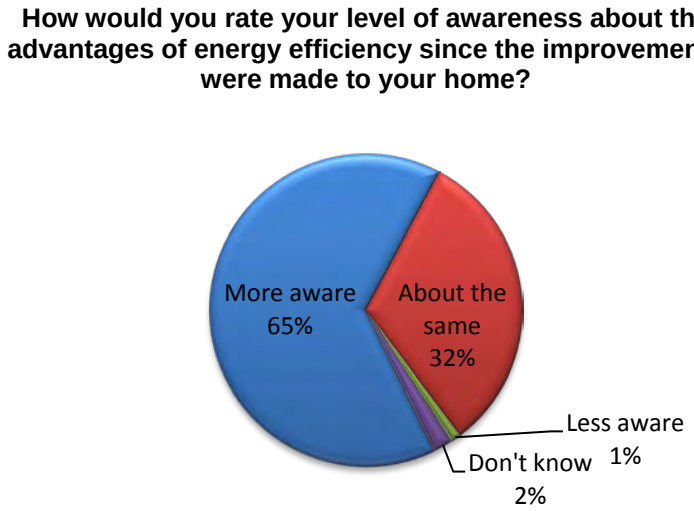
Table 3-61 Perceived Benefits Following Participation

	Response	Percentage of Respondents (n = 150)*
What are the biggest benefits you have noticed since the work was done on your home?	The home feels more comfortable	56%
	The appliances and heating or cooling equipment are more reliable	34%
	The utility bills have decreased	23%
	There is less noise from the appliances	18%
	Other	9%
	The home is safer	6%
	There have been health improvements	5%
	No benefits	3%
	Increased livable space	3%
	Don't know	2%

*Respondents were able to provide multiple responses to this question, and the percentages shown are percentages of respondents rather than percentages of responses. Thus, the total exceeds 100%.

One of the objectives of the Individual Project Approach is to encourage transformation of the PSO customer base towards higher energy efficiency engagement and awareness. When asked whether their level of awareness about energy efficiency had changed since participating in the program, approximately two-thirds of respondents reported that their awareness has increased. It is unclear whether increased awareness will cause these participants to engage in additional energy efficient behaviors or purchases, but these responses indicate that the program is providing educational benefits as well as comfort and financial benefits.

Figure 3-13 Energy Efficiency Awareness Following Participation



Participant Satisfaction with Rebated Equipment

A wide range of measure types were available for incentives through the Individual Project Approach during 2013. In order to gauge customer reception of these energy efficient measures, survey respondents were asked to rate their level of satisfaction with selected equipment types they had received through the program. Responses were provided on a five point scale ranging from 'very satisfied' to 'very dissatisfied'. As shown in Table 3-62, satisfaction levels were very high for each of the represented measure types. None of the respondents reported being at all dissatisfied with any of these specific equipment types.

Table 3-62 Participant Satisfaction with Selected Equipment Types

Equipment Type	Satisfaction Rating						N
	Very satisfied	Satisfied	Neutral	Dissatisfied	Very dissatisfied	Don't know	
Air conditioner or heat pump	85%	11%	4%	-	-	-	80
ENERGY STAR® windows/doors	85%	15%	-	-	-	-	20
Attic insulation	67%	33%	-	-	-	-	43
Ground source heat pump	-	100%	-	-	-	-	1

Respondents were also asked a general question about whether there is anything they particularly dislike about the energy efficient improvements that were installed in their homes through the program. Ninety percent of respondents indicated that there is nothing they dislike about the improvements, while the remaining ten percent were asked to report what they specifically dislike. Examples of open-ended statements provided by this 10% of respondents include:

"I can't change the filters myself."

"The speed fan is noisier. It does not cool the home as well as my other one."

"The style of insulation I chose was a loose style; it limits my ability to move around in the attic."

These comments suggest that some respondents were dissatisfied with specific aspects of measures that they had received, although the majority of comments were related to individual preferences rather than equipment failure or underperformance. It should be noted that these comments represent a small percentage of respondents.

Participant Satisfaction with Selected Program Elements

In addition to satisfaction with the equipment they had received, survey respondents were asked to rate their satisfaction with individual elements of their experience with the program. Responses were again provided on a five point scale ranging from 'very satisfied' to 'very dissatisfied'. As shown in Table 3-63, satisfaction levels were fairly high for all program elements, with few instances of reported dissatisfaction.

Respondents reported being relatively more satisfied with the installation contractors (service providers) and overall program than with the other listed program elements. The program element with the lowest overall satisfaction rating was related to the range of equipment that qualifies for an incentive check. Five percent of respondents reported a level of dissatisfaction with this program element.

Table 3-63 Participant Satisfaction with Selected Program Elements

Program Element	Satisfaction Rating (N = 150)						
	Very satisfied	Satisfied	Neither	Dissatisfied	Very dissatisfied	Don't know	Not applicable
Installation contractors (service providers)	70%	24%	1%	2%	1%	1%	1%
The program overall	51%	44%	3%	1%	1%	-	-
Application process	44%	38%	5%	1%	1%	2%	8%
Interactions with program staff	42%	30%	8%	-	-	3%	17%
Incentive amount received	42%	48%	6%	2%	1%	1%	1%
Amount of time it took to receive incentive check	41%	40%	7%	3%	1%	7%	1%
The range of equipment that qualifies for an incentive check	29%	42%	7%	4%	1%	12%	5%

Respondents who reported being dissatisfied with one or more of the listed program elements were asked to provide further information explaining their response. The summarized results of this satisfaction commentary are as follows:

- **Installation contractors:** Three percent of respondents reported a level of dissatisfaction with this program element. These respondents primarily explained that their particular installation contractor had made mistakes during the installation process or that the process had taken longer than expected.
- **The program overall:** Two percent of respondents reported a level of dissatisfaction with this program element. One of the respondents who provided further information reported that their contractor acted rudely during the site visit, while the other explained that they were dissatisfied about the equipment parameters that are required in order to receive an incentive through the program.
- **Application process:** Two respondents reported a level of dissatisfaction with this program element. Both of the respondents who provided further information indicated that they had to submit the application twice before it was approved.
- **Incentive amount received:** Three percent of respondents reported a level of dissatisfaction with this program element. All of the explanatory responses were related to participants' desire for a higher rebate, with one respondent indicating that they had received a lower rebate than expected.
- **Amount of time it took to receive incentive check:** Four percent of respondents reported a level of dissatisfaction with this program element. All of the explanatory responses indicated that the check had taken longer than expected to arrive, with participants specifically citing a waiting period of between six weeks and four months.
- **The range of equipment that qualifies for an incentive check:** Five percent of respondents reported a level of dissatisfaction with this program element. Open-ended responses mainly indicated that participants would prefer more equipment types to be incentivized, or that higher incentives should be offered.

It should be noted that the above summary represents a small percentage of respondents, and that many of the comments appeared anecdotal in nature rather than reflective of any systematic program issues. A high majority of respondents indicated that they were very satisfied with multiple or all listed program elements, and many participants provided open-ended comments praising the program. Positive comments provided by survey respondents include:

> *"I was very pleased with the program. It allowed us to get better equipment."*
>
> *"I enjoy the availability of [the program] and the ease of using it."*

"I think their offerings are great."

"Keep up the good job."

"They need to keep the program going."

"I hope that they will continue the offerings in the coming years."

Participant Residence Characteristics

In order to inform aspects of the program impact analysis and to track participant characteristics, survey respondents were asked a series of questions related to their residences. These questions addressed metrics such as the age and square footage of their home. Responses to these questions are displayed in Table 3-64 through Table 3-66 for reference purposes.

Table 3-64 Participant Residence Type

	Response	Percentage of Respondents (n = 150)
Which of the following best describes your home?	Single-family home, detached construction	95%
	Single-family home, factory manufactured/modular	3%
	Condominium	1%
	Two or Three family attached residence	1%

Table 3-65 Participant Residence Age

	Response	Percentage of Respondents (n = 150)
Approximately when was your home built?	Before 1960	25%
	1960-1969	13%
	1970-1979	15%
	1980-1989	14%
	1990-1999	21%
	2000-2005	10%
	2006 or Later	3%

Table 3-66 Participant Residence Square Footage

	Response	Percentage of Respondents (n = 150)
About how much living space do you have in your home?	Less than 1,000 square feet	4%
	1000-2000 square feet	48%
	2000-3000 square feet	29%
	3000-4000 square feet	13%
	4000-5000 square feet	4%
	Greater than 5000 square feet	3%

When asked, only four percent of respondents indicated that their home has a basement. None of these respondents provided information about the square footage of their basement. Finally, when asked whether they own or rent their home, all but one survey respondent identified themselves as a homeowner.

Overall Participant Survey Results

Overall, the results of the participant survey suggest that participants are highly satisfied with their experiences in the Individual Project Approach and that they have perceived several qualitative and quantitative benefits as a result of their participation. There were few instances of reported dissatisfaction with equipment or with aspects of their program experience, and many participants praised the program's educational and financial value.

Program awareness appears to be growing throughout the service provider and customer market, and may be more influential than direct marketing materials. Some participants have installed additional energy efficient equipment as a result of participating in the program, and the majority of participants reported that they are more familiar with the advantages of energy efficiency as compared to before they participated.

Service Provider Interviews

A total of ten registered service providers were interviewed about their participation in PSO's residential energy efficiency programs. Generally, the service providers helped PSO customers to obtain rebates for energy efficiency measures through either the Whole House Approach component of the High Performance Homes program or through the Individual Project Approach component of the Energy Saving Products and Services program. That is, the service providers worked with customers installing single measures and customers installing multiple measures or whole house retrofits.

To avoid redundancy, the findings from the service provider interviews are presented in the section for High Performance Homes within this report. The findings presented

represent service providers' perspectives on both the IPA and WHA components. Details can be found in Section 3.4.3.3.

Interviews with Program Staff

ADM conducted interviews with program management staff from PSO as well as key staff members from ICF, the Individual Project Approach implementation contractor. These interviews provide insight into various aspects of the program and its organization. PSO program staff members provide information regarding recent organizational and procedural improvements that have been implemented in order to enhance program efficiency and effectiveness, while ICF staff provides insight into additional program design considerations, service provider engagement, and other operational procedures.

The key findings from these interviews are as follows:

- **The overall program transition has been beneficial.** 2013 marked the first year of this program iteration, as previous years had involved a different set of offerings operated by a different implementation contractor. Program staff reported that the design of the 2013 program had been somewhat of a collaborative process between PSO and ICF. ICF provided analysis of the PSO customer base and assisted in redesigning the program to match the market. Discussions between ICF and PSO were focused on identify the range of possible program offerings and the participation potential for individual programs.

  PSO staff explained that during the transition to the new program designs in early 2013, customers and service providers reported certain changes as unclear or complicated. After conducting a focus group with contractors towards the end of 2013, PSO decided to simplify certain programs requirements and create a unified set of offerings that would be more appealing to the market. Program marketing in 2013 and 2014 is conducted by VI Marketing and Branding, which works with PSO and ICF to develop promotional materials and unify PSO programs under the "Power Forward" brand. Program staff reported that overall, the changes that have been made to the PSO energy efficiency portfolio of programs have been positive. Contractors appear to understand the incentive structure and the differences between the Individual Project Approach and the Whole House Approach.

- **The program has a straightforward customer facing structure.** The Individual Project Approach was designed to focus on individual product retrofits, while customers who were seeking multiple upgrades or a whole house project would be able to receive increased incentives and additional measures by transitioning into the Whole House Approach component. Although the Whole House Approach component and Individual Project Approach were designed as operationally separate within PSO, customer-facing materials present the available measure offerings as a tiered incentive schedule that increases if more than three measures

are implemented. This was designed to minimize confusion among customers while providing offerings that would satisfy a wide range of customer needs.

- **Operational communications appear to be effective.** In terms of communication between PSO and ICF, the two parties have both regularly scheduled discussions as well as ad hoc communications regarding program updates. ICF sends PSO monthly data reports listing program participants, incentivized measures, current savings levels, and budget information. Additionally, the program has bi-weekly conference calls to discuss program updates. Both PSO and ICF staff reported that the level of communication between the two parties is currently sufficient, and that they have actively collaborated since the inception of the new programs.
- **Program branding is now unified in order to increase market appeal.** Program staff reported that unifying PSO's energy efficiency portfolio of programs under a single brand identity has greatly improved the portfolio's market appeal and customer awareness of programs. Information about all of PSO's incentive offerings and other energy efficiency services are centrally located on a single website (www.powerforwardwithpso.com), and all program marketing materials contain the "Power Forward" branding. The website not only contains descriptive information about program structures, but also provides a list of eligible service providers and a link to the PSO Online Energy Check-up tool. This unifying approach is a primary aspect of the transition to the 2013-2015 program cycle, which focuses on a simplified set of program offerings that is more approachable than previous iterations.
- **Service provider recruitment has been successful, with potential for growth.** In terms of recruiting service providers for the Individual Project Approach, program staff reported that this process had been fairly successful but that there is still room for improvement. For example, the program currently works with the three largest HVAC contractors in the PSO service territory, but has the potential to recruit smaller service providers and service providers that implement other measure types. Specifically, program staff noted that they are focusing on recruiting contractors who implement fewer than 20 HVAC systems per year, as many of these have not yet enrolled. Additionally, ICF is working to introduce HVAC-only contractors to the whole house component of the High Performance Homes program in order to expand their services and generate additional savings.
- **Persisting program perceptions may act as a barrier to service provider participation.** When asked about any barriers to service provider participation, program staff explained that the past program requirements were perceived as too difficult or stringent by many service providers, and that this perception may have persisted into the 2013 program year. According to program staff, the improvements made to the program for the 2013-2015 program cycle have for the most part resolved these perceived issues. For example, the minimum SEER requirement for

air conditioner or heat pump replacement was increased from 14.5 to 16 in 2013, resulting in some service providers suggesting opportunities for program participation and energy savings were constrained. In 2014, the minimum SEER requirement has been lowered to offer rebates for customers at the SEER 15 level who are still choosing above code options. Thus, one objective of current service provider recruitment is to show prospective service providers how their concerns have been addressed.

- **Improving service provider relationships may increase program success.** When asked about potential improvements to the service provider recruitment process, program staff noted that service providers typically work well with individuals who share their background with regard to specific equipment types. For the Individual Project Approach, this could involve sending field staff members that have previous HVAC contracting experience to speak with prospective HVAC service providers.

  PSO staff noted that this type of common contracting background can be very useful for engaging service providers and explaining the structure and requirements of a program. Overall, program staff emphasized the importance of building effective working relationships between service providers and implementation contractor staff in order to build the service provider network and encourage proactive service provider participation.

- **Further service provider education is needed and planned.** Another objective for developing working relationships with service providers is to educate them about building science and teach them how to use energy efficiency as a selling tool. Program staff noted that some service providers are more actively interested in energy efficiency than others, and that those who understand the scientific background to the program offerings are typically better equipped to promote incentives and work with prospective participants.

- **Proactive responses to service provider feedback are crucial.** As one of the main objectives of the program transition for 2013-2015 was to streamline the programs and reduce confusion, program staff emphasized the importance of continually assessing contractor perceptions of the program and promptly making improvements to program clarity and efficiency where necessary. For example, program staff reported that the transition to an online application for the program increased operational efficiency, but may have been viewed by service providers as an unconventional change.

  A paper application was implemented in 2013, but this was done after the cooling season. Since then, service providers have access to both the paper application and the online application, allowing for project submittal in the way that suits them best. These types of minor changes are designed to ease the burden on service providers

and further clarify program structure in order to strengthen the service provider network.

- **Performance struggled during 2013.** The Individual Project Approach component of the ESPS struggled to meet its goals for the 2013 program year. Program staff noted that this was partially due to difficulties in recruiting a sufficient level of new service providers since many of the highest volume service providers transitioned to selling the Whole House Approach. The Manual J requirement was also a barrier for some service providers and the 16 SEER minimum requirements seemed to limit participation for split system ACs and heat pumps from certain manufacturers. Program staff also indicated that articulating high efficiency value propositions to customers was difficult for some service providers (particularly smaller companies). Additionally, some service providers felt the application process was overly burdensome. For these reasons, program participation from customers was lower than expected, and customers expressed higher interest in either the Whole House Approach of the High Performance Homes program or the in-store lighting discounts component of the ESPS. Thus, PSO decided to allocate a larger portion of the ESPS budget towards the Lighting Discounts component in order to assist in meeting program goals and accommodate customer preferences.

  The Lighting Discount component was able to use this funding to implement additional product discounts and generate higher participation levels. Program staff reported that expectations are optimistic for the Individual Project Approach in the 2014 year, as PSO and ICF are continuing to educate and recruit service providers as well as increase customer program awareness.

- **Efficient electric water heaters and solar screens added as new measures for 2014.** Program staff reported that an electric water heater rebate and a solar screens rebate have been added to the program offerings for 2014, although thus far there have been no rebate recipients for this measure. Due to precautions against fuel switching, the addition of the water heater incentive had been somewhat challenging. The 2014 incentive for a single electric water heater replacement is currently set at $80, and is included on the list of eligible measures on the PSO program website.

ESPS Program Recommendations – Individual Project Approach

Based on the findings from the 2013 evaluation of the Individual Project Approach, ADM makes the following recommendation:

- **Ensure accurate savings calculation procedures.** Overall there was a high level of accuracy in applying appropriate inputs for the calculation of deemed savings. One notable exception is for ENERGY STAR windows and glass doors. After reported savings had been finalized for program year 2013, the program implementer discovered an error in the calculation of energy savings and demand

reductions for this measure. ADM's impact evaluation confirmed the error, resulting in a realization rate of just 7.5% for these measures. This error involved multiplying the per-unit savings by the quantity two times, rather than once. Since identifying the error, ICF has corrected the algorithms that populate the program tracking system, and it should not be an issue moving forward. Still, as the ESPS program matures it is important to monitor the tracking system and the underlying inputs/algorithms, especially if there are changes to measures offered.

3.3.4 Program Level Energy and Demand Impacts

The Lighting Discounts and Individual Project Approach components combine to create the Energy Savings Products and Services program as shown in PSO's original program filings. Combining the two program components together, verified gross annual energy savings are estimated at 62,687,594 kWh (a realization rate of 98.7% as compared to reported savings). Verified peak demand reduction is estimated at 9,041 kW representing a realization rate of 94%. Program level reported and verified savings by component are shown in Table 3-67 below.

Table 3-67: Program Level Gross Impacts

Program Component	Reported Energy Savings (kWh)	Reported Peak Demand Savings (kW)	Verified Gross Energy Savings (kWh)	Verified Gross Peak Demand Savings (kW)
Lighting Discounts	61,423,197	8,613	61,582,023	8,638
Individual Project Approach	2,079,110	997	1,105,571	403
Total	**63,502,307**	**9,610**	**62,687,594**	**9,041**

Table 3-68 and Table 3-69 summarize the verified net impacts of the complete Energy Saving Products and Services program. Overall, the evaluation estimates a program level net-to-gross ratio of 0.70.

Table 3-68: Verified Gross and Net kWh Savings

Program Component	Free Ridership	Participant Spillover	NTGR	Verified Gross Annual Energy Savings (kWh)	Net Savings (kWh)
Lighting Discounts	30%	Not Measured	0.70	61,582,023	42,893,448
Individual Project Approach	26%	10%	0.84	1,105,571	929,420
		Total	**0.70**	**62,687,594**	**43,822,868**

Table 3-69: Verified Gross and Net Peak kW Reduction

Program Component	Free Ridership	Participant Spillover	NTGR	Verified Gross Peak Demand Reduction (kW)	Net Reduction (kWh)
Lighting Discounts	30%	Not Measured	0.70	8,638	6,018
Individual Project Approach	26%	10%	0.84	403	339
		Total	**0.70**	**9,041**	**6,357**

3.3.5 Planned Program Changes

The Energy Saving Products and Service program will remain largely unchanged in 2014. The primary driver of energy and demand savings continues to be the upstream lighting discounts in the early part of the year. One new feature of the lighting discounts program is the addition of a food bank distribution channel. PSO will provide a designated number of CFLs for distribution through local food pantries in the PSO service territory. The goal of the program is to reach lower income PSO customers who otherwise might be unable to afford energy efficient lighting options.

The Individual Project Approach component will have some minor changes as well, including eliminating the advanced power strips measure and adding rebates for efficient electric water heaters and solar screens. The program qualification requirements for residential cooling equipment have been changed from a minimum SEER of 16 to a minimum SEER of 15.

3.4 High Performance Homes Program

3.4.1 Program Overview

PSO's High Performance Homes program seeks to generate energy and demand savings for residential customers through the promotion of comprehensive efficiency upgrades to building envelope measures and HVAC equipment for both new construction homes and retrofits to existing homes. Offering PSO customers direct inducements for higher efficiency measures offsets the first cost obstacle, encouraging customers to choose the upgraded products. The program can essentially be divided into two components: New Homes and the Whole House Approach (WHA).

The New Homes component provides home builders with inducements for increasing building envelope, HVAC system, and lighting efficiency for homes built in the PSO service territory. Inducements are paid to builders based on the estimated kWh savings relative to a baseline International Residential Code (IRC) 2009 reference home. Specifically, builders can receive $0.50 per estimated kWh saved plus the performance bonuses listed below. The maximum inducement a builder can receive is $1,500 per home.

- 10% kWh savings beyond IRC 2009 - $200 bonus
- 15% kWh savings beyond IRC 2009 - $250 bonus
- 20% kWh savings beyond IRC 2009 - $300 bonus
- 30% kWh savings beyond IRC 2009 - $350 bonus
- ENERGY STAR® V3.0 qualification - $100 bonus

The Whole House Approach component of the program focuses on energy efficiency upgrades to existing residential homes. In order to qualify for the program in 2013, customers needed to complete three or more eligible equipment upgrades. Eligible measures include:

- Central air-conditioning systems (CAC) – SEER 14.5 or higher
- Air source heat pumps (ASHP) – SEER 14.5 or higher
- Ground source heat pumps (GSHP) – SEER 14.5 or higher
- Duct system sealing (or replacement)
- Air Infiltration reduction measures
- Attic insulation
- Exterior wall, knee wall and floor/crawlspace insulation

- ENERGY STAR® windows and glass doors
- Solar screens
- Radiant barriers
- Electronically Commutated Furnace Fan Motor (ECM)
- High Efficiency Electric Water Heater

The Whole House Approach includes a walk-through assessment from a PSO approved contractor to help identify energy efficiency measures that could improve customers' comfort level while reducing energy costs. Once the initial audit is performed, a PSO/ICF contracted employee, also referred to as PSO Home Energy Rater, will perform a diagnostic test on the home before and after installation of upgrades are made. This process is in place to measure and document efficiency gains from infiltration reduction and duct sealing measures.

In 2013, the program had a total of 792 participants who received rebates through the Whole House Approach component of the program. Additionally, participating builders completed 697 rebated homes through the New Homes component. PY2013 performance metrics are summarized in Table 3-70. Overall, reported energy savings are slightly less than projected values. Verified gross energy savings of 3,948,604 kWh represent 104% of reported values.

Table 3-70: Performance Metrics – High Performance Homes Program

Metric	PY2013
Number of Customers	1,489
Budgeted Expenditures	$4,019,037
Actual Expenditures	$4,415,459
Energy Impacts (kWh)	
Projected Energy Savings	3,973,279
Reported Energy Savings	3,798,642
Gross Verified Energy Savings	3,948,604
Net Verified Energy Savings	3,121,148
Peak Demand Impacts (kW)	
Projected Peak Demand Savings	2,549
Reported Peak Demand Savings	1,476
Gross Verified Peak Demand Savings	1,459
Net Verified Peak Demand Savings	1,156
Benefit / Cost Ratios	
Total Resource Cost Test Ratio	1.01
Utility Cost Test Ratio	0.80

The remainder of this section details the EM&V methodologies and findings for the High Performance Homes program. The New Homes component is reported first in Section 3.4.2, with the Whole House Approach (WHA) component following in Section 3.4.3

3.4.2 New Homes Component

3.4.2.1 EM&V Methodologies

This section provides a brief overview of the data collection activities, gross and net impact estimation methodologies, and process evaluation activities that ADM employed in the evaluation of the New Homes component of the High Performance Homes program.

Data Collection

For the New Homes component, the main impact evaluation activity was an engineering review of building simulation models and project documentation for a sample of program rebated homes. Data collection activities that supported the evaluation include builder interviews, verification site visits, and in-depth interviews with program staff at PSO and ICF.

The sample for the engineering review of building simulation models was designed to achieve ±10% relative precision or better at the 90% confidence interval. Table 3-71 below shows the achieved sample design.

Table 3-71: Sample Design High Performance New Homes

Stratum Number	Reported kWh Savings	Strata Boundaries (kWh)	Population Size	CV[27]	Sample Size
1	30,076	< 1,000	44	.42	5
2	728,297	1,000 – 2,000	482	.16	13
3	497,838	> 2,000	171	.30	5
Total	**1,256,211**	**N/A**	**697**	**N/A**	**23**

For each sampled home, ADM requested and received project documentation and modeling files from the program implementer. The provided materials included REM/Rate simulation files, HERS rating certificates, QA/QC field data forms, DOE2 Input files, DOE2 Output files, and DOE2 simulation files.

The documentation reviews were supplemented by ride-along field visits with the implementation contractor and interviews with builders. The ride along visits allowed

[27] The coefficient of variation (CV) used for sample design purposes was the based on the variation in reported kWh savings within each stratum: CV = σ (kWh) / μ (kWh).

ADM to observe the program data collection protocols and access the inputs to the simulation models. The builder interviews were used for the program attribution analysis and to obtain builder feedback about the program. Table 3-72 summarizes the data collection activities and sample size for the New Homes component of the program.

Table 3-72: Samples Sizes for Data Collection Efforts – New Homes

Data Collection Activity	Achieved Sample Size
New Homes: Engineering Reviews	23
New Homes: On-Site M&V	6
Builder Interviews	15
In-depth Interviews with Program Staff	2

Gross Impact Methodologies

The first step in conducting measurement of the New Homes component activity was to review program tracking data and identify the population of homes and plan types built and rebated through the program in 2013. The data tracking system was reviewed to ensure that the proper data fields required to support this evaluation as well as future evaluations were included. Furthermore, the tracking data was screened to ensure there were no duplicate entries or other inconsistencies.

After reviewing the program tracking data, establishing a program population, and pulling a sample of rebated homes for further engineering review, ADM performed the following verification steps for the 2013 analysis:

- **REM/Rate Models** –The building characteristics that form the basis of the simulation modeling for each rebated home are initially submitted by participating builders/HERS raters in the form of REM/Rate modeling files. For each sampled prototype home, the modeling inputs were verified by obtaining the original electronic data file from the builder's simulation software and updating it to match the as-built conditions observed during on-site data collection visits performed by program staff as part of program QA/QC inspections. Home orientations were confirmed using a satellite mapping system.
- **Beacon Predictive Savings Tool (Beacon PST™) Input Summaries** – The reported savings for each home rebated through the program is estimated through ICF's proprietary Beacon Predictive Savings Tool, which involves DOE2 simulation modeling and external engineering calculations. Modeling inputs are taken from the builder submitted REM/Rate files and transferred to the Beacon PST system. The project documentation for each sampled home contained savings summaries as well as input files for the REM/Rate files and the DOE2/Beacon savings tool for both as-built and baseline homes. These

modeling inputs were verified to ensure they matched the updated REM/Rate models, DOE2 output files, and the QA/QC Checklists.

- **Baseline savings assumptions** – ADM reviewed the baseline assumptions used in the DOE2/Beacon PST modeling for reported savings. The baseline modeling assumptions are outlined in Table 3-73 below. All assumptions were determined to be reasonable based on current building code and building practices in the PSO service territory.

Table 3-73: PY2013 Baseline Home Assumptions

Input	Beacon PST Reference Home	Source
Roof Solar Absorptivity	0.75	2009 IECC reference home, Table 405.5.2(1).
Attic Ins:	R-30	2009 IRC Table N1102.1 values.
Cathedral Ceiling Ins:	R-19	2009 IRC section N1102.2.2 requirements of ceilings without attic spaces.
Ceiling Insulation Grade:	2	The overall U-factor of the ceiling assembly is calculated based on RESNET standards.
Wall Construction :	2x4-16 inch on center spacing	
Wall Insulation :	R-13	2009 IRC Table N1102.1 values.
Wall Sheathing:	Plywood	2009 IRC Table N1102.1 values.
Door R:	R-2	2009 IRC Table N1102.1 fenestration requirements.
Window U	0.50	2009 IRC Table N1102.1 values.
Window SHGC	0.35	2009 IRC Table N1102.1 values.
Infiltration	7 ACH50	2009 IRC levels. This is a conservative baseline given that the OK code exempts blower-door
Mechanical Ventilation:	None	ASHRAE 62.2 Equation 4.1a rates and 2009 IECC Table 405.5.2(1) fan energy usage which uses the following equation: kWh/yr = 0.03942 × CFA + 29.565 × (Nbr +1).
Slab Edge Insulation	None	2009 IRC Table N1102.1 values.
HVAC Equipment	Central AC with Gas Furnace	
Cooling Efficiency (SEER)	13	NAECA minimum values.
Heating Efficiency (AFUE)	80	NAECA minimum values.
Duct Location	Variable	Version 3.0 of the ENERGY STAR New Homes guidelines. Dependent on number of stories and foundation type.
Duct R Value	R-8	Average of code required duct insulation values for reference home ducts located in unconditioned spaces.
Duct Leakage to Outside (CFM @ 25 Pa per 100 sq. ft.)	8 CFA	2009 IRC post-construction test requirements
DSE (Heating / Cooling)	Variable	DOE ASHRAE Standard 152 calculator.
Percent Fluorescent Lighting	50%	IRC 2009 Prescriptive Requirements

- **Beacon Predictive Savings Tool Methodology for Scheduling and Savings Calculation** – ADM reviewed the methodology provided by the implementer which detailed the assumptions and references used to estimate savings in the Beacon PST tool. The methodology provided, outlined adjustments to model inputs that impacted energy savings from: lighting, HVAC systems, and hot water systems. ADM reviewed both the references used and the assumptions made in the Beacon PST savings calculations. Both the references and assumptions were found to be reasonable and verifiable.
- **DOE2 Output and Simulation Files** – ADM generated DOE2 input files from the implementer provided DOE2 output files for each sample home. By running these recreated ex ante input files through DOE2 and then performing the model post processing according to the assumptions and algorithms detailed in the Beacon PST documentation, ADM was able to reproduce the reported energy and demand impacts for each sample home within 5%. The DOE2 model post processing included external calculations for domestic hot water energy usage and HVAC Distribution System Efficiency (DSE). While these components impact energy usage in the homes, they are not included in the DOE2 modeling software. Therefore, the energy impacts of both the domestic hot water systems and the HVAC DSE are accounted for through additional calculations made after the DOE2 simulations have been completed.

For homes where a discrepancy was found between either 1) the REM/Rate model and the QA/QC paperwork or 2) the Beacon PST and REM/Rate models, ADM adjusted the DOE2 input file and ran the model and post processing methodology to generate the verified energy and demand impacts. In all sampled homes that were adjusted, both the reference and rated home models were re-run to eliminate discrepancies in savings estimates due to differences in post processing methodologies.

Using the hourly outputs from the DOE2 models, verified gross peak demand reduction was calculated as the difference between the baseline and as-built homes' demand between 2PM and 9PM on weekday non-holidays, June through September.

Realization rates were calculated for kWh and kW savings. Results from the review of sampled projects were extrapolated to the population of participating homes using kWh and kW weights for each sampling strata.

Net-to-Gross Estimation

ADM interviewed participating builders to estimate a Net-to-Gross ratio for the New Homes component of the High Performance Homes program. The Net-to-Gross analysis was restricted to estimating free ridership only. Spillover was not considered for the New Homes component of the program based on feedback from participating

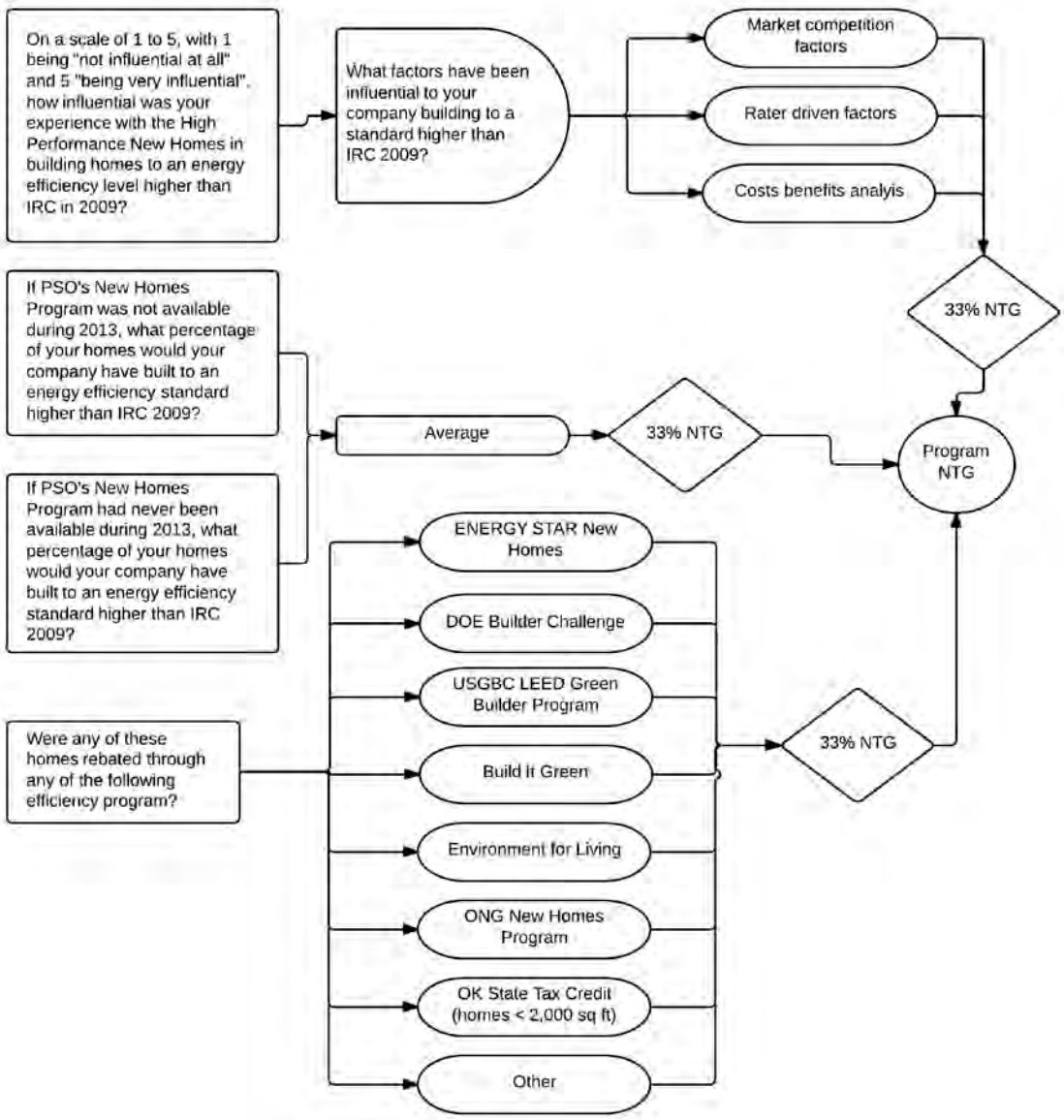
builders and program staff. Builders reported that they include energy efficiency measures designed specifically to qualify for the program for all of the homes they build within the PSO service territory. Many also suggested that outside of the PSO service territory the homes they build do not include such energy efficiency improvements. That is, their responses indicate that there are no participant spillover effects. Additionally, based on conversations with program staff, those builders who do not participate in the program often choose not to because they are not interested in adopting the required efficiency measures or undergoing the HERS rating requirements of the program. As such, anecdotal evidence suggests that non-participant spillover is likely limited or non-existent as well. The program may have some market transformation effects through builder education. These effects are not quantified for this analysis.

Free ridership scores were developed for each interviewed builder by analyzing responses to three lines of questioning: program influence, building practices in the absence of the program, and co-participation in other rebate programs. Each line of questioning was used to account for 1/3 of the overall free ridership score for each respondent. That is: Total Free Ridership = 1/3 x Program Influence FR + 1/3 x Building Practices in the Absence of the Program FR + 1/3 x Co-Participation FR. The scoring for each line of questioning is detailed below. The process is also outlined in Figure 3-14.

- **Program Influence**: Builders were asked to rate the influence of the program on their decision to build an energy efficient home. The ranking was recorded on a scale of one to five with one representing “not at all influential” and five representing “very influential”. Free ridership percentages were applied to the answer as follows; 1= 100%, 2=75%, 3=50%, 4=25%, and 5=0%. The builders were then asked to list all factors influencing in their decision to build an above code energy saving home. In cases where builders reported the program as having very little or no influence, but also reported consideration of rebate reductions to building costs, guidance from raters or program staff, or competition with other program builders as being a contributing factor, the initial free ridership score was decreased by 10 percent.
- **Building Practices in the Absence of the Program:** Builders were then asked about the percentage of homes they would have built to an above code energy standard if the PSO New Homes Program were not available during 2013. They were also asked to report the percentage of homes they would build to an above code standard if the program had never existed (to account for prior year program influence). The reported percentages from the two questions were averaged to determine a free ridership score for this line of questioning.

- **Co-participation in other Rebate Programs:** Builders were then asked about any participation in other energy efficiency new home building programs. If they did not participate in any other program a free ridership score of zero was applied for this line of questioning. If they did participate in another energy efficiency new homes program, many of which offer rebates for similar energy usage reduction measures, a free ridership score of 75% was applied.

Figure 3-14: New Homes Free Ridership Logic Chart



Process Evaluation Activities

The purpose of the process evaluation was to examine program operations and results throughout the program operating year, and to identify potential areas that may need to be addressed in order to increase program efficiency or strengthen the builder network.

Key research questions addressed through the process evaluation of the New Homes program component are listed below.

- How was the program promoted to builders? Was builder recruitment successful? What barriers to builder participation continue to persist?
- What communication between PSO, ICF, and builders exists? Do builders find that level of communication sufficient? How familiar are builders with the requirements and structure of the program?
- Were there any significant changes or new obstacles during the 2013 program year? Are there any notable improvements or changes being implemented for the 2014 program year?
- Looking forward, what are the key barriers and drivers to program success within PSO's market?

During the evaluation, data and information from several sources are analyzed to achieve the stated research objectives. Insight into the builder perspective on the program is developed from interviews with builders that participated in the New Homes component during 2013. The internal organization and operational efficiency of program delivery is examined through analysis of interviews conducted with PSO program staff and ICF staff.

3.4.2.2 Impact Evaluation Findings

Verified Gross Impacts

The engineering review in large part validated that the sampled reference homes were modeled in accordance with the building characteristics verified during implementation QA/QC field verification visits. There were some small discrepancies between on-site identified building characteristics and simulation modeling inputs, but overall the effect of these discrepancies was negligible. The efficiency measures documented during the ADM QA/QC ride-along field visits were confirmed with builders when interviewed.

Overall, verified gross energy savings are estimated at 1,232,341 kWh, as shown in Table 3-75. This represents a gross realization rate of 98%. Verified gross peak demand reduction is estimated at 432 kW, a realization rate of 93%. The difference in the reported and verified energy savings results from differing model inputs for some of the sample homes. Model inputs for verified savings were developed from QA/QC audit findings as opposed to the original REM/Rate input files provided by participating

builders. In some cases, there were discrepancies between the QA/QC audit findings and the original builder submitted input files. The specific discrepancies by sampled home are outlined in Table 3-74. Insulation R-value and home orientation changes increased the kWh realization rate while the CFL percentages decreased the realization rate.

Table 3-74: Changes to Reported Model Inputs by Sample Home

Sample Site	No changes	Internal Gains (Due to lighting %)	Orientation	Infiltration Rate	Attic Insulation	DHW Efficiency	Window U Factor/ SHGC	Site Level RR
Home001	X							100%
Home002	X							100%
Home 003		x						36%
Home 004	x							105%
Home 005	x							100%
Home 006	x							100%
Home 008					x			110%
Home 009					x	x		108%
Home 010					x			108%
Home 011					x		x	109%
Home 012		x						139%
Home 013		x			x			57%
Home 014						x		100%
Home 015	x							100%
Home 016	x							100%
Home 017	x							100%
Home 018			x	x				127%
Home 019	x							100%
Home 020		x		x		x		69%
Home 021	x							100%
Home 022	x							100%
Home 023	x							100%
Home 024	x							100%
Home 025	x							100%
Home 026	x							100%
Count	15	4	1	2	5	3	1	

The peak demand reduction realization rate was affected by similar discrepancies, as well as differing peak definitions. Verified peak demand reduction is estimated as the average kW reduction during 2 PM – 9 PM, June through September on weekday non-holidays. This is consistent with the coincident peak demand period used to estimate peak demand reduction for all non-deemed savings measures throughout this report.

Reported peak demand reduction was based on the average kW reduction at 5 PM for all weekdays in August.

Table 3-75: Reported and Verified Gross Impacts - New Homes

Component	Reported Energy Savings (kWh)	Reported Peak Demand Savings (kW)	Verified Gross Energy Savings (kWh)	Verified Gross Peak Demand Savings (kW)
New Homes	1,256,211	465	1,232,341	432

Net-to-Gross Estimation Results

Builder interviews were used to estimate net-to-gross ratios for the New Homes component of the High Performance Homes program. The methodology used for the net-to-gross analysis is described in Section 3.4.2.1.

For the New Homes program component, free ridership scores (ranging from 0 for no free ridership to 1 for complete free ridership) were determined for fifteen participating home builders, representing 81% of reported program savings. One respondent represented 25% of reported savings. This respondent's free ridership score was applied only to the savings associated with the homes they built, as they were clearly unique amongst program participants in terms of home quantity. For the remaining 14 respondents, free ridership scores were weighted by the builders kWh savings contributions to the program, then averaged to develop a New Homes component net-to-gross ratio estimate. The final component level free-ridership score was 27.3 percent.

Anecdotal evidence suggests that the magnitude of both participant and non-participant spillover is negligible. The program may have some market transformation effects, but no attempt was made to quantify these effects in terms of additional energy and demand impacts. The net-to-gross ratio for the New Homes component of the program is calculated as one minus the estimated free ridership level, resulting in a net-to-gross ratio of 72.7%.

Results from the builder interviews suggest that the new program design for the New Homes component has had a positive impact on free ridership levels. Evaluation of the program in 2012 showed that cross-program participation with the local gas utility program was a considerable source of free ridership. The 2013 builder interviews reveal that while builders are still participating in both programs, the new program qualification criteria are pushing them to focus more on achieving electric energy savings. Table 3-76 below summarizes gross and net impacts for the New Homes component.

Table 3-76: Verified Gross and Net Impacts – New Homes

Program Component	Verified Gross kWh	Verified Gross Peak kW	NTGR	Net kWh	Net Peak kW
New Homes	1,232,341	432	73%	895,631	314

3.4.2.3 Process Evaluation Findings

This section presents the key findings derived from interviews conducted with participating builders and key program operations staff members of PSO's New Homes component of the High Performance Homes program.

The purpose of the builder interviews was to better understand the builder's current building process and the role the New Homes program had in that process. In total, ADM interviewed 15 participating homebuilders. Collectively these builders accounted for 81 percent of program kWh. The key points for these interviews are outlined below.

- **Satisfaction with program elements is high among builders.** All of the builders interviewed were happy with their working relationship with both PSO and ICF. Builders stated that they were provided with the needed technical support. Builders reported appreciating receiving "immediate responses" and noted that they "always receive everything they ask for and need".
- **Builders understand the program's requirements but need additional support in order to effectively maximize kWh savings.** All of the builders seemed to understand the program requirements, although some were still relying heavily on the HERS raters to determine which measures would be needed in order to meet program requirements. The majority of builders were interested in determining the measures that would maximize their kWh savings and therefore increase their rebates. Builders were unable to identify these measures without assistance from the raters in making the changes to the REM/rate models. However, builders expressed difficulty in obtaining this support from the raters. Builders are also using raters primarily to estimate incremental costs. Incentivizing the raters to perform multiple modeling exercises on behalf the builders could increase the implementation of measures with higher kWh savings potential.
- **Builders are reporting that the REM/Rate models or building summaries are not being provided to them after they are created.** Builders are unable to verify that the inputs within the models are in line with what they are planning to build in the field. Encouraging HERS raters to providing Building Summary Reports to builders would essentially serve as an additional program quality control check.

- **The participating builders all plan to have all of their buildings qualify for the program in 2014.** All fifteen builders who responded to the interview indicated that they plan to build all of their homes to qualify for the 2014 program. Builders indicated these plans under the assumption that the qualification criteria for 2014 will be consistent with 2013.
- **Overall builders report the PSO submittal process is easy to use, although improvements can be made.** All but one of the builders who responded to the interview reported that the submission process is easy. However, builders were interested in having the system auto-fill the address and permit information in order to expedite the submission process. A few builders reported that the paperwork process was cumbersome and needed to be more streamlined. One builder reported that they received too many automatic emails and that the reminder process needed to be simplified. This builder preferred to receive one email with a list of reminders for all houses, while another builder suggested that addresses should be included next to the check numbers for all rebates.
- **Builders are using PSO provided signage and flyers but would like to see television commercials.** Builders appreciate PSO marketing materials and are providing them in their models. Flyers are being handed out by sales staff and during parade of homes events. Builders indicate that the program is adding credibility to their building designs. They would also like to see television commercials which highlight the builders that are participating in PSOs New Homes program.
- **The cost of meeting ENERGY STAR® Version 3.0 is still viewed as too high for most builders.** Currently there is only one builder in the market place participating in ENERGY STAR®. The $100.00 incentive to build to new V.3.0 standard is not considered substantial enough to cover builder cost for additional testing requirements.

ADM also conducted interviews with program management staff from PSO as well as key staff members from ICF, the implementation contractor. These interviews provide insight into various aspects of the program and its organization. PSO program staff members provided information regarding recent organizational and procedural improvements that have been implemented in order to enhance program efficiency and effectiveness, while ICF staff provided insight into additional program design considerations, builder engagement, and other operational procedures.

The key findings from these interviews are as follows:

- **Home Builders Association engagement is a core aspect of builder recruiting.** Promoting the New Homes component is largely done through the

Home Builders Association (HBA). PSO sponsors the monthly meeting of the Green Building Council, who provides a list of potential builder participants. Additionally, program staff organizes recruitment meetings and holds events in order to increase interest in the program. Program staff reported that Tulsa's HBA is one of the most well attended HBA's in the country, which benefits the program by providing access to a large number of participants. The process is the same for the smaller HBAs in areas other than Tulsa. This promotional strategy appears to be fairly effective, and PSO staff reported that builder interest has been high since program inception.

- **Builder familiarity with the program has improved, and builders are primarily focused on incentive maximization.** Program staff reported that there have been some challenges in explaining the program parameters to builders, although these issues have for the most part been addressed for the 2014 program year. Staff noted that when builders have questions, they are able to contact either PSO or ICF for assistance; the most common questions involve the program incentive amount.

  This is consistent with findings from the interviews that were conducted with builders as a part of the current evaluation. Builders most commonly reported that they needed more information regarding which measures would provide the highest rebate amount, as this information was often difficult to obtain from their HERS raters. Thus, it appears that the most commonly needed clarifications are due to imperfect communications between builders and raters, rather than a lack of information provided by PSO.

- **There are some persisting barriers to builder participation.** When asked whether there are persisting barriers to participation for some builders, program staff explained that some builders resist working with the Home Energy Rating System (HERS) raters that are required to evaluate the home's energy efficiency and code compliance. Staff noted that some HERS raters may not be actively providing builders with the energy models used to evaluate homes, which causes builders to feel somewhat uninformed throughout the assessment process.

  Additionally, program staff reported that if builders were aware of the potential energy savings they could achieve through the program, they would be more willing to actively participate. Staff noted that the incentive to HERS raters has been increased in an attempt to facilitate the relationship between the raters and builders by encouraging HERS raters to more actively share information.

- **Additional energy efficiency education is needed for realtors and appraisers.** Program staff noted that the realtors and home appraisers in the PSO service territory are typically not familiar with promoting the benefits of the New Homes program or energy efficiency in general. As knowledge of energy efficiency and familiarity with the New Homes programs among realtors and

appraisers would likely improve market awareness of the program and customer interest in energy efficient homes, PSO and ICF are planning to implement a workshop for these individuals in May of 2014. This will provide attendees with continuing education credits, and will educate them about the features and benefits of energy efficient new construction.

- **Builders are becoming more focused on electric savings.** Program staff noted that prior to the revisions to the New Homes component, builders were primarily focusing on gas savings rather than electric energy savings. This was mainly due to the local gas utility in PSO's service territory offering a high incentive for gas-efficient new homes. Program staff noted that because the PSO New Homes component now has a higher kWh focused incentive structure, builders are beginning to focus on achieving electric savings rather than exclusively pursuing gas savings. Several builders noted that they would not be focusing on electric savings without the New Homes rebates. This not only contributes to electric energy savings, but also decreases the likelihood of builder free ridership in the program.
- **Upcoming case study may expand program scope.** Program staff reported that they are currently working with a Native American community to build new homes in the PSO service territory. This consists of thorough planning discussions and a workshop that is designed to evaluate proposed building plans and determine whether the project can be completed through the High Performance New Homes Program. Currently, program staff reported that they are considering modifying the program incentive cap in this specific case, as the full project could potentially generate a very high portion of the program's savings. This initiative is considered to be a case study, and suggests that program staff is continually seeking new and unique opportunities for customer engagement and program expansion.

3.4.3 Whole House Approach (WHA) Component

3.4.3.1 EM&V Methodologies

This section provides a brief overview of the data collection activities, gross and net impact estimation methodologies, and process evaluation activities that ADM employed in the evaluation of the Whole House Approach (WHA) component of the High Performance Homes program.

Data Collection

The primary data collection activities for the WHA component of the program consisted of a participant telephone survey, in-home verification visits, in-depth interviews with program staff, and discussions with project auditors. In total, 105 participants were

surveyed by telephone and an additional 17 homes were visited for on-site verification. ADM staff also participated in ride-alongs and discussions with test-in/test-out contractors and program QA/QC staff.

Additional data reviewed included program tracking data and project documentation obtained from VisionDSM and associated SSRS reports. Table 3-77 summarizes the sample size for each data collection activity.

Table 3-77: Sample Sizes for Data Collection Efforts – Whole House Approach

Data Collection Activity	Achieved Sample Size
Participant Survey	103
On-Site M&V	17
Informal Discussions with Auditors	2
In-Depth Interviews with Program Staff	2

Gross Impact Methodologies

The methodology used to calculate energy and demand impacts consisted of verifying measure installation for a sample of program participants, reviewing deemed savings estimates for each measure as described in the Oklahoma Deemed Savings Documents, and reviewing the program tracking data to ensure that deemed savings were applied appropriately. ADM's review of the tracking data was performed to ensure correct deemed savings application for a census of projects and measures rebated through the program during PY2013.

Verification of measure installation was conducted through telephone surveys with program participants and on-site visits to participating homes. The telephone surveys included questions aimed at verifying program participation and the number and type of measures installed by program participants. During the site visits, ADM field staff verified that the claimed energy efficiency measures were installed, and recorded key inputs to savings calculations such as capacity and efficiency of HVAC equipment, and R-value and square footage of installed insulation. Data collected through these activities was used to develop measure level verification rates. The measure verification rates were then applied to the deemed savings estimates to determine verified savings.

Net-to-Gross Estimation

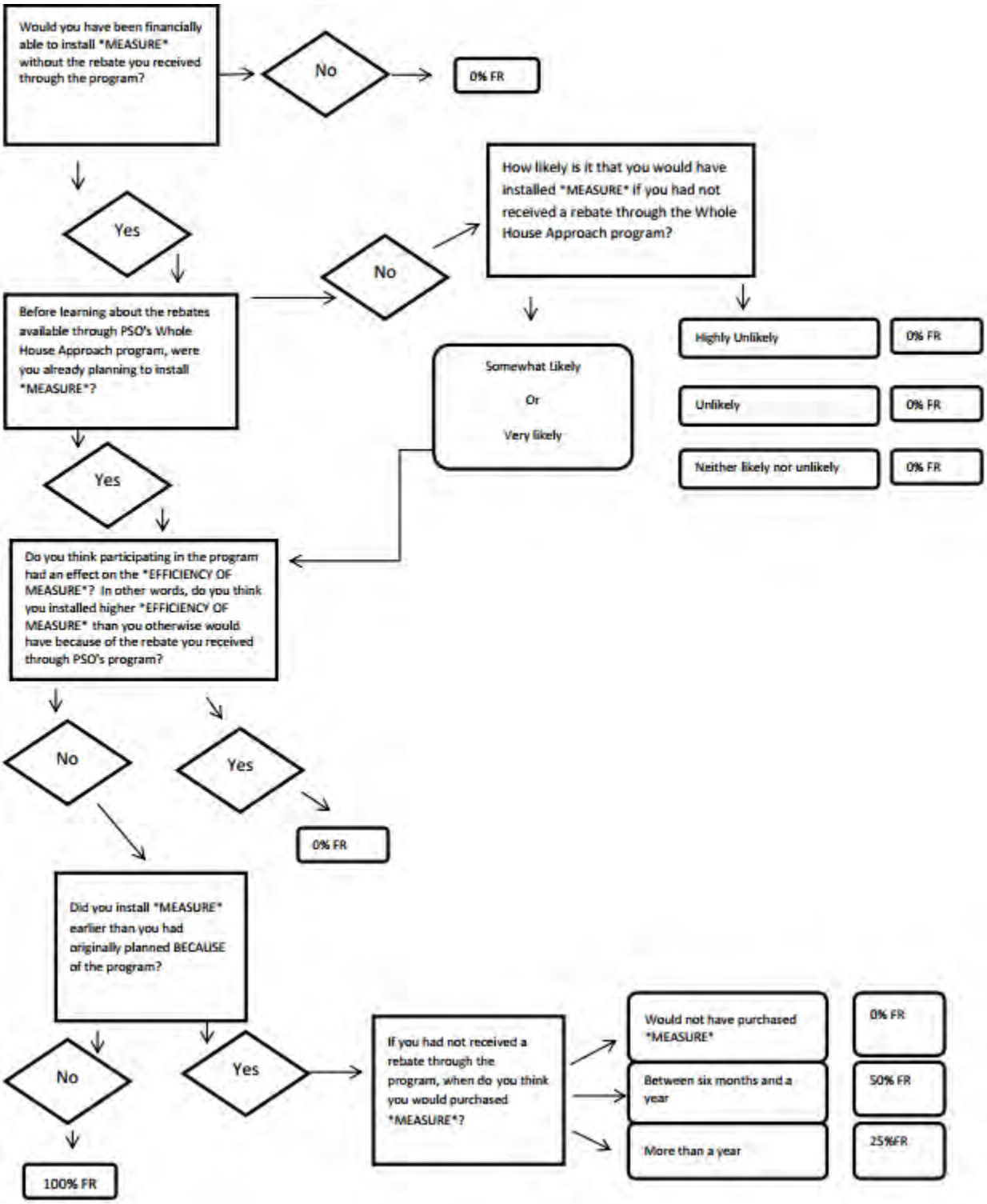
PSO customers who received rebates through the Whole House Approach component of the High Performance Homes program were surveyed and asked a series of questions aimed at estimating program attribution. A total of 103 participants completed the survey.

Survey questions regarding customers' financial ability to install the measures without rebates, planning prior to program awareness, effect of the program on efficiency levels chosen/ timing of equipment purchases, and likelihood of installing the same measures in the absence of the program were used to assess free ridership. The scoring used to determine free ridership for each respondent (by measure) is depicted in Figure 3-15 on the following page.

The participant survey also included a series of questions aimed to determine whether there were any participant spillover effects attributable to the program. First, customers were asked "Following your participation in the Whole House Approach (WHA) program, did you install any additional energy efficiency measures in your home for which you did not receive a rebate or financial incentive?" Customers who responded "no" to this question were determined to not be potential spillover candidates. If a respondent indicated that they have installed additional energy efficiency measures, they were then asked "Did your participation in the WHA program influence your decision to install the additional energy efficient upgrades in your home?" Customers who responded "yes" or "yes, very much so" were considered potential spillover candidates, and were asked to identify the additional measures they have installed.

Two respondents indicated that they had installed efficient lighting (CFLs or LEDs) in their homes. These respondents were not considered to exhibit spillover effects, because of the likelihood that the energy savings for such measures are already captured in the Energy Saving Products and Services program. For the remaining survey respondents, spillover savings were roughly estimated based on the additional measures they claimed to have installed. A program level spillover percentage was then estimated as the ratio of participant spillover kWh to total kWh for all survey respondents (net-of-free-ridership).

Figure 3-15: Free Ridership Scoring – Whole House Approach



Process Evaluation Activities

The purpose of the process evaluation was to examine program operations and results throughout the program operating year, and to identify potential areas that may need to be addressed in order to increase program efficiency or strengthen the builder network.

Key research questions addressed through the process evaluation of the WHA program are listed below.

- How was the program promoted to service providers? Was service provider recruitment successful? What barriers to service provider participation continue to persist?
- How do customers learn about the program? Are they familiar with program offerings, and the difference between the Individual Project Approach and Whole House Approach?
- What communication between PSO, ICF, and customers exists? Do customers find that level of communication sufficient?
- Were there any significant changes or new obstacles during the 2013 program year? Are there any notable improvements or changes being implemented for the 2014 program year?
- Looking forward, what are the key barriers and drivers to program success within PSO's market?

During the evaluation, data and information from several sources are analyzed to achieve the stated research objectives. The internal organization and operational efficiency of program delivery is examined through analysis of interviews conducted with PSO program staff and ICF staff. Participating Whole House Approach customers were surveyed to obtain their feedback regarding the program as well.

3.4.3.2 Impact Evaluation Findings

Verified Gross Impacts

As described in Section 3.4.3.1, the gross impact analysis consisted of verifying measure installation and checking the program tracking data to ensure that deemed savings algorithms were appropriately applied. In-Service Rates (ISR) for each measure type were developed based on the findings from the participant telephone survey and on-site visits. Findings from these activities are summarized below for each measure type.

Infiltration Reduction: The Oklahoma Deemed Savings Documents specifies the following formula for use in calculating energy and demand impacts for infiltration reduction measures. The air infiltration reduction estimate in CFM is obtained through

blower door testing performed by the program contractor for each home serviced. Only homes with electric cooling systems are eligible for the measure (central AC or room AC).

$$Deemed\ Savings\ (kWh) = CFM_{50} \times V$$

Where:

CFM_{50} = Air infiltration reduction in cubic feet per minute at 50 Pascal
V = the value in the following table that corresponds to the climate zone and heating and cooling type.

Table 3-78: Deemed Savings Table – Infiltration Reduction kWh Savings

Zone	Impact per CFM50 Reduction					
	AC/Gas Heat kWh	Gas Heat (no AC) kWh	Gas Heat (no AC) Therms	AC/Electric Resistance kWh	Heat Pump kWh	AC Peak Savings kW
Zone 9	0.1870	0.0000	0.1220	2.4696	1.5368	0.0001
Zone 8A	0.4324	0.0562	0.0835	2.0884	1.3721	0.0003
Zone 8B	0.4587	0.0536	0.0799	2.0442	1.3854	0.0002
Zone 7	0.4030	0.0407	0.0612	1.6236	1.066	0.0002
Zone 6	0.2730	0.0000	0.0600	1.3830	0.8404	0.0002

Seventy-four of the 103 participants surveyed were identified in the program tracking database as having infiltration reduction measures installed and blower-door testing performed. Seventy-two of these 74 respondents verified that air-sealing measures were installed in their homes. One participant claimed he/she did not participate in the program. Another claimed that air sealing measures were not part of the upgrades installed at their home. However, for both of these respondents ADM reviewed project documentation in the VisionDSM program database that confirmed infiltration reduction measures. The documentation included pictures of air sealing measures and pictures of blower-door test readings. It is unclear why these two respondents did not verify the air sealing measures, but evidence suggests they were indeed installed. Ten of the 17 on-site verification visits that ADM performed were homes that had infiltration reduction measures installed. In all ten cases, evidence of air-sealing measures was identified. As a result, an In-Service Rate (ISR) of 100% was applied for air sealing measures.

ADM reviewed the deemed savings values used for each home and determined they were applied correctly for the majority of homes, based on the reported infiltration reduction. For a small number of homes (37), there were errors found in the climate zone and/or heating system type listed. For two other homes, the peak kW savings

were incorrectly listed as the kWh savings. Overall, correcting these entries led to verified savings estimates slightly lower than reported values (realization rates of 96% for kWh and 98% for kW).

***Central AC/Heat Pump Replacement**:* The Oklahoma Deemed Savings Documents specify cooling energy savings values based on climate zone, capacity, and SEER of the installed unit. New units must have and AHRI listed SEER rating of 14.5 or higher (EER of 12 or higher). New units qualifying for deemed savings must also have a minimum cooling capacity of 1.5 tons and a maximum of 5 tons. Examples of the deemed cooling savings for heat pumps in climate zone 9 are shown in Table 3-79. Similarly, deemed energy savings for central air conditioners in climate zone 9 are shown in Table 3-80.

Table 3-79: Example Deemed Savings –HP Cooling kWh Zone 9

Zone 9 Heat Pump Energy Savings – Cooling Only (kWh)							
	ARI Rated BTU/Hr		SEER Range				
Size (tons)	Minimum	Maximum	14.50-14.99	15.00-15.99	16.00-16.99	17.00-17.99	18+
1.5	15,000	20,999	294	384	514	550	658
2	21,000	26,999	392	512	685	733	877
2.5	27,000	32,999	489	640	857	916	1,097
3	33,000	38,999	587	769	1,028	1,099	1,316
3.5	39,000	44,999	685	897	1,199	1,282	1,536
4	45,000	50,999	783	1,025	1,371	1,466	1,755
5	57,000	62,999	979	1,281	1,713	1,832	2,194

Table 3-80: Example Deemed Savings – CAC kWh Zone 9

Zone 9 Central Air Conditioner Energy Savings (kWh)							
	ARI Rated BTU/Hr		SEER Range				
Size (tons)	Minimum	Maximum	14.50-14.99	15.00-15.99	16.00-16.99	17.00-17.99	18+
1.5	15,000	20,999	303	389	452	623	668
2	21,000	26,999	405	518	603	831	891
2.5	27,000	32,999	506	648	754	1,038	1,114
3	33,000	38,999	607	777	905	1,246	1,337
3.5	39,000	44,999	708	907	1,055	1,453	1,560
4	45,000	50,999	809	1,037	1,206	1,661	1,783
5	57,000	62,999	1,012	1,296	1,508	2,076	2,228

For heat pumps, energy savings during the heating season are determined by climate zone, heating capacity, and Heating Season Performance Factor (HSPF). A minimum

HSPF of 8.2 is required for the deemed savings to apply. Table 3-81 below shows example deemed savings for climate zone 9.

Table 3-81: Example Deemed Savings – HP Heating kWh Zone 9

Zone 9 Heat Pump Energy Savings – Heating Only					
	HSPF Range				
Size (tons)	**8.2 - 8.3**	**8.4 - 8.5**	**8.6 - 8.7**	**8.8 - 8.9**	**9.0 - 9.1**
1.5	507	500	495	476	446
2	676	667	660	635	595
2.5	845	834	825	794	744
3	1,014	1,001	990	953	893
3.5	1,183	1,167	1,154	1,112	1,042
4	1,352	1,334	1,319	1,271	1,191
5	1,690	1,668	1,649	1,588	1,488

Eighty-eight of the 103 survey respondents had central air conditioner or heat pump retrofits as part of their participation in the program. All of the surveyed respondents verified that the new systems were installed. All 14 on-site visits involving CAC or HP replacements verified installation and correct capacity and efficiency ratings. As such, an In-Service Rate (ISR) of 100% is applied for the measures.

ADM's review of the program tracking data found that for the most part the deemed savings were applied correctly. There were however 73 instances in which either the SEER or the capacity was incorrectly input into the tracking system. Similarly, for 11 heat pumps the capacity was incorrectly listed. ADM corrected for these instances, which had very minor effects on verified savings. Overall, both CACs and HPs had realization rates between 99 and 100% for kWh and kW.

Electronically Commutated Furnace Fan Motors (ECMs): The program tracking listed energy savings for ECMs installed as part of 643 furnace upgrades. ECM motors are more efficient than typical permanent split capacitor motors, and produce energy savings during the winter heating season as well as during the cooling season if the fan is also the primary air mover for the cooling system. However, if the cooling system is replaced at the same time as the furnace, with incentives being paid for the cooling system upgrade, then cooling season fan energy savings should not be claimed. This is because the cooling savings are captured in the air conditioner upgraded SEER level.

The deemed values for furnace ECM fans as specified in the Oklahoma Deemed Savings Documents require a climate zone designation and square footage of conditioned space. ADM reviewed the tracking system and determined that in six cases, the incorrect climate zone was applied. This had a negligible effect on verified savings. The square footage of conditioned space listed in the Vision tracking system was

compared to values listed in the implementation contractor's internal data entry system and found no discrepancies. Survey respondents were also asked to provide the square footage of their homes within predetermined size bins. In all but three cases, the square footage of conditioned space listed in the tracking database matched the binned square footage given by respondents. As a result, no adjustments were made to the claimed square footage of conditioned space.

There were eight instances where cooling energy savings were claimed for installed ECMs. ADM confirmed that for seven out of the eight instances, there was no rebate offered for the installed cooling system, because it did not meet program efficiency levels. The cooling savings for the one other ECM that accompanied a program qualified central AC replacement was deducted from verified savings. Overall, verified savings differed only slightly from reported values.

Insulation and Radiant Barrier*:* For insulation measures, deemed savings values per square foot installed are based on climate zone, heating and cooling equipment and existing level of insulation. The Oklahoma Residential Deemed Savings Document provides tables for each insulation type in each climate zone that present the kW and kWh savings that can be claimed per square foot of insulation improved. Table 3-82 below is an example that shows deemed savings per square foot of attic insulation installed in climate zone 8B.

Table 3-82: Example Deemed Savings Table - Attic Insulation

Zone 8B Ceiling Insulation Deemed Savings						
Ceiling Insulation Base R-value	AC/Gas Heat kWh	Gas Heat (no AC) kWh	Gas Heat Therms	AC/Electric Resistance kWh	Heat Pump kWh	Summer Peak kW Savings
	(per sq. ft.)	(per sq. ft.)	(per sq. ft.)	(per sq. ft.)	(per sq. ft.)	(per sq. ft.)
R-0 to R-4	1.3653	0.1226	0.1433	4.1846	2.8426	0.0002
R-5 to R-8	0.7444	0.0621	0.0769	2.2625	1.5611	0.0002
R-9 to R-14	0.422	0.0345	0.0439	1.2851	0.8913	0.0002
R-15 to R-22	0.213	0.0175	0.0226	0.6593	0.4565	0.0001

Attic insulation made up approximately 70% of the claimed energy savings for insulation measures, with the rest spread between crawlspace insulation, exterior wall insulation, and knee wall insulation. Radiant barrier installation made up less than 1% of program savings.

Sixty-eight of the 103 survey respondents had insulation measures installed in their homes. All 68 verified the appropriate insulation types. ADM compared the square footage responses from the survey to claimed levels of installed attic insulation and found no instances where installed attic insulation was outside the range of survey

responses. The nine on-site verification homes that included insulation also matched expected R-values. A remaining uncertainty in the verified savings is the existing insulation levels, which outside the nine on-site visits were not verified.

The tracking database review showed that for the vast majority of homes deemed savings values for insulation were applied correctly, given the recorded existing R-value and HVAC system. Overall, verified energy and demand impacts for insulation measures were only slightly different than reported values.

Duct Sealing or Replacement: The 2010 version of the Oklahoma Deemed Savings Documents calls for the use of Frontier Associates, LLC's proprietary savings calculator in order to calculate savings for duct sealing. However, the recent 2013 updates to the Oklahoma Deemed Savings Documents include transparent savings algorithms for cooling and heating energy savings. For the Home Weatherization program, PSO reported savings based on the 2013 updated duct sealing algorithms. For the sake of consistency and transparency, the 2013 updates are also used for verified savings for the Whole House Approach. The algorithms for cooling and energy savings as listed in the 2013 Deemed Savings Documents are:

Cooling Savings:

$$kWh_{savings,C} = \frac{(DL_{pre} - DL_{post}) \times EFLH_C \times (h_{out}\rho_{out} - h_{in}\rho_{in}) \times 60}{1{,}000 \times SEER}$$

Where:

DL_{pre} =	Pre-improvement duct leakage at 25 Pa (ft3/min)
DL_{post} =	Post-improvement duct leakage at 25 Pa (ft3/min)
$EFLH_c$ =	Equivalent full load cooling hours, from table
h =	Outdoor/Indoor seasonal specific enthalpy (Btu/lb), from table
ρ_{out} =	Density of outdoor air (lb/ft3), from table Savings
ρ_{in} =	Density of conditioned air at 75°F = 0.0756 (lb/ft3) (default)
60 =	Constant to convert from minutes to hours
1,000 =	Constant to convert from W to kW
SEER =	Seasonal Energy Efficiency Ratio of existing system (Btu/W·hr) = 13 (default)

Heating Savings (Heat Pump):

$$kWh_{savings,H} = \frac{(DL_{pre} - DL_{post}) \times 60 \times 0.77 \times HDD \times 24 \times 0.018}{1{,}000 \times HSPF}$$

Where:

DL_{pre} =	Pre-improvement duct leakage at 25 Pa (ft3/min); assume 35% of fan flow if duct system cannot be pressurized
DL_{post} =	Post-improvement duct leakage at 25 Pa (ft3/min)
60 =	Constant to convert from minutes to hours
0.77=	Factor to correlate design load hours to EFLH under actual working conditions (to account for the fact that people do not always operate their heating system when the outside temperature is less than 65°F)
HDD=	Heating Degree Days, from table in Deemed Savings Document
1,000 =	Constant to convert from W to kW
HSPF =	Heating Seasonal Performance Factor of existing system (Btu/W·hr) = 7.7 (default)

Heating Savings (Electric Resistance):

$$kWh_{savings,H} = \frac{(DL_{pre} - DL_{post}) \times 60 \times 0.77 \times HDD \times 24 \times 0.018}{3{,}412}$$

Where:

DL_{pre} =	Pre-improvement duct leakage at 25 Pa (ft3/min); assume 35% of fan flow if duct system cannot be pressurized
DL_{post} =	Post-improvement duct leakage at 25 Pa (ft3/min)
60 =	Constant to convert from minutes to hours
0.77=	Factor to correlate design load hours to EFLH under actual working conditions (to account for the fact that people do not always operate their heating system when the outside temperature is less than 65°F)
HDD=	Heating Degree Days, from table in Deemed Savings Document
24 =	Constant to convert from days to hours
0.018 =	Volumetric heat capacity of air (Btu/ft3°F)
3.412 =	Constant to convert from Btu to kWh

Ninety survey respondents had either duct sealing or complete duct replacement performed at their home. All survey respondents verified having duct work done. ADM also found evidence of duct sealing at all fifteen of the on-site verification homes where it was claimed to be performed. As a result, a 100% In-Service Rate (ISR) was applied.

Reported savings were reviewed in the tracking system and determined to be based on the 2010 Oklahoma Deemed Savings Documents. For the sake of consistency with the Home Weatherization program and transparency of the savings algorithms, verified energy savings were calculated using the 2013 Deemed Savings Documents' updated

methodology. For duct sealing, ADM's application of the updated deemed savings algorithm resulted in a gross kWh realization rate of 135%. The verified kW for duct sealing resulted in a gross realization rate of 109%. Similarly, duct replacement gross realization rates came out to 136% and 102% for kWh and kW.

ENERGY STAR® Windows and Doors: The Oklahoma Deemed Savings Documents require climate zone designations, existing window type designations (single or double pane), HVAC system designations, and square footage of windows or doors installed in order to calculate savings. ADM was unable to recreate the reported savings for this measure, as the number of windows, number of glass doors, and the square footage was not clearly defined in the program tracking system. All five of the survey respondents that were listed as having windows or glass doors verified measure installation. ADM was able to estimate the number of windows installed by dividing the total rebate for the measure by $50 (the rebate offered per window). ADM then assumed 12 square feet per window in order to calculate verified savings. This resulted in a realization rate of 87% for kWh attributable to window and glass door improvements.

Whole House Approach Component Level Gross Impacts

Combining the measure level adjustments detailed above results in the component level verified gross energy and demand impacts detailed in Table 3-83.

Table 3-83: Reported and Verified Gross Impacts – Whole House Approach

Measure	Reported Energy Savings (kWh)	Reported Peak Demand Savings (kW)	Verified Gross Energy Savings (kWh)	Verified Gross Peak Demand Savings (kW)
Infiltration Reduction	289,222	107	289,333	105
Central AC and Heat Pumps	968,333	388	959,261	386
Furnace ECMs	254,153	5	253,603	5
Insulation & Radiant Barrier	453,219	150	451,143	151
Duct Sealing & Replacement	544,549	346	734,354	364
ENERGY STAR Windows/Doors	32,956	17	28,568	15
Total	**2,542,432**	**1,012**	**2,716,263**	**1,027**

Overall, verified gross energy savings are estimated at 2,716,263 kWh, representing a realization rate of 107% for the Whole House Approach component of the program. Verified gross peak demand reduction is estimated at 1,027 kW, a gross realization rate of 101%.

Net-to-Gross Estimation Results

ADM surveyed 103 Whole House Approach participants to determine the net-to-gross ratio for this program. Survey respondents were asked a series of questions aimed at determining the program influence on purchase and installation decisions for each installed measure. Each respondent was assigned a free ridership score (ranging from 0 for no free ridership to 1 for complete free ridership) based on their responses for each measure they installed. The free ridership scores for all survey respondents were then weighted by kWh savings and averaged to determine the program level free ridership rate. The resulting WHA component level free ridership estimate is 20.4%.

Survey respondents were also asked a series of questions to determine if they had installed any additional energy efficiency measures because of their participation in the program. Fourteen respondents said they had installed additional measures, and that their participation in the program was influential to their decision to do so. Two of these respondents indicated installing efficient lighting in their homes, which was not counted as participant spillover because of the possible interaction with the Energy Saving Products and Services program. Of the remaining 12 respondents, the most commonly cited installations were additional infiltration reduction measures. Other measures cited include insulation, window film, a water heater, and kitchen appliances.

To estimate a program level participant spillover rate, ADM assigned rough energy savings estimates to each additional measure. The total energy savings from spillover measures was then divided by net-of-free-ridership energy savings for all survey respondents. The result is a WHA component level participant spillover rate of 2.4%.

The final WHA net-to-gross ratio is calculated as 1 – free ridership + participant spillover, and is estimated at 81.9%. This is consistent with 2012 evaluation findings, which estimated a net-to-gross ratio of 84% for the Residential Solutions program (the predecessor to the WHA).

Table 3-84 below summarizes gross and net impacts for the New Homes component.

Table 3-84: Verified Gross and Net Impacts – WHA

Program Component	Verified Gross kWh	Verified Gross Peak kW	NTGR	Net kWh	Net Peak kW
WHA	2,716,623	1,027	82%	2,225,517	842

3.4.3.3 Process Evaluation Findings

This section presents the core findings derived from surveys conducted with participating customers as well as interviews conducted with registered Whole House Approach service providers and program staff at PSO and ICF.

- **Customers are highly satisfied with the program:** Customers were asked to rate their level of satisfaction for several different aspects of the program. The findings from this survey are detailed in Table 3-85 below:

Table 3-85: Customer Satisfaction – Whole House Approach

Aspect of Program	Very satisfied	Satisfied	Neither	Dissatisfied	Very dissatisfied	N/A
Interactions with program staff	58%	23%	3%	2%	5%	9%
Application process	51%	31%	6%	1%	5%	6%
Rebate amount	46%	39%	5%	2%	4%	3%
Installation contractor	60%	32%	0%	3%	5%	0%
Time it took to receive rebate	47%	31%	6%	4%	6%	5%
Equipment eligible for	44%	42%	3%	1%	5%	4%
The program overall	65%	28%	1%	2%	4%	0%

- **Initial service provider program awareness:** Three out of the ten service providers interviewed said they were participating in PSO energy efficiency programs before 2013. When asked how the found out about the PSO programs, five of ten indicated they heard about the program directly from PSO or ICF (through either direct conversations or email). Other respondents indicated that they heard through word of mouth, by attending a program seminar, or from a trade association.
- **Overall, service providers felt the application process and documentation requirements were reasonable:** All ten service providers indicated that they were primarily responsible for filling out rebate application forms and submitting them to PSO on behalf of their customers. Eight of ten respondents expressed high satisfaction with the application process. One participant, however, reported an increase in difficulty because of multiple updates and system changes, stating that "It's gotten harder. The system changes all of the time. It keeps getting updated even when I'm mid-process. The instant rebate is different."

  When asked if there was anything about the application process that the contractors would change, four service providers offered suggestions. Comments included:

  > *"[Do] something with rental homes. I work a lot with rental homes. When it comes to bills, I have to work with tenants too. It's a struggle. It's a lot to work around."*
  >
  > *"Last year we check marked if we left the application with the customer, it didn't say that we had to upload the agreement, but we had to do it anyway to get the check."*
  >
  > *"More incentives" and "payable faster…it's a little slow."*

- **All but one of the service providers interviewed said they have participated in program training:** Three respondents said they were visited by an ICF representative for personalized program training relating to the application submittal process. Most of the contractors who attended formal training sessions offered by PSO, reported attending multiple training sessions. All but one contractor reported the trainings as being very useful. One contractor reported the trainings as being somewhat useful. Generally the service providers implied that ICF and PSO staff members were readily available to answer any questions they had about the program or application process.
- **Nine out of ten service providers reported that the PSO Whole House Approach and/or Individual Project Approach helped them to sell their products or services:** The rebates are helpful in making the products affordable and the instant rebate is a big selling point. Two respondents indicated the PSO programs have encouraged their company to focus more on energy saving projects, offering more program qualified equipment and service options.
- **Rebate levels are sufficient, though service providers feel certain measures could receive more attention:** Seven of the service providers reported that the incentive levels were adequate to encourage customers to select energy efficient equipment options. Service providers did however feel that rebates for air sealing, windows, and geothermal equipment could be higher.
- **Service providers reported that PSO could more effectively market the program by increasing incentives, increasing marketing funds, and adding additional television spots.** Typically customers find out about programs once they have already contacted a contractor for the project they want to install. Service Providers reported marketing the PSO program to their customers through word of mouth, mailers, television commercials, and at trade shows.
- **PSO and service provider marketing efforts:** All ten service providers interviewed said they actively market the program to their customers. Commercials, door tags, mail advertisements, and direct marketing of the rebates to potential customers were commonly reported. When asked if they felt PSO could improve market efforts for the program, two respondents offered suggestions. One respondent felt the co-advertising funds of $1,500 offered by PSO should be increased. These co-advertising funds were newly introduced in early 2014, with another offering planned for the third quarter of 2014. The other felt that more TV advertisement would be helpful.
- **Nine out of ten service providers were either somewhat satisfied or very satisfied with PSO's residential energy efficiency programs**. Only one respondent reported being dissatisfied, citing a high level of work required to participate. However, all ten respondents indicated that they plan to be more active in promoting PSO programs in the future.

- **Program staff members report that the 2013 program changes have been beneficial:** 2013 marked the first year of this program iteration, as previous years had involved a different set of offerings. Program staff reported that the design of the 2013 program had been somewhat of a collaborative process between PSO and ICF. ICF provided analysis of the PSO customer base and assisted in redesigning the program to match the market. Discussions between ICF and PSO were focused on identify the range of possible program offerings and the participation potential for individual programs.

  PSO staff explained that during the transition to the new program designs in early 2013, customers and service providers reported certain changes as unclear or complicated. After conducting a focus group with contractors towards the end of 2013, PSO decided to simplify certain programs requirements and create a unified set of offerings that would be more appealing to the market. Program staff reports that these changes have been beneficial and they are continuing to look for areas where program operations and customer requirements can be simplified.

- **Program branding is now unified in order to increase market appeal:** Program staff reported that unifying PSO's energy efficiency portfolio of programs under a single brand identity has greatly improved the portfolio's market appeal and customer awareness of programs. Information about all of PSO's incentive offerings and other energy efficiency services are centrally located on a single website (www.powerforwardwithpso.com), and nearly all program marketing materials contain the "Power Forward" branding. The website not only contains descriptive information about program structures, but also provides a list of eligible service providers and a link to the PSO Online Energy Check-up tool. This unifying approach is a primary aspect of the transition to the 2013-2015 program cycle, which focuses on a simplified set of program offerings that is more approachable than previous iterations.

- **Program staff is focused on recruiting and retaining active service providers:** Program staff noted that a main focus of the Whole House Approach has been to recruit service providers, or service providers. In order to participate in PSO retrofit rebates, customers are required to install measures through an enrolled PSO service provider. The program is limited to enrolled service providers in order to maintain measure and service quality, as well as to ensure that all service providers are sufficiently familiar with program requirements. Service providers that are interested in participating in the program are required to complete a service provider application prior to submitting any incentive applications. Enrolled service providers benefit by gaining access to marketing resources, training resources, account management support, and guidance from PSO and ICF.

Additionally, service providers that bundle their promotional materials with PSO marketing are eligible to receive a reimbursement for half of their expenses, up to $1,500 in 2014. Once a service provider becomes an eligible service provider, they have six months to submit a project through the program in order to avoid becoming inactive. If a service provider is deemed inactive, their name is removed from the program website. This is done in order to prevent service providers from taking advantage of PSO marketing resources without providing any benefit to the program.

- **The program has a straightforward customer facing structure:** The Individual Project Approach was designed to focus on individual product retrofits, while customers who were seeking multiple upgrades or a whole house project would be able to receive increased incentives and additional measures by transitioning into the Whole House Approach component. Although the Whole House Approach and Individual Project Approach were designed as operationally separate within PSO, customer-facing materials present the available measure offerings as a tiered incentive schedule that increases if more than three measures are implemented. This was designed to minimize confusion among customers while providing offerings that would satisfy a wide range of customer needs.
- **The program has proactive and thorough quality assurance procedures:** For the Whole House Approach, on-site quality control procedures are conducted with approximately five percent of participating homes. This consists of an ICF staff member visiting the home and verifying that the listed measures have been installed fully and properly. This staff member also conducts measurements such as a blower door test, duct blaster test, and recording insulation thickness. All collected data is uploaded into the Vision database. If the inspector determines that any measures are not installed or operating as reported by service providers, this is recorded.

  Additionally, the relevant service provider is notified in order to ensure that the issues are resolved as soon as possible. This also serves to improve the quality of work conducted by service providers, as it informs them of common mistakes that they may be making in other participating homes. Other than on-site visits, ICF reviews all submitted project data in order to ensure that contractors are collecting the correct measure inputs and are accurately reporting project details.
- **Operational communications appear to be effective:** In terms of communication between PSO and ICF, the two parties have both regularly scheduled discussions as well as ad hoc communications regarding program updates. ICF sends PSO monthly data reports listing program participants, incentivized measures, current savings levels, and budget information. Previously, ICF conducted bi-weekly telephone status updates, but now this is

done as a bi-weekly presentation. Both PSO and ICF staff reported that the level of communication between the two parties is currently sufficient, and that they have actively collaborated since the inception of the new programs.

- **Program performance has been fairly high, and is expected to improve.** Overall, program staff noted that the High Performance Homes program nearly met its goal in 2013, and that it was expected to meet its goal for 2014.

3.4.4 Program Level Energy and Demand Impacts

The New Homes and Whole House Approach components combine to create the High Performance Homes program as shown in PSO's original program filings. Combining the two program components together, verified gross annual energy savings are estimated at 3,948,604 kWh (a realization rate of 104% as compared to reported savings). Verified peak demand reductions are estimated at 1,459 kW representing a realization rate of 99%. Program level reported and verified savings by component are shown in Table 3-86 below.

Table 3-86: Program Level Gross Impacts

Program Component	Reported Energy Savings (kWh)	Reported Peak Demand Savings (kW)	Verified Gross Energy Savings (kWh)	Verified Gross Peak Demand Savings (kW)
High Performance New Homes	1,256,209	464	1,232,341	432
Whole House Approach	2,542,432	1,012	2,716,263	1,027
Total	**3,798,642**	**1,476**	**3,948,604**	**1,459**

Table 3-87 and Table 3-88 summarize the verified net impacts of the complete High Performance Homes program. Overall, the evaluation estimates a program level net-to-gross ratio of 0.79.

Table 3-87: Verified Gross and Net kWh Savings

Program Component	Free Ridership	Participant Spillover	NTG Ratio	Verified Gross Annual Energy Savings (kWh)	Net Savings (kWh)
New Homes	27%	0%	73%	1,232,341	895,631
Whole House Approach	20%	2%	82%	2,716,263	2,225,517
		Total	**79%**	**3,948,604**	**3,121,148**

Table 3-88: Verified Gross and Net Peak kW Reduction

Program Component	Free Ridership	Participant Spillover	NTG Ratio	Verified Gross Peak Demand Reduction (kW)	Net Reduction (kWh)
New Homes	27%	0%	73%	432	314
Whole House Approach	20%	2%	82%	1,027	842
		Total	**79%**	**1,459**	**1,156**

3.4.5 Planned Program Changes

From an operational perspective, the responsibilities for the Whole House Approach and the Individual Project Approach component of the Energy Saving Products and Services program are being consolidated. This change reflects the similarity of the different paths in terms of measures and participating service providers in 2014. The goal is to streamline the program from the customer and service provider perspective as the marketing strategy for the two offerings becomes one program with two options. Aside from this shift in operational responsibilities, there are no major changes planned for the High Performance Homes program.

3.5 Education Program

3.5.1 Program Overview

PSO's Education program seeks to generate energy and demand savings for residential customers by providing elementary school students with easy self-install energy efficiency measures, such as LEDs and Advanced Power Strips. The purpose of the Education program is to provide PSO residential customers with an educational experience on how to make their homes more efficient. A lesson plan is provided to classroom teachers, which engages fifth grade students in learning about energy efficiency while also practicing mathematics and science. The students are then provided a take-home energy efficiency kit. PSO spent $1,629,846 on this program in 2013.[28] Energy savings are achieved when these measures are installed in homes, however PSO does not claim any kW or kWh savings associated with these kits. Table 3-89 provides a summary of program metrics.

Table 3-89: Performance Metrics – Education Program[29]

Metric	PY2013
Number of Participants	15,546
Budgeted Expenditures	$1,000,000
Actual Expenditures	$1,629,846
Energy Impacts (kWh)	
Projected Energy Savings	0
Reported Energy Savings	2,785,229
Gross Verified Energy Savings	NA
Net Verified Energy Savings	NA
Peak Demand Impacts (kW)	
Projected Peak Demand Savings	0
Reported Peak Demand Savings	652
Gross Verified Peak Demand Savings	NA
Net Verified Peak Demand Savings	NA
Benefit / Cost Ratios	
Total Resource Cost Test Ratio	0.00
Utility Cost Test Ratio	0.00

[28] Of the total spending in 2013, $551,721 went toward invoices from PY2012 that were not paid before the end of the calendar year. Therefore, $1,078,125 was spent on the implementation of the 2013 program.

[29] The reported kWh and kW impacts for this program represent calculations based on the number of energy efficiency kits distributed and estimated installation rates. PSO does not claim energy or demand impacts for the Education program and EM&V was not performed.

The Education program is marketed to students, teachers, and parents under the name "Energy Wise program." In 2013, 15,546 fifth grade teachers, students and their families were involved in the program and received energy efficiency kits (referred to as Super Power Saver kits). Each student involved in the program receives the following items:

- Student Guide
- Student Workbook
- Parent/Guardian Program Introduction Letter
- Home Survey
- Certificate of Achievement
- PSO "Power Forward/ Energy Wise" wristband
- Interactive Program Website Access
- Toll-Free HELP Line
- Super Power Saver Kit containing:
    - (1) Smart Power Strip
    - (1) 8W LED Light Bulb
    - (1) Air Filter Alarm
    - (1) LED Night Light
    - Natural Resource Fact Chart
    - Reminder Stickers and Magnets
    - Installation DVD
    - Quick Start Guide
    - Installation Instruction Booklet
    - Parent/Guardian Program Evaluation

There are a number of items the program provides to each teacher/classroom implementing the program as well. These items include:

- Teacher Book
- Program Checklist
- Five and 10 day Teaching Unit Plan
- Teacher Program Evaluation
- Oklahoma State Education Standards Correlation Chart
- Pre/Post Test Answer Keys

- Oklahoma Electricity Poster
- Self-Addressed Postage-Paid Envelope

The materials provided support state and national educational standards, which allow the program to easily fit into teachers' existing schedules and requirements. Program delivery starts with classroom discussions that teach the importance of using energy efficiently, followed by hands-on, creative problem solving. Next, participants take home the Super Power Saver kit containing energy efficiency measures. With help from parents/guardians, students install the measures in their homes using provided instructions and then fill out the home survey.

Results from the home survey, teacher program evaluations, and parent/guardian program evaluations are then used by the program implementer, Resource Action Programs, to develop a program summary report.

3.5.2 EM&V Methodologies and Findings

Because PSO does not claim energy or demand impacts for the Education program, no EM&V activities were performed by ADM.

However, energy and demand impacts are achieved when students install the energy efficiency kit contents in their homes. Resource Action Programs developed a summary of program results based on data collected from students, teachers, and parents. These results include estimates of energy savings attributable to the program. Select findings from Resource Action Programs' research are provided below.

Energy Impacts

A total of 15,451 energy efficiency kits were distributed through the program in 2013. Resource Actions Programs estimated kWh savings from the installation of the following measures provided in the kit:

- 8W LED Light Bulbs
- Smart Power Strips
- LED Night Lights
- Air-Filter Alarms

Energy savings for the LED light bulbs and smart power strips were based on the Oklahoma Deemed Savings Documents, with some adjustments for existing bulb wattages. Energy impacts for LED night lights and air-filter alarms are based on other secondary sources of deemed or partially-deemed savings.

Results from the Home Surveys were tabulated by Resource Action Programs and used to estimate installation rates for each measure. A total of 7,313 students returned their

surveys[30], representing a robust sample size (population = 15,451 kits distributed). Questions asked of students used to determine installation rates were:

- Did your family install the LED Night Light?
- Did your family install the 8-watt LED Light Bulb?
- Did your family install the Smart Power Strip?
- Did your family install the FilterTone® Alarm?

Answers to these questions resulted in the estimated installation rates shown in Table 3-90.

Table 3-90: Resource Action Programs' Estimated Installation Rates (n=7,313)

Measure	Installation Rate
LED Night Light	85%
8W LED Light Bulb	72%
Smart Power Strip	69%
Air-Filter Alarm	47%

Based on these installation rates and per-unit impact assumptions for each measure, Resource Actions Programs estimated total annual energy savings for the program to be equal to 2,785,229 kWh. The assumptions behind this estimate are presented in the following figures, taken directly from Resource Action Programs' Program Summary Report.

Again, these estimated impacts do not reflect verified energy savings developed through independent EM&V.

[30] The surveys are returned to the teachers, who then consolidate and mail the responses back to Resource Action Programs. A total of 489 teachers received kits for their students; 271 of these teachers sent back completed surveys representing 7,313 students.

Figure 3-16: Estimated Energy Savings – 8-Watt LED Light Bulb

Projected Savings from 8-watt LED Light Bulb Retrofit

8-watt LED Light Bulb retrofit inputs and assumptions:

Effective useful life:	20	years[1]
Hours of operation per day:	1023	hours per year[1]
Watts used by the LED light bulb:	8	watts[2]
Watts used by the replaced incandescent light bulb:	63	watts[3]
Homes heated with natural gas:	41%	[3]
Homes heated with electricity:	41%	[3]
Homes heated with other fuel type:	18%	[3]
Installation / participation rate of:	72%	[3]
Number of Participants:	15,451	[3]

Projected Electricity Savings:

The LED Light Bulb retrofit projects an **annual** reduction of:	623,585	kWh[2,4]
The LED Light Bulb retrofit projects a **lifetime** reduction of:	12,471,703	kWh[2,5]

1 *Frontier & Associates "Residential, Oklahoma Deemed Saving, Installation & Efficiency Standards" November 27, 2013*

2 *Provided by manufacturer.*

3 *Reported by Participants*

4 *{[(Wattage of incandescent light bulb replaced - Wattage of LED light bulb)/1000] x Hours of operation per year x Installation rate x Number Participants x % Natural gas heating x IEFE (1.15)) + {[(Wattage of incandescent light bulb replaced - Wattage of LED light bulb)/1000] x Hours of operation per year x Installation rate x Number Participants x % Electric heating x IEFE (0.84)} + {[(Wattage of incandescent light bulb replaced - Wattage of LED light bulb)/1000] x Hours of operation per year x Installation rate x Number Participants x % Other heating type x IEFE (0.96)}*

5 *Annual Savings x Product Life*

Figure 3-17: Estimated Energy Savings – LED Night Light

Projected Savings from LED Night Light Retrofit

LED Night Light retrofit inputs and assumptions:

Average length of use:	4,380	hours per year[1]
Average nightlight uses:	7	watts
Retrofit nightlight uses:	0.5	watts
Effective useful life:	10	years[2]
Energy saved per year:	28	kWh per year
Energy saved over life expectancy:	285	kWh
Installation / participation rate of:	85%	[3]
Number of Participants:	15,451	[3]

Projected Electricity Savings:

The LED Night Light retrofit projects an **annual** reduction of:	373,906	kWh
The LED Night Light retrofit projects a **lifetime** reduction of:	3,739,065	kWh

1 *Assumption (12 hours per day)*

2 *Product life provided by manufacturer*

3 *Data reported by program participants*

Figure 3-18: Estimated Energy Savings – Smart Power Strips

Projected Savings from Smart Power Strip Installation

Smart Power Strip

Product life:	10	years[1]
Entertainment Center Deemed Savings:	141	kWh[1]
Home Office Deemed Savings:	84	kWh[1]
Other Electronics Deemed Savings:	75	kWh[1]
Number of Participants:	15,451	[2]
Overall Installation / participation rate of:	69%	[3]
Entertainment Center Installation / participation rate of:	37%	[3]
Home Office Installation / participation rate of:	17%	[3]
Other Electronics Installation / participation rate of:	45%	[3]

Projected Electricity Savings:

The Smart Power Strip retrofit projects an **annual** reduction of:	1,068,251	kWh[4]
The Smart Power Strip retrofit projects a **lifetime** reduction of:	10,682,512	kWh[5]

1 *Frontier & Associates "Residential, Oklahoma Deemed Saving, Installation & Efficiency Standards" November 27, 2013*

2 *Program Participants*

3 *Data reported by participants.*

4 *Deemed Savings per category x Participants x Installation Rate*

5 *Annual savings x product life*

Figure 3-19: Estimated Energy Savings – Air-Filter Alarm

Projected Savings from FilterTone® Alarm Retrofit

FilterTone® retrofit inputs and assumptions:

Annual energy (electricity) use by a central system air conditioner:	5,661	kWh[1]
Annual energy (natural gas) use by central space heating or furnace:	24	Therms[1]
Projected increase in efficiency (electricity):	1.75%	[2]
Projected increase in efficiency (natural gas):	0.92%	[2]
Product life:	10	years[3]
Installation / participation rate of:	47%	[4]
Number of participants:	15,451	[4]

Projected Electricity Savings:

The FilterTone retrofit projects an **annual** reduction of:	719,425	kWh[5]
The FilterTone retrofit projects a **lifetime** reduction of:	7,194,252	kWh[6]

Projected Natural Gas Savings:

The FilterTone retrofit projects an **annual** reduction of:	1,603	Therms[7]
The FilterTone retrofit projects a **lifetime** reduction of:	16,034	Therms[8]

1 *U.S. Department of Energy, Energy Information Administration 2005 Residential Energy Consumption Web site for Mountain West States: http://www.eia.gov/consumption/residential/data/2005/*

2 *Reichmuth P.E., Howard. (1999). Engineering Review and Savings Estimates for the 'Filtertone' Filter Restriction Alarm.*

3 *Provided by manufacturer.*

4 *Data reported by program participants.*

5 *Annual energy (electricity) use by a central air conditioner, heat pump or furnace x Projected increase in efficiency (electricity) x Installation rate x Number of participants*

6 *Annual energy (electricity) use by a central air conditioner, heat pump or furnace x Projected increase in efficiency (electricity) x Installation rate x Number of participants x Product life*

7 *Annual energy (natural gas) use by a central air conditioner, heat pump or furnace x Projected increase in efficiency (natural gas) x Installation rate x Number of participants*

8 *Annual energy (natural gas) use by a central air conditioner, heat pump or furnace x Projected increase in efficiency (natural gas) x Installation rate x Number of participants x Product life*

Additional researchable issues that could be addressed in the future to help understand the energy impacts of the program include:

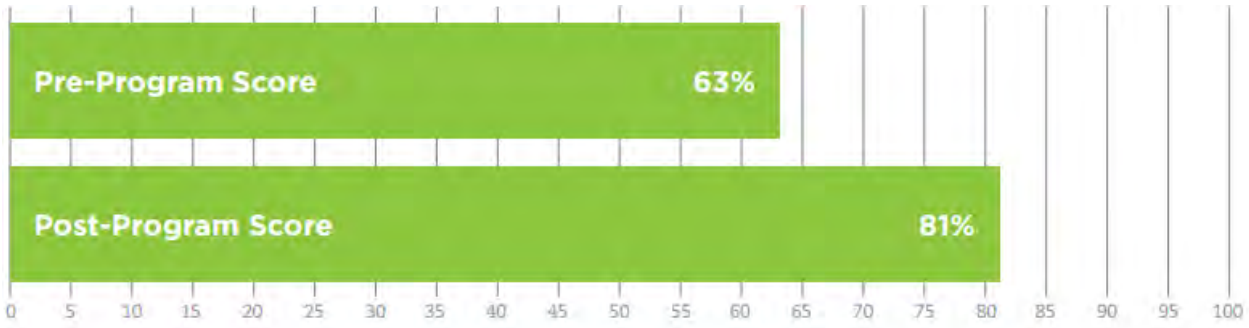
- Estimating the percentage of smart power strip installations that are configured correctly in a manner that produces energy savings.
- Estimating the percentage of LED night light installations that displace old, less efficient night lights as opposed to reflecting new installations.

- Estimating PSO service territory specific effects of the air-filter alarms. Specifically, what percentage of kit recipients indeed replaces their air filter earlier? How much earlier?

Education Outcomes

The program delivery includes pre- and post-curriculum testing for students. Both tests are identical, and include ten questions aimed at assessing the amount of knowledge gained through the program. Figure 3-20 below shows the pre-and post-program test scores.

Figure 3-20: Pre- and Post- Program Test Scores[31]



The Home Survey also asked students whether or not the program changed the way their families use energy. Seventy-four percent of respondents responded affirmatively.

Teacher and Parent/Guardian Feedback

Teachers and parent/guardians were provided program evaluations to fill out and return to Resource Action Programs. One hundred percent of teachers who returned the evaluations said they would conduct the program again given the opportunity. Similarly, 100% of teacher respondents said they would recommend the program to their colleagues. Teachers also responded to a series of open ended questions. Selected Responses are highlighted below.

- What did students like best about the program? Explain.
  - "Feeling like they could do something to help and take charge."
  - "Utilizing the kits in their own homes."
  - "Students loved the kit and program overall."
  - "Learning about electricity."

[31] This figure is taken directly from Resource Action Programs' Program Summary Report. The number of completed tests is unknown.

    - “The activities, certificates, and grades.”

- What did you like best about the program? Explain.
    - “Easy to follow. Also helps us prepare for a better future.”
    - “I love that it excites the kids about conservation.”
    - “I liked that it went along with our PASS and the hands on activities.”
    - “The lessons followed Oklahoma curriculum and were fun for kids.”
    - “I liked the kit because students were able to install everything without supervision.”

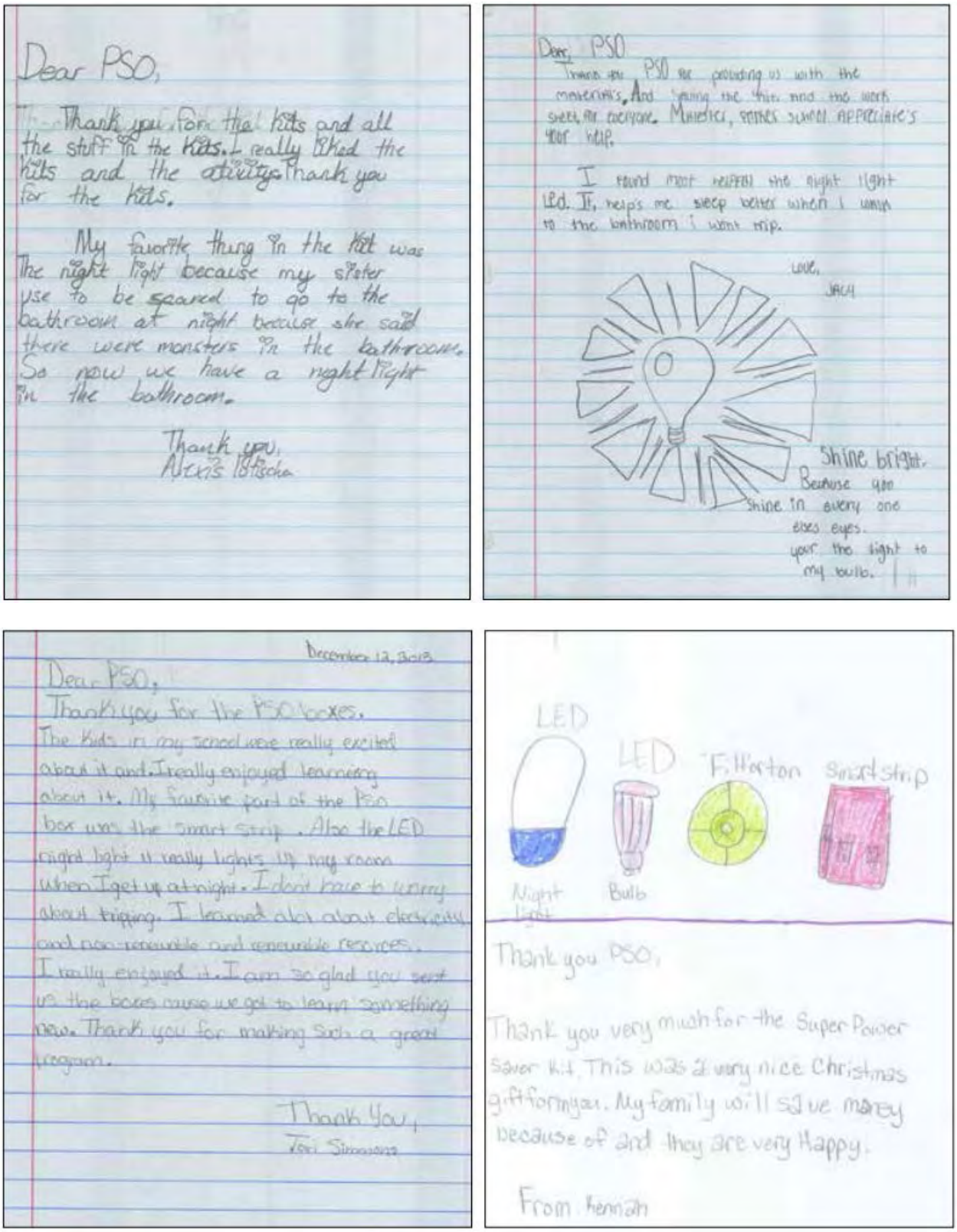
Parent/Guardians were also asked similar questions in their program evaluations. Of the parent/guardians who responded, 99% said the program was easy to use. One hundred percent of parent respondents said they would like to see the program continued in local schools.

- As a parent, which aspect of the program did you like best?
    - “Saving energy -> saves money -> saves the environment and the future. Go green!”
    - “The lessons that came with the kit were very interesting and informative.”
    - “Very hands-on and a great learning experience.”
    - “I think it is important to teach children about conservation. We teach this lesson so it is nice to see it reinforced at school.”

Student and Teacher Letters of Appreciation

The images below show example letters of appreciation PSO has received from students and teachers who participated in the program.

Figure 3-21: Student Letter Examples



Dear PSO,

Thank you for the kits and all the stuff in the kits. I really liked the kits and the activity. Thank you for the kits.

My favorite thing in the kit was the night light because my sister use to be scared to go to the bathroom at night because she said there were monsters in the bathroom. So now we have a night light in the bathroom.

Thank you,
Alexis Ibisha

Dear PSO
Thank you PSO for providing us with the materials. And saving the earth and the work sheet for everyone. Materials, sheets, sweet appreciate's your help.

I found most helpful the night light LED. It, helps me sleep better when I wake to the bathroom I wont trip.

Love,
JACY

Shine bright.
Because you shine in every one eyes eyes.
your the light to my bulb.

December 12, 2013

Dear PSO,
Thank you for the PSO boxes.
The kids in my school were really excited about it and I really enjoyed learning about it. My favorite part of the PSO box was the smart strip. Also the LED night light it really lights up my room when I get up at night. I dont have to worry about tripping. I learned also about clean energy and non-renewable and renewable resources. I really enjoyed it. I am so glad you sent us the boxes cause we got to learn something new. Thank you for making such a great program.

Thank You,
Tori Simmons

Thank you PSO,

Thank you very much for the Super Power Saver kit. This was a very nice Christmas gift for my ya. My family will save money because of and they are very Happy.

From hennah

Figure 3-22: Example Teacher Letter

Dear Public Service Company of Oklahoma,

On behalf of my students and myself, thank you for making a difference in so many lives! Because of you, my students are excited about learning! I have been an educator for 17 years. In those 17 years I have NEVER seen any program like yours. You have top notch curriculum and you couple that with useful items that can make an impact in each child's home.

Because the majority of my students are on free and reduced lunches, they feel like they have won the lottery when they open up their kits. They are often overwhelmed and they are always very thankful. This year they are beside themselves with the smart strip! Several of them are going to wrap it up as a present for their parents at Christmas. It indeed is a present that will give their families money back into their pockets.

Not only are the kits valuable, but also the curriculum. I appreciate the student guide, student workbook, and DVD that accompany the kits. In addition I found the teacher's resource book to be extremely beneficial. This summer I was accepted to the Honeywell Green Boot Camp in San Diego. I was, in fact, bragging about PSO. Educators from around the world joined me in saying they have NEVER heard of an electric company providing not only the curriculum, but also the valuable supplies to give to every single student. I am sure several of them could have contacted you because they wanted to know if this was available in their state or country.

So from the bottom of my heart, THANK YOU! You have put many Christmas presents under the tree this year here in Delaware County that will save families a lot of money and help them make a difference in our world.

My Best,

Jennifer Dattari, Jay Upper Elementary School

3.5.3 Planned Program Changes

No changes are planned for the Education program in 2014.

4. Demand Response Programs

PSO's demand response portfolio in 2013 consisted of one program that targeted commercial and industrial customers.

As shown in Table 4-1, reported peak demand reduction of 45.65 MW fell short of projections of 58.89 MW. This shortfall is largely explained by a relatively mild summer in 2013 and fewer than expected days of high demand. Evaluation, measurement and verification resulted in verified peak demand reduction of 40.66 MW, as shown below in Table 4-1. This represents a realization rate of 89% percent as compared to reported demand reduction for demand response programs.

Table 4-1: Peak Demand Reduction – Demand Response Programs

Program	Gross Peak Demand Reduction (MW)				Net Impacts	
	Projected	Reported	Verified	Gross Realization Rate	NTG Ratio	Net Peak Demand Reduction (MW)
Business Demand Response	58.89	45.65	40.66	89%	1	40.66
Demand Response Totals	**58.89**	**45.65**	**40.66**	**89%**	**1**	**40.66**

As shown in Table 4-2, PSO did not project or report annual energy savings for demand response programs. These programs sole aim is to provide load reduction capabilities during times of high demand. However, as a result of participants' voluntary load reductions during event hours, there are energy savings associated with the program. These energy savings are not persistent, in the sense that an energy efficient equipment installation provides energy savings for the life of the equipment, while energy savings from DR programs only occur during event days. The program evaluation findings resulted in verified energy savings of 634 MWh that occurred during the three event days in 2013.

Table 4-2: Annual Energy Savings – Demand Response Programs

Program	Gross Annual Energy Savings (MWh)				Net Impacts	
	Projected	Reported	Verified	Gross Realization Rate	NTG Ratio	Net Annual Energy Savings (MWh)
Business Demand Response	0	0	634.32	NA	1	634.32
Demand Response Totals	**0**	**0**	**634.32**	**NA**	**1**	**634.32**

4.1 Business Demand Response

4.1.1 Program Overview

The Business Demand Response program, also referred to as Peak Performers[32], is a Demand Response (DR) program for commercial and industrial customers in the PSO service territory. Participating customers are paid $32.00 for each kW shed during demand response events (averaged over all events), plus an additional 5% bonus when a customer participates in all events during a given summer (three in 2013).

During the summer of 2013, 61 customers (representing a total of 250 account numbers) participated in three DR events each lasting from 2-6 PM. Table 4-3 provides an overview of PY2013 program metrics. Overall, reported peak demand reduction fell short of projections, likely in part due to a relatively mild summer in the PSO service territory. Only three event days were initiated, with an average daytime high temperature of 98° F in Tulsa. Additionally, there were some customers who participated in 2012 but dropped out in 2013, contributing to reported demand reduction less than projections.

ADM's evaluation developed verified demand reduction estimates that were slightly lower than reported values. Both reported and verified peak demand reduction represent the average kW reduction for each customer over all 12 event hours (three event days, four hours per event), summed across participants.

[32] While the official program name is "Business Demand Response," it is marketed to customers as "Peak Performers." Both names are used interchangeably in this report.

Table 4-3: Performance Metrics – Business Demand Response Program

Metric	PY2013
Number of Customers	61
Budgeted Expenditures	$2,965,333
Actual Expenditures	$2,381,055
Energy Impacts (kWh)	
Projected Energy Savings	0
Reported Energy Savings	0
Gross Verified Energy Savings	634,324
Net Verified Energy Savings	634,324
Peak Demand Impacts (kW)	
Projected Peak Demand Savings	58,886
Reported Peak Demand Savings	45,653
Gross Verified Peak Demand Savings	40,656
Net Verified Peak Demand Savings	40,656
Benefit / Cost Ratios	
Total Resource Cost Test Ratio	0.53
Utility Cost Test Ratio	0.80

4.1.2 EM&V Methodologies

4.1.2.1 Impact Evaluation Methodologies

The impact evaluation for the Business Demand Response program involves calculating participants' load reduction during event periods in reference to a counterfactual baseline demand estimation. The details regarding how this process was used to estimate verified impacts is provided in the following subsections.

Replicating Reported Impacts

For the purposes of financial settlement with Peak Performer participants, PSO uses a "top 3-of-10 baseline days" methodology to estimate participants' baseline load, or the demand that participants would have used had no Peak Performer event been called. Reported program impacts were calculated based on this baseline estimation methodology. For each participant[33], one applies the following algorithm:

1. For an event day D, let $D(h)$ be the participant's actual electric demand at hour h on D.

[33] By "participant," we mean an individual premise. Multiple premises may belong to a single customer, but the impacts are calculated on a per-premise basis.

2. Starting with the day before D, take the most recent 10 non-weekend, non-holiday, non-Peak Event days. These are the *eligible baseline days*.
3. For each of the eligible baseline days, calculate the average midday electric demand during the hours corresponding to the Peak Event (usually 2 PM – 6 PM, but can be any two to four hour period between 1 PM and 7 PM). Rank the eligible baseline days in descending order of this average peak time demand.
4. Take the top 3 days from the previous step and average their loads hour by hour. This is the *unadjusted baseline,* $B(h)$.
5. If, on average, the ratio of $B(h)/D(h)$, between 10 AM and 12 PM, is less than 1 (that is, the baseline is too low), multiply $B(h)$ by the reciprocal of that ratio so that the baseline and event loads match prior to the event. The most $B(h)$ can be adjusted upward is 30%; no downward adjustments are made.

Reported demand reduction and payments made to Peak Performers participants depend on the difference, $B(h) - D(h)$.

PSO provided hourly interval data for all of the facilities involved in the Peak Performers program. PSO staff also provided internal audits for all of the events, which are produced by a database script that implements the 3-of-10 baseline. ADM used these audits and interval data to independently verify that the baseline loads reported by PSO were calculated according to algorithm described above.

Calculating Verified Impacts

For the purposes of providing an independent and accurate estimate of program demand reductions, ADM used a generalized version of the 3-of-10 algorithm, which is identical to the rules used above except in two respects. The first is that Step 5 is also modified to allow *downward* baseline adjustments. The second is that the magnitude of the adjustment is not limited to $\pm$30%. This kind of adjustment, which can increase or decrease the baseline, is known as a “symmetric” adjustment. By design, the default “asymmetric” baseline must have a positive bias, since the baseline can only increase, even when having a lower baseline would be more accurate, which is what using a symmetric baseline allows for.

Another difference in ADM’s evaluation is that a single large industrial customer (which we call Customer X), whose demand reductions are one third of the reported program impacts, was evaluated separately from the rest of the participants for extra scrutiny on the operations of this influential customer. Customer X operates a number of facilities that interact with each other and the facilities electric demand is process driven. As a result, in some cases the 3-of 10 with symmetric adjustment baseline methodology needed adjustment to more accurately reflect the facilities operations before, during, and after event periods.

Net-to-Gross

Demand response programs are not likely to have net-to-gross effects because customers are unlikely to curtail load without incentives. A net-to-gross ratio of 100% was assumed for this program.

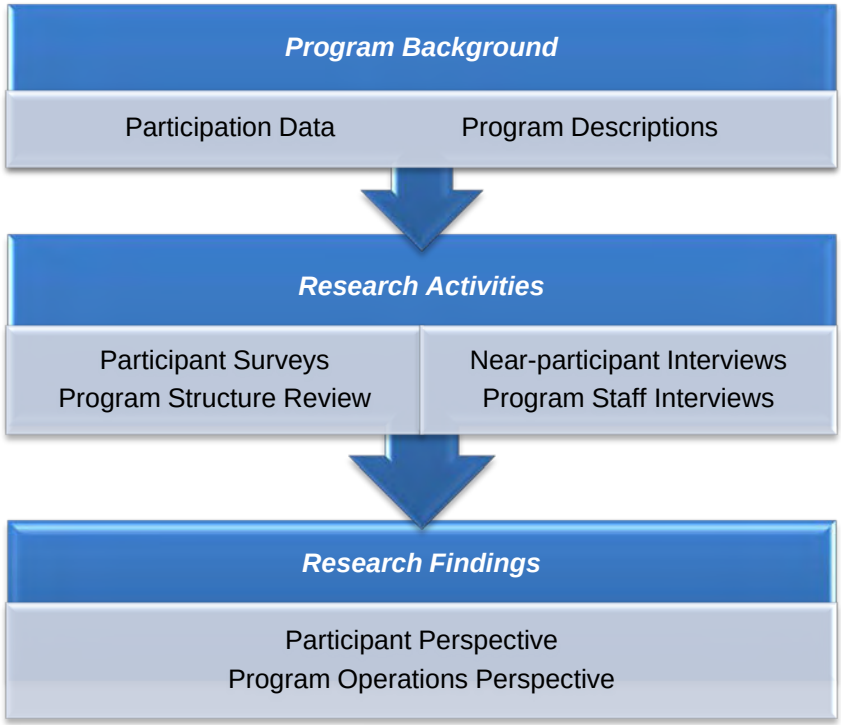
4.1.2.2 Process Evaluation Methodologies

This section discusses the methodologies and activities used for the process evaluation of the 2013 Business Demand Response program. The purpose of the process evaluation is to assess the program from a structural and operational perspective in order to identify program strengths, weaknesses, and opportunities. This evaluation is based upon surveys with Business Demand Response participants, interviews with program staff, interviews with near-participants of the program, and analysis of program data and documentation. This section provides a description of the process evaluation objectives, and a summary of the program design, background and structure.

Evaluation Objectives

The purpose of the process evaluation is to examine program operations and results throughout the program operating year, and to identify potential program improvements that may prospectively increase program efficiency or effectiveness in terms of participation and satisfaction levels. This process evaluation was designed to document the operations and delivery of the PSO Peak Performers program during the 2013 program year. Figure 4-1 provides an overview of the evaluation process, including research activities performed.

Figure 4-1: Process Evaluation Overview



Key research questions to be addressed by this evaluation of the 2013 program year include:

- How was the program marketed to customers? Were the marketing efforts successful? What barriers to participation exist?
- What communication between PSO and participating customers exists? Do customers find that level of communication sufficient? Are events communicated appropriately to maximize program participation?
- Were the program participants satisfied with their experience? What was the level of satisfaction with the incentive amount, the event calling process, and other aspects of program participation?
- Were there any significant changes or new obstacles during the 2013 program year?
- Are there incentive processing, data tracking, settlement, and/or communication efficiencies that can be gained?
- Looking forward, what are the key barriers and drivers to program success within PSO's market?

During the evaluation, data and information from several sources are analyzed to achieve the stated research objectives. Insight into the participant perspective on the

program is developed from an online survey of building operators and other facility staff for organizations that participated in the Peak Performers program during 2013, as well as telephone interviews with individuals classified as near-participants. The internal organization and operational efficiency of program delivery is examined through analysis of interviews conducted with PSO program staff and demand analysis and notification staff, as well as a review of program documentation such as promotional literature and participant tracking data.

Summary of Primary Data Collection

- **Participant surveys**: Participant surveys serve as the foundation for understanding the participant perspective. The participant surveys provide participant feedback and insight regarding participant experiences with the Peak Performers program. Respondents report on their satisfaction with the program, detail their motivations and the factors affecting their participation decisions, and provide recommendations related to improving the program. For the 2013 Peak Performers program evaluation, 30 program participants responded to the participant survey
- **Near-participant interviews:** Interviews with individuals representing near-participant facilities provide insight into customer perceptions of the program as well as any persisting barriers to participation. For the purposes of this evaluation, near-participants are classified as any customer who was contacted by PSO or had discussions with program staff regarding the possibility of participation, but ultimately decided not to enroll in the program. PSO program staff provided a list of approximately 25 such facilities, and the evaluators were able to reach and conduct the near-participant interview with individuals at three of the listed facilities.
- **Interviews with program staff members:** Interviews with staff members provide insight into various aspects of the program and its organization. PSO program staff members provide information regarding recent organizational and procedural improvements that have been implemented in order to enhance program efficiency and effectiveness. Program staff members representing the load research department, provides information regarding the structure of program demand analysis and the procedures that take place during program operation. For the 2013 Peak Performers program evaluation, the evaluators conducted in-depth interviews with two PSO program management staff members and three staff members involved in load research and setting up criteria for threshold breaches that may trigger the calling of an event.

4.1.3 Impact Evaluation Findings

Demand response event impacts are estimated by comparing the event day demand curves with the estimated baseline demand curves; the difference between the two is the estimated peak demand reduction. As described in Section 4.1.2, ADM used hourly

interval data to recreate the baseline estimations used to determine reported impacts. The process was then repeated, this time using a symmetric adjustment based on pre-event usage in order to increase baseline accuracy. The figures below show the results of the baseline estimation effort, along with actual electric demand for participants on event days. One influential participant (Customer X) is excluded as they were analyzed separately.

Figure 4-2: Event 1, 7-10-2013

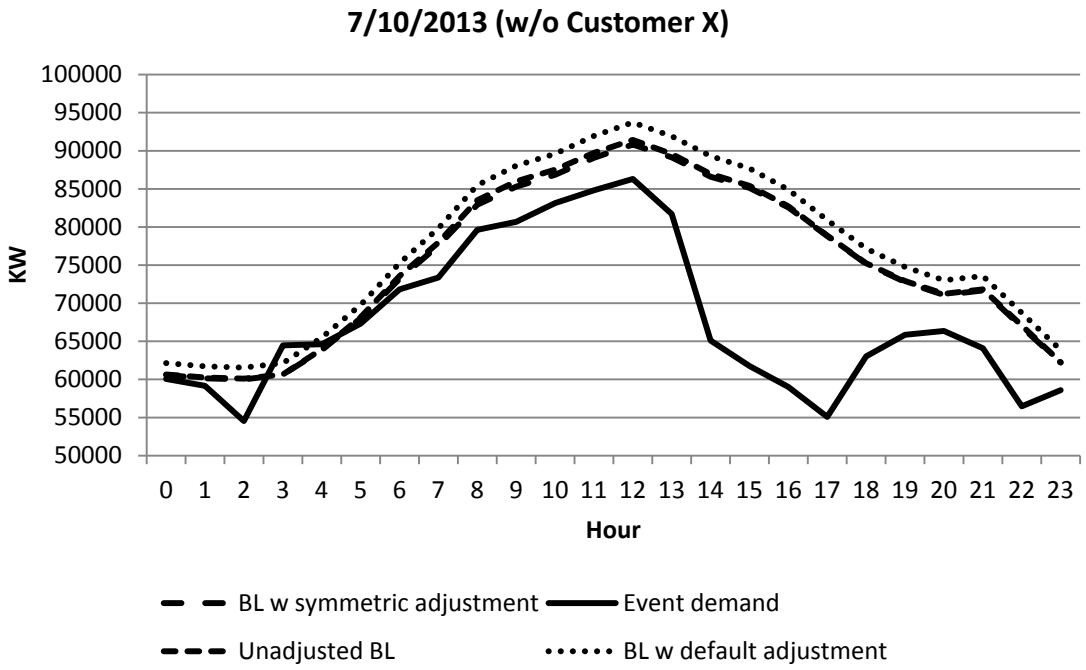


Figure 4-3: Event 2, 7-23-2013

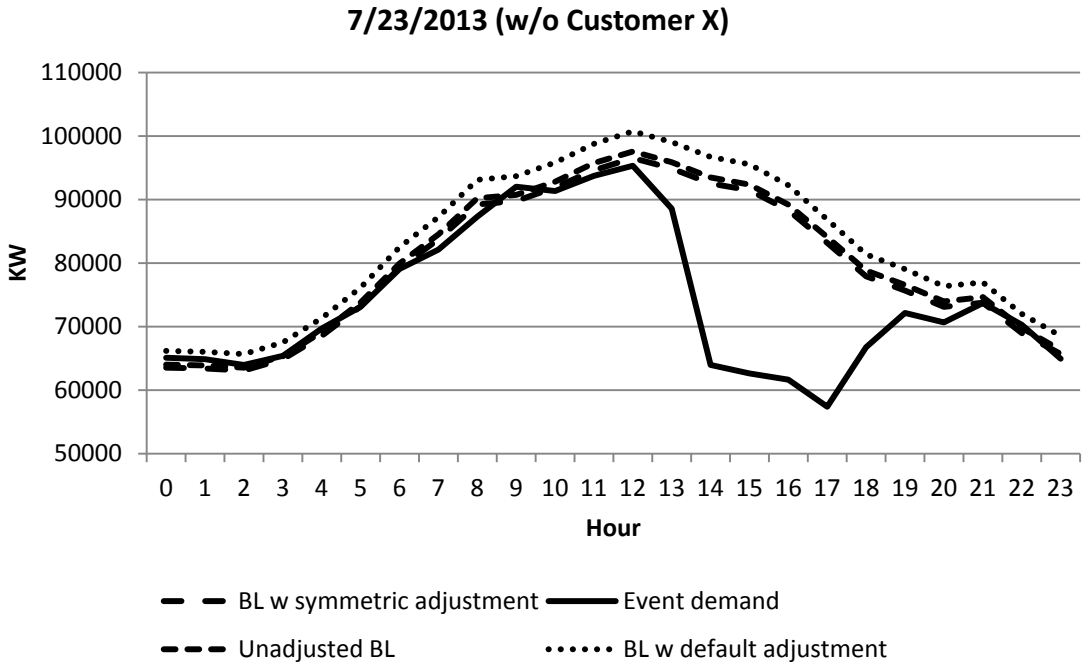
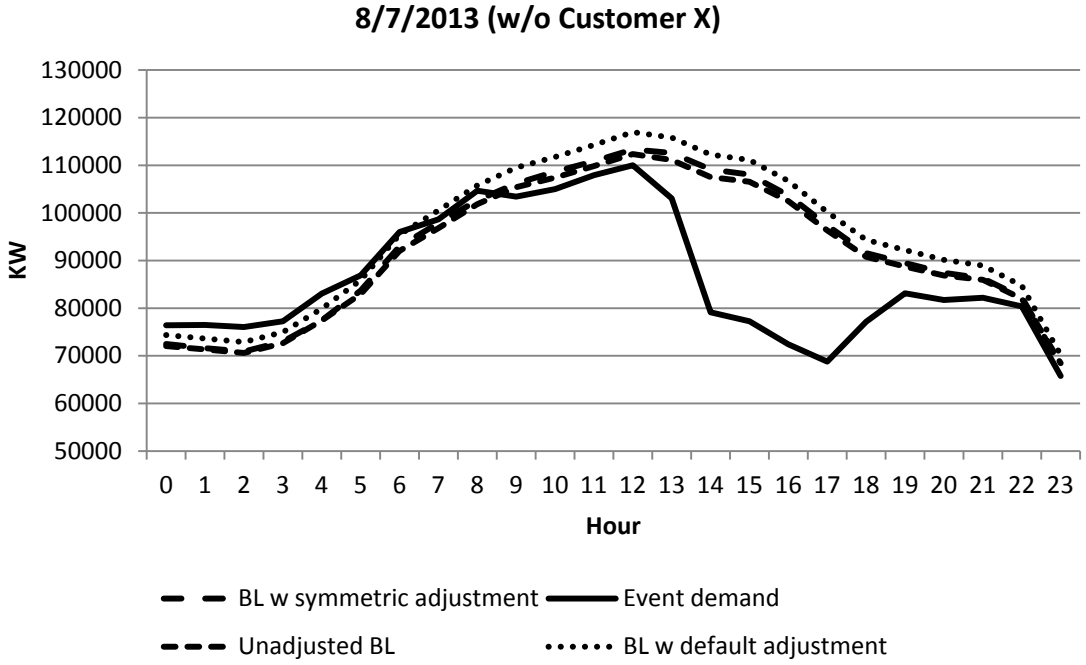


Figure 4-4: Event 3, 8-07-2013



As shown in the figures above, the baseline with symmetric adjustment was slightly lower than the default adjustment used by PSO for all event days. To quantify the

potential bias in the baseline estimation algorithms, the symmetric and asymmetric baselines were calculated for all non-event days and compared to the actual usage.

Figure 4-5: Average Weekday Real and Predicted Loads

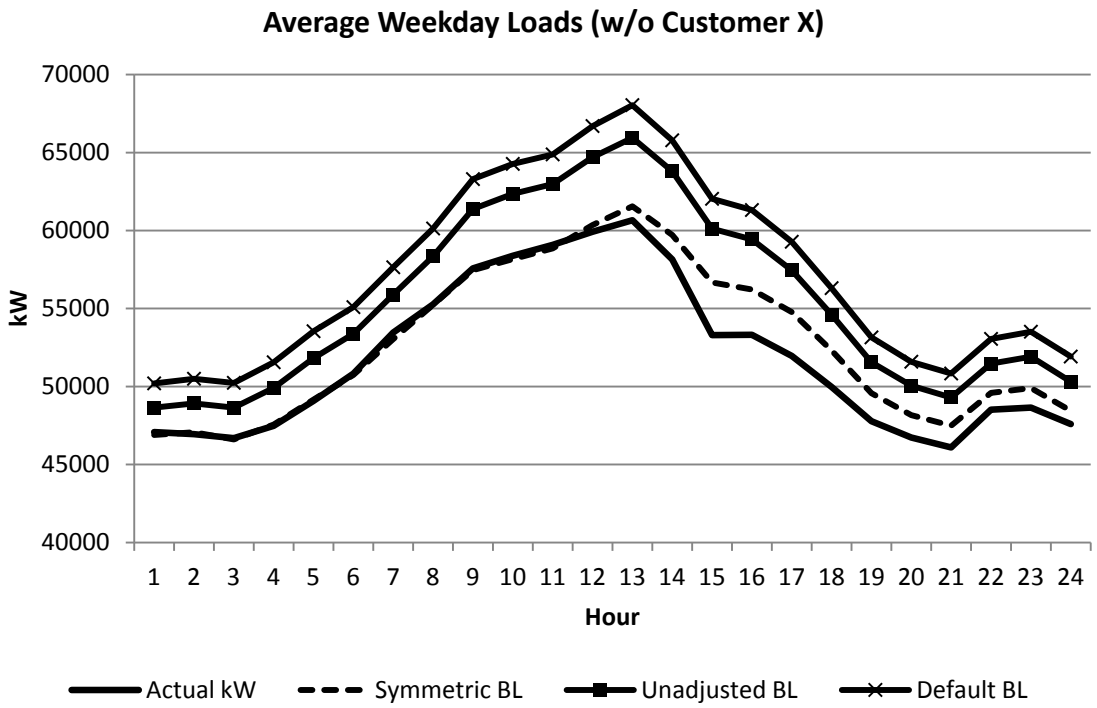
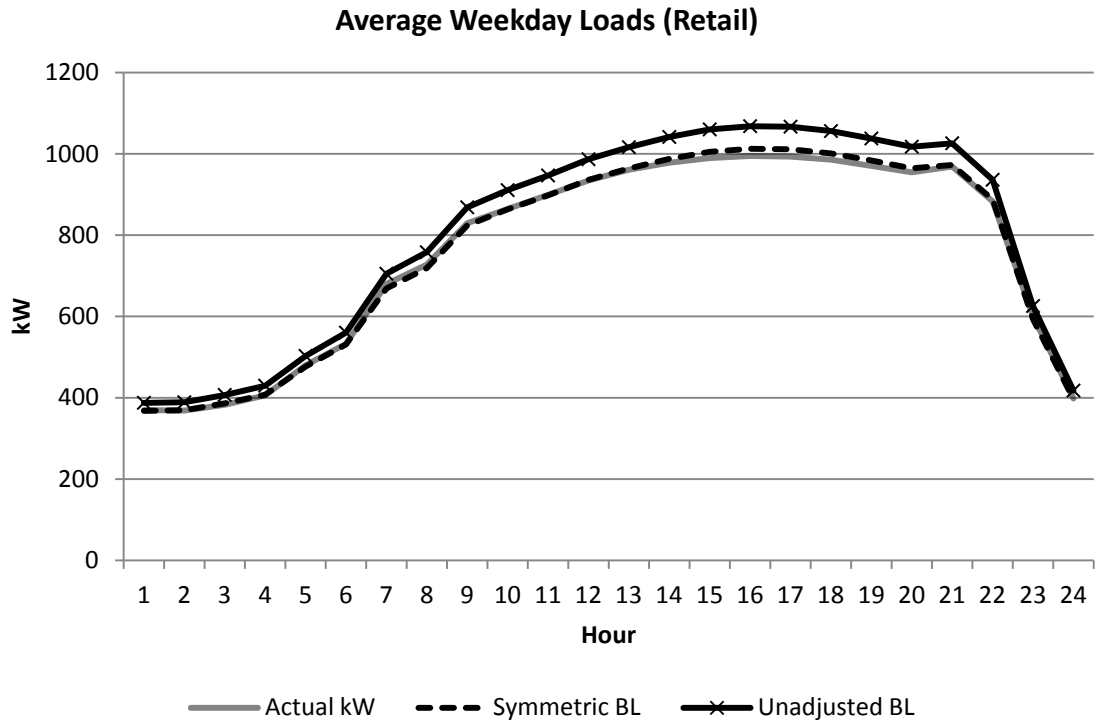


Figure 4-10 compares the typical weekday load for all Peak Performer customers (except Customer X) with the loads predicted by the 3-of-10 rule with 1) no adjustment, 2) the default adjustment, and 3) the symmetric adjustment. Of the three, the symmetric adjustment achieves the best overall fit, especially during pre-event hours (by design there will be some residual positive bias during the event hours, since the baseline uses the three past days with the *highest* usage during the event hours). Moreover, this residual bias is primarily driven by a few large industrial customers whose load patterns are both volatile and of a high magnitude; for small- and medium-sized business, as well as large C&I customers with more predictable loads, the symmetric baseline predicts actual usage almost exactly. Figure 4-6 below illustrates this with the predicted and actual loads for the two large retail chains participating in the program.

Figure 4-6: Average Weekday Real and Predicted Loads for Retail Participants



Based on the weekday load profile in Figure 4-6, the default 3-of-10 baseline tends to overestimate this customer group's actual usage by about 7.6 MW, a relative bias of +16.4%. The symmetric baseline tends to overestimate actual usage by 2.9 MW, a relative bias of +5.4%. We note that the difference, 7.6 – 2.9 = 4.7 MW, which is consistent with the differential of 4.8 MW between the reported verified demand reduction for "All Other Participants" in Table 4-4.

In the hour prior to an event, load reductions are observable during what is known as the "ramp-in" period. Similarly, after the conclusion of an event, it often takes a number of hours for a facility to restore itself to pre-event operations. This interval is known as the "snapback" period. While outside of the official event hours, these periods may contribute additional energy impacts (positive or negative, depending on the conditions and facilities involved). While PSO did not report any energy savings (kWh) for the program, ADM calculated kWh savings using a defined ramp-in period of 1 pre-event hour and a snapback period of 2 post-event hours. Verified kWh savings therefore represent the net difference in energy consumption (between the estimated baseline and the observed usage) summed over the event hours, plus an additional 3 hours of ramp-in/snapback per event (21 total hours).

Peak demand reduction for the Business Demand Response program is defined as the amount of load reduced among all participants, averaged over all three DR event days (12 event hours). Table 4-4 summarizes the verified program impacts. Results for

"Customer X" are listed separately in the table because this customer represents a third of the program impacts and the operational characteristics of the customer's facilities required additional baseline modeling considerations.

Table 4-4: Program Impact Summary

Customer	Reported Peak kW Reduction	Verified Average Peak kW Reduction	Reported kWh Savings	Verified kWh Savings	Peak kW Realization Rate
Customer X	15,292	13,760	0	233,685	90%
All Other Participants	30,361	26,896	0	400,639	89%
All Customers	**45,653**	**40,656**	**0**	**634,324**	**89%**

4.1.4 Process Evaluation Findings

This section provides the results from the 2013 Peak Performers participant survey and near-participant interviews. The section continues by presenting the results of interviews that were conducted with PSO program managers and program operations staff. The chapter concludes by highlighting key findings and program recommendations resulting from the process evaluation.

4.1.4.1 Program Design Overview

The Peak Performers program is designed to incentivize commercial and industrial facilities for curtailing their energy usage during periods of high electrical demand. Nonresidential PSO customers enroll in the program and are notified when a load reduction event is initiated. Participants have the option of participating in each event individually, and are paid incentives based on average reduction over the course of all events. Incentives are set at $32 per kW reduction, and participants receive a 5% payment bonus if they opt to participate in all reduction events throughout the year. There is no direct penalty for opting out of specific event days.

The program is active during summer months, when average demand typically approaches designated capacity thresholds. Electric demand forecasts are generated by AEP Load Research staff members, who communicate with PSO Peak Performers program staff members and notify them of upcoming high-demand periods. PSO then assesses the need for a reduction event based on the forecasted demand levels for the current period, the number of possible events remaining, and the number of potential high-demand days remaining in the year. The Peak Performers program has the following limits for calling demand reduction events:

- Up to three events per week;
- Up to four events per month; and
- Up to twelve events per year.

Events may be called on any non-holiday weekday from June 1st to September 30th. Events may only be called from 1 p.m. to 7 p.m., and have duration of 2-4 hours.

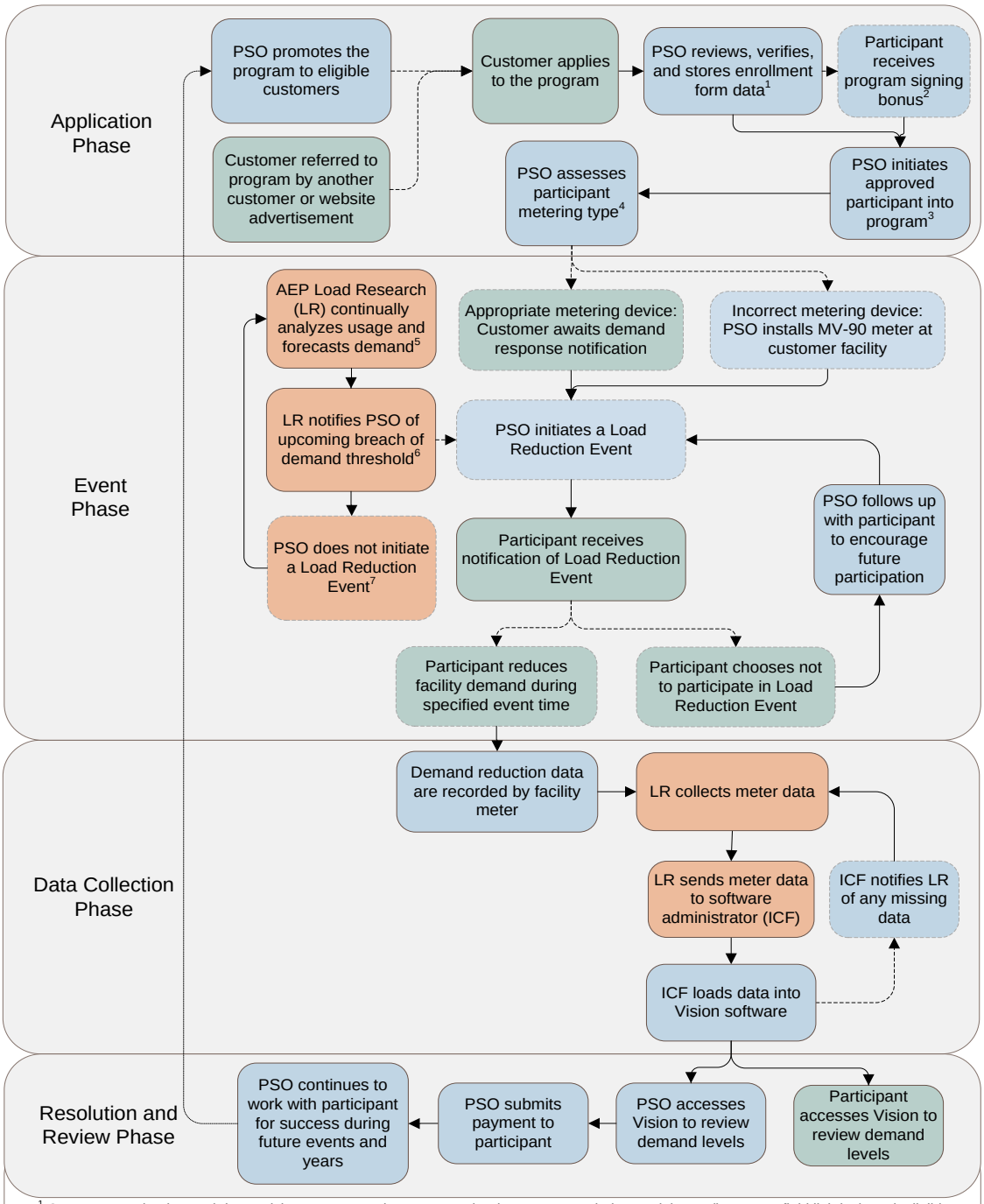
The load research department in Columbus, Ohio is responsible for monitoring and forecasting the electric demand in the PSO territory and other AEP regions. Staff members in this facility estimate future demand levels and identify peak periods where the demand is likely to approach a specified threshold (the threshold is set at 94% of the system's historic peak). If demand is forecast to reach this threshold, the load research department sends a notification to PSO detailing the time frame and expected demand levels. Peak Performers program management staff then decides whether to initiate a demand reduction event. This decision is based on the number of allowable events remaining in the day, month, and year, as well as other factors such as whether there are likely to be higher-demand days in the near future.

Once the decision to initiate a peak event is made, participants are notified by various methods including email, phone call, and text message. These notifications are sent out at least two hours prior to the beginning of the event, and many participants choose to have notifications sent to multiple individuals within the facility. Customers are able to list up to 10 individuals to be notified of upcoming peak events, and PSO sends out test notifications in order to ensure that the contact information is correct.

The incentive is paid out to participants after the final event of the program year, and includes the per-kW payment amount as well as any participation bonuses. Customers may reapply to the program for repeat participation in future years.

A full process flowchart for the Business Demand Response program, including individual tasks and phases, is illustrated in Figure 4-7.

Figure 4-7: Business Demand Response Process Flowchart



[1] Customers under the "real-time" pricing rate are, and customers who do not operate during peak hours (i.e. sports field lighting) are ineligible for participation.

[2] In 2013, customers who signed up for the program prior to May 10th received a $100 signing bonus as a promotional incentive.

[3] Participants are introduced to the Vision energy tracking software and are advised about how to participate in load reduction events.

[4] The majority of participants are equipped with a proper meter. If participants are already equipped with AMI meters using radio signals, these remain installed for data collection. PSO defaults to installing MV-90 meters if a meter replacement is needed.

[5] Load Research uses historical data to forecast future demand, and continually updates PSO with demand estimates at least once per week.

[6] When the demand forecast breaches 94% of the historical demand threshold, LR notifies PSO. Other atypical demand forecast characteristics may also prompt a notification.

[7] PSO is able to call up to 12 events per season. PSO assesses the forecasted breach of threshold and chooses whether to initiate an event based on the duration and magnitude of the threshold breach, as well as how many available events remain.

4.1.4.2 Program Enrollment Review

The PSO website includes detailed information regarding the purpose, structure, and operation of the Peak Performers program. The website provides a link to the enrollment application and relays important program details, including:

- A general overview of the program's purpose;
- Why PSO offers the program;
- The timing and duration of demand reduction events;
- The event notification process;
- Maximum events per week/month/year;
- The participation payment structure; and
- A link to contact PSO with any additional questions.

Additionally, the web page provides a link that allows prospective participants to download a document explaining the application process. This document contains extensive information regarding the type of information required, and provides instructions for each portion of the application.

The application itself is hosted online, and allows customers to create a user account in order to electronically store their application information. Upon submitting the application and returning to the site, customers are able to review their application, check its status, and manage the information they have provided. The online application requests a wide range of information from customers, including:

- Contact information for one or multiple contact persons;
- Facility operating schedule;
- Facility name and address;
- Payment information;
- Existing opportunities to reduce demand (includes a list of prompts); and
- A link to the program agreement.

In addition to the online program details and enrollment application, PSO representatives regularly inform customers about the Peak Performers program and other incentive opportunities as appropriate.

4.1.4.3 Participant Outcomes

A telephone survey was conducted to collect data about participant decision-making, preferences, and opinions of the Peak Performers program. In the 2013 program year,

61 customers representing 250 premises participated in the program and were notified of peak reduction events. In total, 30 participants fully responded to the process evaluation components of the online survey.

Participant Characteristics

Facility Types: The total participant pool for the 2013 Peak Performers program included participants representing a wide range of facility types, including:

- Elementary schools and universities;
- Retail stores;
- Industrial facilities;
- Medical facilities;
- Large and medium offices; and
- Other commercial facilities.

The 30 survey respondents were distributed among these facility types, and the most common survey respondent facility types were industrial facilities and schools and universities.

Program Engagement: In terms of event participation, approximately 65% of all 2013 program participants were listed as having participated in every available demand reduction event, while 35% of participants did not participate in at least one of the events. Within the survey sample, 87% of respondent facilities had participated in all of the demand reduction events.

Organizational Roles: Survey respondents were first asked to describe their role in the participating organization, as well as to explain how they had been involved with the Peak Performers program participation process. The majority of respondents stated that they were the operations manager, plant manager, or superintendent of the facility, while several respondents reported that they were the facility owner. Other roles held by survey respondents included safety managers, energy analysts, and environmental coordinators. Specific open-ended comments regarding respondents' roles in program participation include:

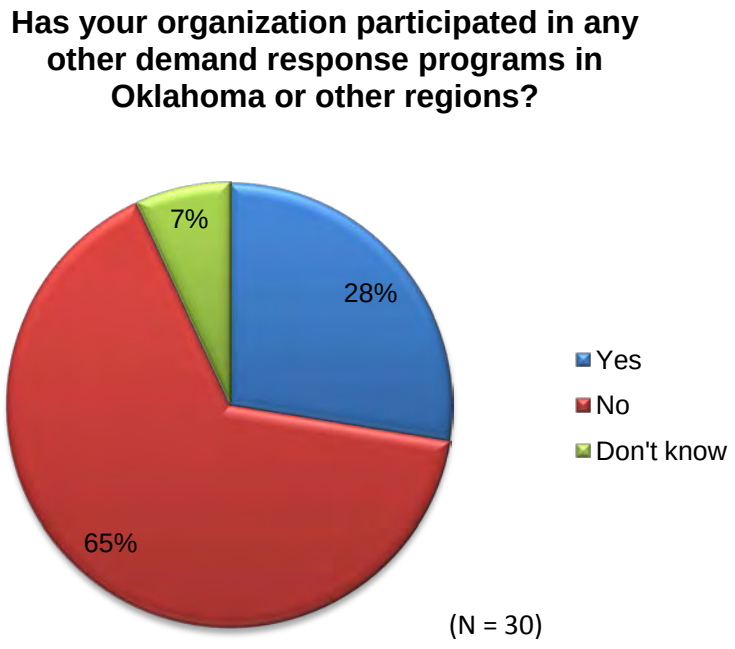
> *"I enrolled us in the program, developed [the] curtailment plan, and managed our participation."*
>
> *"I was one of two on the notification list, myself and the plant director."*
>
> *"I am the coordinator for all demand response initiatives; that involves the analysis and implementation of the program."*
>
> *"I'm the company point of contact to PSO."*

Each of the survey respondents was aware of their organization's participation in the Peak Performers program and had been involved in one or more aspects of program enrollment, demand reduction planning, communication with PSO, and/or managing facility operations during demand reduction events.

Past Participation in Demand Response Programs

In order to gauge participants' prior and current involvement in demand response programs, respondents were asked whether their organization had participated in any other demand response programs either in Oklahoma or elsewhere. As shown in Figure 4-8, approximately two-thirds of respondents reported that they had not participated in any other demand response programs. The 28% of respondents who indicated that they had participated in such a program were asked which specific programs they had previously been involved with. These respondents mainly explained that their organization had participated in demand response programs in other regions, as many of the respondent organizations were national companies with facilities in multiple states. Two of the respondents noted that they had participated in the PSO Demand Response program in prior years.

Figure 4-8: Past Participation in Other DR Programs



The respondents who reported participating in other demand response programs were then asked an open-ended question regarding how those programs compared to the Peak Performers program. Respondents provided short explanations of the other

programs, mainly indicating that they were fairly similar to the Peak Performers program. Specific responses to this question include:

> *"[The other program] was less of a volunteer activity and you had to commit to a certain level."*
>
> *"They are all pretty similar to PSO programs."*
>
> *"[The Peak Performers program is] very similar to what we call medium independent utility programs."*

When asked whether they preferred one demand response program over another, most of the respondents reported that they did not have a preference. However, one respondent noted that they like the flexibility of the Peak Performers program and wished that other programs were more flexible as well. Another respondent explained that program preference depends on the situation in each region, but that the Peak Performers program is ideal for their Oklahoma facility.

These results suggest that the majority of participants are not highly experienced with peak demand reduction programs, and that those who are experienced view the Peak Performers program as comparable to the other programs.

Program Awareness and Marketing

The participant survey included several questions related to the marketing and promotion of the Peak Performers program. Respondents were asked how they first heard about the program, and Table 4-5 shows that the majority (67%) of respondents reported learning about the program directly from a PSO representative. Only two respondents indicated that they first learned about the program through the PSO website, bill insert, or other marketing material published by PSO. A few respondents noted that they learned of the program from someone else in their organization, or that their facility had already been participating in the Peak Performers program when the respondent was hired.

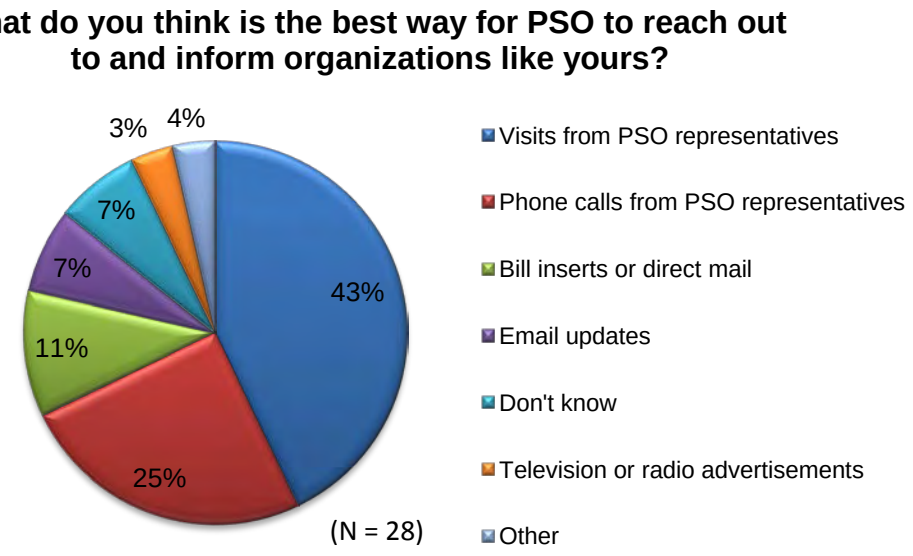
These results suggest that direct promotion from PSO representatives has been the most effective way to market the program thus far. Additionally, responses within other portions of the survey indicate that participants highly value the information that PSO staff have been able to provide in general.

Table 4-5: Method of Initial Program Awareness

	Response	Percent of Respondents (n=30)
How did you first hear about the Peak Performers program?	Call or visit from a PSO representative	67%
	Someone within your organization	10%
	Friend or colleague from outside your organization	7%
	PSO Marketing materials	7%
	Other	10%

In order to gauge whether participants had any suggestions for program promotion, respondents were asked to identify the most effective methods of reaching out to their type of organization. The majority of respondents, who represented a wide range of facility types, indicated that direct contact from utility representatives is the best outreach method. A few respondents reported that bill inserts or direct mail are effective methods, but overall these findings suggest that the personal outreach from utility staff is a valuable tool that appeals to a range of customer types.

Figure 4-9: Reported Effective Outreach Methods



Some of the respondents provided commentary regarding their preference for direct PSO outreach. These comments included:

> *"Having representatives reach out in person is effective. The other mediums that people use come across as a barrage of information; word of mouth on a personal basis is best."*

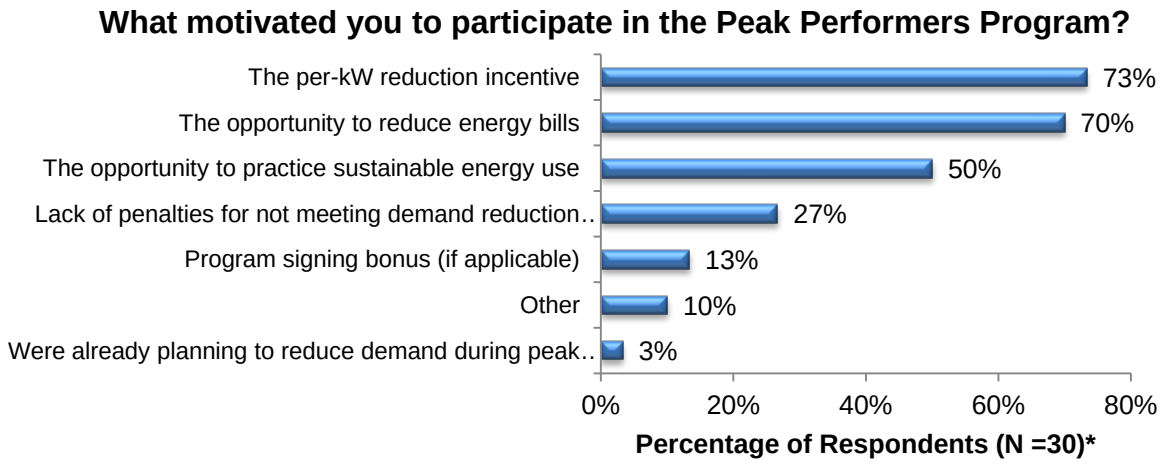
"If you send something in the bill it goes to a third party, so that wouldn't work so well."

"Talking with account representatives has been effective."

Factors Affecting Participation

In order to gain insight into participants' decision making process when enrolling in the Peak Performers program, respondents were asked what motivated them to participate in the program. Respondents were able to provide multiple responses to this question, and the results are displayed in Figure 4-10. The majority of respondents indicated that both the demand reduction incentives, and the opportunity to reduce their energy bills, were motivating factors. Additionally, half of the respondents reported that they wanted to contribute to sustainable energy use. Only one respondent noted that they were already planning to practice demand reduction during peak times.

Figure 4-10: Reported Motivations for Program Participation



When asked to state the single most influential factor that motivated them to participate in the program, the majority of respondents identified the reduction incentive or decreased utility bills as the main motivators. Several respondents provided open-ended comments regarding the factors that motivated them to participate, including:

"It's a good thing to do, [it] helps everybody out, we get a little money back. It's pretty easy to comply with."

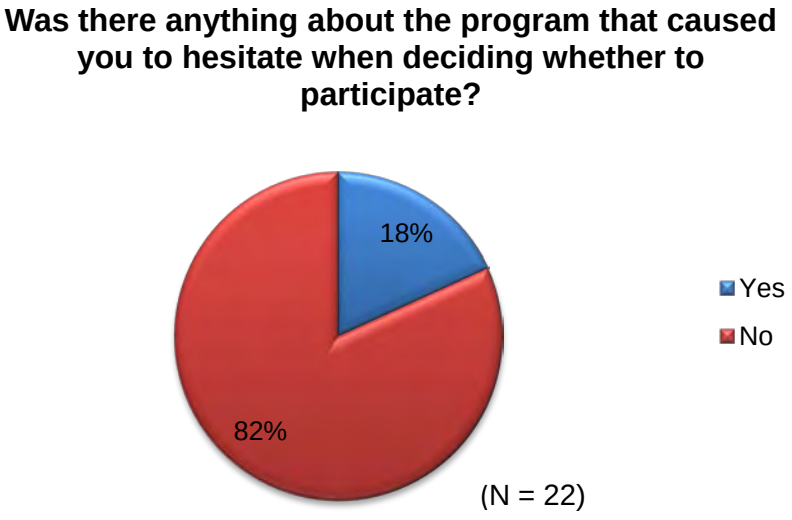
"It was a good fit for how we operate our facilities and what was being offered."

"There was an opportunity to receive rebates, but the real motivation was to help PSO reduce energy usage and make it better for everyone."

> *"After hearing about it, I thought that my facility would be perfect for that. We can change demand easily."*

Respondents were then asked whether they had any initial reservations about participating in the program. As shown in Figure 4-11 , only four (18%) of the respondents to this question indicated that there was something about the program that caused them to hesitate. When asked to explain these initial concerns, two of the respondents noted that as their facility is an office building, they are required to keep the facility within specific temperature ranges. These respondents were concerned that the program would have negative impacts on the building's tenants, and that the reduction procedures they would have to implement would violate the temperature requirements. One of the other respondents explained that their organization had to analyze the program's financial costs and benefits before making the decision to participate.

Figure 4-11: Initial Perception of the Peak Performers Program



Overall, these responses suggest that the structure and design of the Peak Performers program is well-received by participant organizations, and that any hesitations are mainly due to the need for cost analysis and organizational approval.

Demand Response Procedures and Program Delivery

In order to gain further insight into how participants are able to meet demand reduction targets, respondents were asked to identify the specific actions that they have taken during peak events. Respondents provided a wide range of responses, and the most commonly cited activities were:

- Partial lighting shutoff;
- Complete shutoff of HVAC equipment;

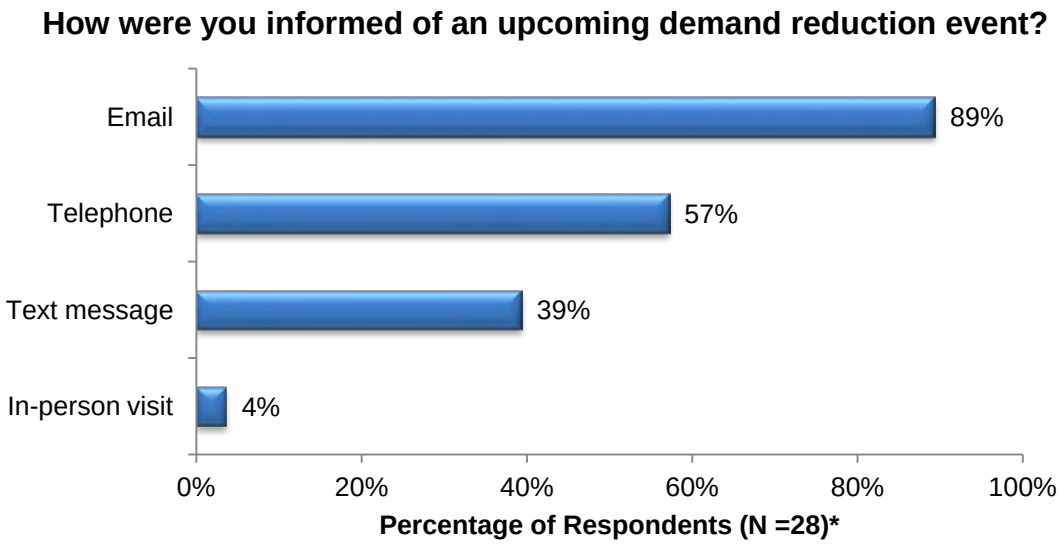
- Raising thermostat set points;
- Complete shutoff of other large equipment; and
- Complete shutdown of specific areas of the facility.

Additionally, several respondents mentioned that their energy management system contains a program that automatically curtails electrical usage upon request, so that the facility can easily comply with peak events when they are called. Two of the respondents reported that during demand reduction events, they shift the facility load to a generator in order to remain operational. The majority of respondents indicated that they make adjustments to multiple types of equipment in order to sufficiently reduce their energy load.

When asked whether they were able to reduce as much load as they had initially expected, the majority of respondents indicated that they had. Most of the remaining respondents explained that there had been one or two instances where high facility demands had prevented them from participating in a peak reduction event. Only one respondent indicated that despite their best efforts to reduce demand during peak events, their facility had not curtailed as much load as expected.

All survey respondents were asked to identify how they were informed of an upcoming demand reduction event. Respondents were able to provide more than one response. As shown in Figure 4-12 the most common notification method was email, followed by telephone calls. The majority of respondents reported being notified via more than one of these methods, and several respondents mentioned that the notifications were sent to multiple contact persons within the facility.

Figure 4-12: Reported DR Event Notification Methods



*Respondents were able to provide more than one response. The percentages shown are based on the number of respondents, rather than the number of responses. Thus, the total exceeds 100%.

When asked whether they had received enough advance notice of an upcoming event, all but one respondent indicated that they had. The single respondent who reported otherwise explained that they had received very short notice for the first event, but that this issue was quickly resolved.

In 2013, the Peak Performers program called three reduction events out of the annual maximum of 12 events. This was due to a relatively cool summer, where there were few days that would warrant initiating the demand reduction process. As the program guidelines allow for a substantially higher rate of demand reduction events, survey respondents were asked how many events they had initially expected. As shown in Table 4-6, half of the respondents expected six or more events to be called. Slightly more than a third of the respondents stated that they expected three to five events, while only one (3%) of the respondents indicated that they expected fewer than three events.

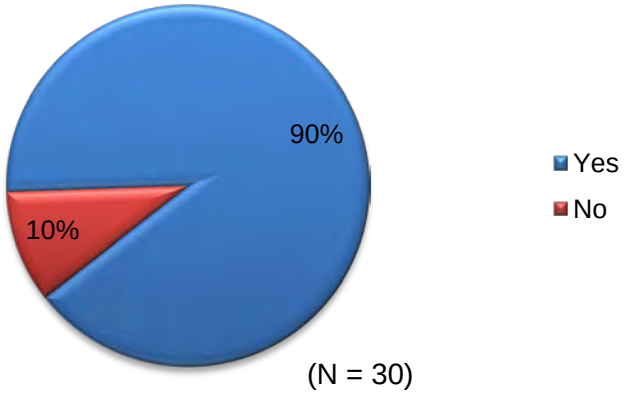
Table 4-6: Participant Expectation of DR Event Quantity

	Response	Percent of Respondents (n=30)
How many demand reduction events did you expect to be called?	Fewer than three events	3%
	Three to five events	37%
	Six to eight events	43%
	More than eight events	7%
	Don't know	10%

The program is structured such that participants receive incentives based on average demand reductions rather than total demand reductions, so a higher number of events does not necessarily equate to higher participant incentives. This incentive structure allows customers to control their incentive level regardless of event frequency, rather than having to rely on a large number of events being called. Along with this, respondents were asked whether they thought that the incentives provided through the program were adequate. Figure 4-13 shows that a high majority of respondents perceive the incentives as adequate, while only 10% of respondents view the incentives as inadequate. When asked whether they had any specific recommendations to modify the program’s incentive structure, these 10% of respondents did not provide any suggestions.

Figure 4-13: Reported Adequacy of Program Incentives

Are the incentives provided through this program adequate?

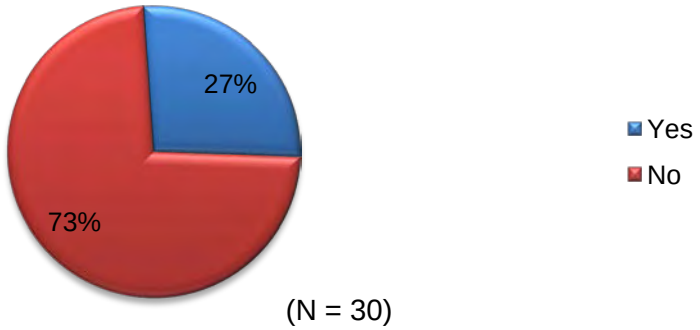


Energy Use Monitoring

Beginning in the 2013 program year, participants of the Peak Performers program were able to access a software portal that contained information about their load profile and demand reduction achievements. PSO has been able to use this software to monitor many aspects of program performance, including participant enrollment levels, energy savings levels, and other parameters. The software also allows participants to view information about their facility and gain insight into how well they are meeting reduction goals. In order to gauge whether participants are actively using this tool for these purposes, respondents were asked about their general awareness of the software's capabilities. As shown in Figure 4-14, nearly three-quarters of respondents reported that they were not aware of the ability to monitor their load reduction levels.

Figure 4-14: Awareness of Load Profile Tracking Tool

Are you aware of the software portal that allows program participants to monitor their energy usage?



Five (16% of total) respondents indicated that they had used the portal for this purpose, and two of these respondents noted that they had encountered issues when attempting to access the information. Specifically, these respondents stated the following:

> *"Yes, [we] had some difficulty with the online side. We wanted to check our performance and some of the links were confusing."*
>
> *"I used it but it was operating intermittently. There were corrections and glitches that PSO had to address."*

When asked whether they would like to see any changes made to the software portal, one of these respondents suggested that the program should be easier to navigate. These results suggest that the level of engagement with the online software portal is fairly low, and that participants are encountering difficulties when attempting to use the software's energy tracking capabilities.

Participant Satisfaction with the Program

Respondents were asked about their levels of satisfaction with selected elements of the program. Responses were provided on a scale of very dissatisfied to very satisfied. Table 4-7 shows participant satisfaction responses for each listed program element.

Overall, participants reported fairly high levels of satisfaction with each program element. Respondents reported the highest average satisfaction levels for their interactions with PSO staff, although 11 respondents indicated that they had not had any direct interactions with staff members since they enrolled in the program. Ninety percent of respondents reported that they were very satisfied or somewhat satisfied with the event notification process. Additionally, none of the respondents reported being at all dissatisfied with the level of program information they initially received from PSO.

Reported dissatisfaction was very minimal, with a maximum of one respondent indicating that they were dissatisfied in any one of the selected program elements. Although only three peak events were called during the 2013 program year, the majority of respondents indicated that they were at least somewhat satisfied with the number of events that had occurred. Overall, the reasons for dissatisfaction among respondents were fairly anecdotal and isolated, and did not suggest any systemic issues with program design or delivery. For example, one respondent indicated that they were not initially notified of an upcoming event, but that this issue had been corrected. Another respondent restated their desire for more demand reduction events.

Table 4-7: Participant Satisfaction Ratings by program Element

Element of Program Experience	*Satisfaction Rating*						
	Very Satisfied	*Somewhat Satisfied*	*Neutral*	*Somewhat Dissatisfied*	*Very Dissatisfied*	*Don't know*	*N*
Information initially received from PSO	60%	37%	3%	-	-	-	30
Number of events called	50%	23%	23%	3%	-	-	30
Availability of energy usage data	40%	33%	10%	3%	-	13%	30
Program application process	60%	23%	7%	3%	-	7%	30
Event notification process	70%	20%	3%	3%	-	3%	30
Interactions with PSO staff	84%	11%	-	-	-	5%	19
Incentive agreement	40%	33%	13%	3%	-	10%	30
Overall program experience	50%	47%	-	-	3%	-	30

Respondents were given the opportunity to provide commentary regarding their overall experiences with the Peak Performers program and to recommend improvements to the program. One respondent explained that they would like to have an option to remain in the program until they opt out, so that it is not necessary to reapply each year. Another respondent noted that it would be useful to receive event notifications on their pager rather than through email or over the phone. Finally, one respondent noted that there had been difficulties in accessing their energy usage data, and that any issues with the software portal should be addressed.

As an alternative to program recommendations, many respondents used this opportunity to provide praise for the Peak Performers program, citing their positive experiences. Specific comments of this nature include:

> *"I think that all of the programs are useful, and I am looking into participating in other PSO programs as well. Usually we don't hear about incentives unless it's by word of mouth, so more promotion with postcards would be great."*
>
> *"I don't know that there's any way to improve that, your staff work really well to make the program run smoothly. We have several people from PSO who are very attentive and helpful."*
>
> *"Our overall experience went well, the staff was informed prior to all events making it easy to respond."*
>
> *"We track our energy use internally and we use it as a promotion of the program internally. It's a great tool and a good system."*

Overall, the survey findings indicate that participants of the Peak Performers program are very satisfied with their program experiences, and that they highly value the incentive and demand reduction opportunity provided by PSO.

4.1.4.4 Near Participant Interviews

In order to gain insight into existing participation barriers and compare program participant characteristics with non-participants, the evaluators conducted interviews with a sample of customers who did not ultimately enroll in the Peak Performers program. PSO provided the evaluators with a list of customers who had engaged in discussions with PSO staff about the program, or who had expressed initial interest in participation. At the time the list was generated, none of these customers had proceeded to enroll in the program.

The evaluators attempted to contact each of the 25 listed near-participants, but many of these customers did not actively respond to emails or telephone calls. Ultimately, the evaluators were able to reach and conduct interviews with three near-participant customers. This section provides a summary of findings from these interviews. It should be noted that the information gathered through this interview process represents a small portion of the total near-participant population, and that these results may not be representative of the group as a whole.

- **Participation in Similar Programs:** Each near-participant was first asked whether their organization had participated in any other demand response programs in Oklahoma or other regions. All of the respondents reported that they had not participated in any programs that were similar to the Peak Performers program.
- **Perceived Program Benefits:** When asked which parts of the program were the most appealing, all three near-participants stated that the reduction incentive was the most appealing characteristic. Two of the near-participants noted that they also liked the fact that there was no penalty for falling short of demand reduction targets. Additionally, two of the respondents stated that the ability to closely monitor energy usage was also appealing.
- **Perceived Barriers to Participation:** Near-participant respondents were given a list of potential barriers to program participation, and were asked to identify which of the barriers were relevant to their decision to not enroll in the program. Once they indicated that a specific barrier was relevant, respondents were asked to indicate the strength of the barrier (i.e. how significant the barrier was in their decision to not participate). The results are summarized as follows:
- **Barriers to Participation: Respondent 1**

  This respondent identified the following barriers to participation:

  - Inability to modify equipment energy usage (very significant barrier)

- Would rarely be able to participate in an event (very significant barrier)
- Facility demand does not allow for peak demand reductions (very significant barrier)

When asked to explain these barriers in their own words, this respondent stated that they would be unable to participate in any events without falling short of the demand required to keep the facility operational. This participant represented an industrial facility that has constant demand requirements which are not flexible.

- **Barriers to Participation: Respondent 2**

  This respondent identified the following barriers to participation:

  - Incentive was not large enough (very significant barrier)
  - Would rarely be able to participate in an event (very significant barrier)
  - Inability to obtain participation approval from organization (very significant barrier)
  - Facility demand does not allow for peak demand reductions (very significant barrier)
  - Inability to modify equipment energy usage (slight barrier)
  - Insufficient staffing to meet program requirements (slight barrier)

  When asked to explain further, this respondent stated that due to production and demand requirements, the facility would incur costs by participating in the program. The respondent noted that a much higher incentive could potentially motivate the facility to participate, but that the amount would have to be unrealistically high before enrolling in the program would make financial sense.

- **Barriers to Participation: Respondent 3**

  This respondent identified the following barrier to participation:

  - Timing (very significant barrier)

  When asked to elaborate on this barrier, the respondent explained that when they had initially learned of the program, they needed time to consider the benefits of participation. Additionally, the respondent's facility takes time to approve program participation, and each opportunity must be carefully considered. The respondent reported that the facility had taken the time to think about participating, and that their facility was planning to enroll in the program during the following year.

- **Program Suggestions:** When asked whether there was anything that could be done to make the Peak Performers program more appealing, none of the

respondents provided any suggestions for program-wide improvements. One of the respondents noted that the only way their organization would likely be able to participate in the program is if they received a gas generator from PSO in exchange for participating. This would possibly allow the participant to keep their facility operational during peak events, but it is not within the scope of the program.

- **Current Demand Reduction Activities:** Respondents were asked whether they currently take any actions to reduce the demand of their facility during peak hours. Two of the respondents stated that they do currently perform specific actions to do so. When asked to explain, these respondents both stated that their organization has an in-house energy program that focuses on reducing overall usage. One of the two respondents mentioned that their program has been in place since 2007.
- **Satisfaction Levels:** All three near-participant respondents were asked about their satisfaction levels with the information they received about the Peak Performers program. All three respondents indicated that they were very satisfied with the information that they had received. Additionally, respondents were asked how satisfied they were with any interactions they had had with PSO staff members. Again, all three respondents indicated that they were very satisfied with these interactions.

Additionally, near-participant respondents were asked if they had any final comments regarding the Peak Performers program. The respondent whose organization plans to participate in the upcoming year stated that they were looking forward to working with PSO. Another one of the respondents explained that although they cannot participate in the program, they value their local PSO representatives, and that they have a good overall working relationship with the utility.

4.1.4.5 Program Operations Assessment

This section summarizes the core findings of interviews with key program staff members. These interviews provide information regarding the structure of program demand analysis and the procedures that take place during program operation. For the 2013 Peak Performers program evaluation, the evaluators conducted in-depth interviews with two PSO program management staff members, and three staff members involved in load research and setting up criteria for threshold breaches that may trigger the calling of an event.

Summary of Findings

- **Organizational Transition:** Program staff explained that PSO had shifted from using a third-party contractor to using in-house staff to manage the Peak Performers program. This transition occurred in late 2012, and was intended to improve program management and increase overall program performance. Both of the interviewed program staff had started working with the Peak Performers program at that time,

and had attended training courses to familiarize themselves with their roles. Prior to the transition, the program had been generating demand reduction, but the staffing transition allowed PSO to control all aspects of program management and make improvements where necessary.

- **Program Performance:** Program staff noted that the total reduction in the prior year (from the two C&I demand response programs PSO operated in 2012) was approximately 29 Megawatts, and that the 2013 year had seen a significant increase to approximately 47 Megawatts. This represented a substantial increase in enrollment levels, from fewer than 30 participants to more than 60 participants. However, even with the participation and savings increases, program staff stated that the Peak Performers program has fallen short of its goal of 58 Megawatts. This may present a challenge in the future, as the goal for the 2014 program will be 65 Megawatts. Program staff identified several factors contributing to the lower than expected savings levels, including:

    - Marketing: Program marketing was not fully initiated until March of the 2013 program year.
    - Customer Demand Reduction: Some customers believe that they can achieve more reduction than they actually do.
    - Customer Learning Curve: Newer customers are continuing to learn which actions they can take to effectively reduce demand.

  In order to address this, program staff explained that they need to recruit more large participants into the program. As of now, there are quite a few small and medium sized commercial customer participants, but participation from a national chain or large facilities is likely needed to sufficiently increase savings levels. Additionally, program staff noted that participants who are in their second year of participation are typically able to achieve greater load reduction than those in their first year. Thus, with high participant retention rates, the program will likely see a substantial increase in savings levels for the upcoming year.

- **Program Drop-outs:** Program staff indicated that there had been several customers who decided to drop out of the program after having been enrolled in previous years. These drop-out customers represented approximately 8 Megawatts, which is a substantial portion of the annual goal. Staff explained that large customers with 15 million kWh usage or more per year have the option to opt-out of utility programs without facing any penalties, and would prefer to do this than to participate. Additionally, one customer who had multiple participating locations decided to opt out because most of their locations were not achieving sufficient demand reduction.

  Program staff noted that customers with multiple locations, or chains, do not have to enroll all of their locations in the program. This means that if one location is

performing well and the others are not, the customer can opt out of the program with their other locations and continue participating with only one or a few facilities. It appears that some customers do not fully understand this detail of the program, or that they do not see the value in participating with only a portion of their businesses.

- **Customer Service Marketing:** Interviewed PSO staff explained that program marketing depends heavily on PSO customer service representatives, as they are the primary interface between PSO and its customers. These representatives are responsible for informing customers about the available energy efficiency programs and answering their initial questions. Once a customer exhibits interest in participating, program management staff typically steps in to explain further details, but the customer service representatives are the main promotional method for the Peak Performers program.

  Program staff reported that these representatives had been very effective in recruiting participants, and that they had in fact been the most successful marketing method for generating program interest. This is supported by the participant survey findings, where the majority of respondents indicated that they learned about the program from a PSO representative.

The following list summarizes key factors, and any associated recommendations, that will likely be important considerations for future program years. These findings are based on the overall evaluation, including program staff interviews, participant and near-participant interviews, and a review of the Peak Performers program as compared to other demand response programs.

- **Minimizing Customer Misconceptions:** The evaluation interviews suggested that some customers do not fully understand the requirements and procedures involved with participating in the Peak Performers program.

  - **Upfront Cost:** Some customers believe that there is an upfront cost to participate, or that they will ultimately lose money by participating. While the costs of the program are paid by the general customer population through monthly bill riders, and some facilities may incur operational or production costs if they practice substantial load reduction, there is no additional enrollment cost or additional participation cost to customers.
  - **Complete Shutdown:** Some customers believe that they must completely shut down their facilities during peak events rather than only partially reducing their electric load. This likely creates resistance to enrollment, as a complete shutdown would clearly not be acceptable for most customers.
  - **Generator Use:** Some participants will only take part in the program if they are able to shift their load to a generator during peak events. This may be related to some customers' belief that they will have to completely shut down

their electrical use during peak events, as most customers would not be able to accomplish this without using a generator. Additionally, program staff reported that the previous implementation contractor would sometimes assist customers with generator costs, which is outside the scope of the Peak Performers program. While it may be beneficial for program staff to recruit customers who will be able to shift their load to generators, it should be emphasized that having or using a generator during peak events is not a prerequisite for participating.

- **Program Penalties:** Some customers may also believe that there is a penalty for failing to meet demand reduction targets, or that they have to participate in all events in order to receive an incentive.

PSO staff stated that they have worked with customers to educate them about program procedures and requirements, but that there are likely many non-participants who share these or other misconceptions. These issues further emphasize the importance of clear and informative messaging within all promotional program materials, and it may even be beneficial to directly address these misconceptions with prospective customers.

- **Maintaining Customer Engagement:** Interviewed program staff discussed improvements in the working relationship between PSO and Peak Performers Participants. Specifically, staff explained that in prior program years there had not been an active feedback loop between the program implementer and the participating customer. This resulted in customers not fully understanding some details of the program, and participants not having a clear idea of how they were performing in terms of demand reduction.

  Program staff noted that now there is an emphasis on communicating with participants and guiding them through the program. This is done through providing customer and facility information to participants through the software portal, as well as through active outreach to customers who may have questions about the program. For example, PSO staff now work with customers who are having difficulties meeting their demand reduction targets so that they learn how to effectively respond to peak events in their specific facility. Responses to the customer survey corroborate this discussion, with participants praising the active involvement and helpful information provided by PSO staff members. This level of engagement should be maintained, as it is clearly well-received by the participant and near-participant population. It would also likely be useful to administer a customer satisfaction survey at least annually, in order to ensure that participants are able to provide formal feedback and identify any issues associated with program operation or delivery.

- **Participation Barriers and Participant Selection:** Overall, the near-participant interviews found that the customers who have decided not to participate in the Peak Performers program believe that they would not be able to effectively reduce demand during peak events. As the program does not have penalties for falling short of demand reduction expectations, and there is no additional enrollment cost, it is likely that many near-participants have come to this same conclusion. There do not appear to be any opportunities to make the program more appealing to this set of near-participants, as they face very strong participation barriers that are ingrained in their facility operations.

  However, there are likely many other customers who are facing weaker barriers, such as a lack of program awareness and education. This may be the most relevant barrier to participation, as is typical for programs that have no additional enrollment or participation cost[34] but are not meeting savings targets. Program marketing efforts, especially the direct approach used by PSO representatives and management staff, have been useful. Continued personal outreach by PSO representatives will likely increase awareness and word-of-mouth marketing, especially if customer misconceptions are clearly addressed upfront.

- **Data Transparency:** During the participant survey, two participants mentioned that they were not sure how their incentive levels were calculated. One of these participants stated that they had initially received one estimate of the incentive they would receive, but that the calculation had later been revised. While it may be a small segment of participants, it appears that some individuals would like more clarity regarding the calculation of their incentive. It is also important to distinguish between an actual revision to the incentive calculation and a revision to the incentive level based on lower than expected demand reduction. PSO should verify that all participants understand how their incentives are calculated, and directly notify participants if there will be a change to this calculation.

  Additionally, most of the participants did not appear to be aware of the fact that they could view their program performance and overall usage through the software portal. Emphasizing this feature to participants will likely help them feel more informed. This may also contribute to overall savings, as participants who are able to compare their performance from event to event may be more likely to actively improve their demand reduction efforts over time.

- **Data Collection and Management Improvements:** As the Peak Performers Program involves customers who have two types of meters (AMI vs. MV-90 meters), there have been challenges with standardizing the data and ensuring that all participants receive timely and accurate feedback on their demand reduction activity.

[34] The Peak Performers Program is paid for by utility customers through riders on their monthly bills. However, there is no additional cost specifically required of program participants.

According to program staff, most of these issues were resolved quickly and were attributable to the learning curve associated with each party becoming familiar with program procedures. There are currently plans to develop a common data repository for both MV-90 and AMI data, which is designed to allow Load Research to quickly access and analyze information. This system is planned for the upcoming program year, and is expected to increase efficiency and minimize delays.

- **Data Transfer Efficiency:** In order to facilitate communications and data tracking between PSO and the load research department, a shared spreadsheet was created that is accessible to both parties. This allows users to input participant information, which can then be retrieved by the load research department and matched to customer meter data. This spreadsheet appears to be the most effective method of transferring customer information between PSO and the load research department, and it may be beneficial for PSO to directly update the shared spreadsheet rather than sending participant updates to Load Research through other methods. If used effectively, this will likely contribute to program efficiency and up-to-date participant tracking.
- **Overall Program Operations:** The interviews conducted with PSO staff, Load Research staff, and Consumer Programs group staff suggested that although the Peak Performers Program encountered minor challenges during its initial startup, it has continually become more refined over time. When asked about the frequency and quality of communications with the load research department and MV-90 data group, PSO staff reported that they communicate weekly about the data transfer process and any updates to data management procedures. Staffing levels appear to be sufficient for the current level of program activity.

Overall, staff members generally reported that internal communication is frequent and effective, and that each department involved in the program has become proficient in their respective roles. Additionally, Interviewed program staff indicated that the transition away from a third-party implementation contractor has been manageable and positive. These comments are supported by the results of the customer survey, where participants reported high satisfaction levels and specifically stated that program staff had been very informative and responsive to their needs. The structure of the Peak Performers program, and the parties involved, appear to be contributing to fairly efficient and reliable program operations.

4.1.5 Planned Program Changes

There are currently no changes planned for the 2014 Business Demand Response program.

Appendix A. Glossary

Cash Inducement Costs: Refers to customer and service provider rebate/incentive costs incurred by PSO in the implementation of a program.

Coincidence Factor (CF): For energy efficiency measures, the CF represents the fraction of connected load reduction that occurs during the peak demand period.

Deemed Savings: A savings estimate for relatively homogeneous measures. Generally, an assumed average savings across a large number of rebated units is applied to each individual unit installed.

Effective Useful Life (EUL): The number of years (or hours) that an energy-efficient technology is expected to function. Also referred to as "measure life."

EM&V Administrative Costs: EM&V administrative costs include all costs associated with evaluation, measurement and verification of reported energy and demand impacts resulting from the implementation of a program.

Ex Ante: Refers to estimates of energy savings and peak demand reduction developed before program evaluation. Equivalent to "reported impacts."

Ex Post: Refers to estimates of energy savings and peak demand reductions developed from program evaluation. Equivalent to "verified impacts."

Free-ridership: Percentage of participants who would have implemented the same energy-efficiency measures in a similar timeframe even in the absence of the program.

Gross Impacts: Changes in energy consumption/demand that result directly from program-promoted actions regardless of the extent or nature of program influence on these actions.

Impact Evaluation: Impact evaluation is the verification and estimation of gross and net impacts resulting from the implementation of one or more energy-efficiency or demand response programs.

Measure: An energy-efficiency "measure" refers to any action taken to increase energy efficiency, whether through changes in equipment, control strategies, or behavior.

Net Savings: The portion of gross savings that is directly attributable to the actions of an energy-efficiency or demand response program.

Net-to-Gross Ratio (NTGR): A factor representing net program savings divided by gross program savings that is applied to gross program impacts to convert them into net program impacts. Generally calculated as 1 – (free-ridership %) + (Spillover %).

Non-Cash Inducement Costs: Non-cash inducement costs include third party implementation costs and advertising costs incurred by PSO in the implementation of a program. PSO earns no incentives on advertising costs.

Non-EM&V Administrative Costs: Non-EM&V administrative costs include PSO staff labor costs and overhead costs associated with implementing a program.

Oklahoma Deemed Savings Documents (OKDSD): Refers to the Oklahoma Deemed Savings, Installation & Efficiency Standards and associated work papers for small commercial and residential energy efficiency measures. These documents were submitted to the OCC as part of Cause # PUD 200900196 and approved for use as part of Order # 572836.

Participant Cost Test (PCT): The PCT examines the cost and benefits from the perspective of the customer installing the energy efficiency measure. Costs include incremental costs of purchasing and installing the efficient equipment, above the cost of standard equipment. Benefits include customer bill savings, incentives received from the utility, and any applicable tax credits.

Peak Demand: For the purposes of this report peak demand refers to the average metered demand during the peak period, defined as 2 to 9 PM during the summer months, June through September, excluding weekends and holidays. Note that for the Business Demand Response program, peak demand reduction is calculated as the average reduction during event hours.

Process Evaluation: A systematic assessment of an energy efficiency program for the purpose of documenting program operations at the time of examination and identifying potential improvements that can be made to increase the programs efficacy or effectiveness.

Projected, Reported, and Verified Savings: Projected impacts refer to the energy savings and peak demand reduction forecasts submitted to the OCC as part of PSO's initial 2013 – 2015 portfolio filing on June 28, 2012.[35] Reported impacts refer to energy savings and peak demand reduction estimates based on actual program participation in PY2013, before program evaluation activities. Finally, verified impacts refer to energy savings and demand reduction estimates for PY2013 developed through independent program evaluation, measurement, and verification (EM&V).

Ratepayer Impact Measure (RIM): The RIM examines the impact of energy efficiency programs on utility rates. Reduced energy sales can lower revenues and put upward pressure on retail rates as the remaining fixed costs are spread over fewer kWh. Costs include overhead and incentive payments and the cost of lost revenue due to reduced sales. Benefits include cost savings associated with not delivering energy to customers. These "avoided costs" include generation, transmission, and distribution costs.

Realization Rate: The ratio of verified (ex post) impacts to reported (ex ante) impacts.

[35] Cause No. PUD 201200128, Direct Testimony of Eric Raines.

Societal Cost Test (SCT): The SCT includes the same costs and benefits as the TRC, but uses a lower discount rate to reflect the overall benefit to society over the long term.

Spillover: Energy and/or demand savings caused by a program, but for which the utility did not have to provide cash inducements.

Total Resource Cost Test (TRC): The TRC measures the net benefits of the energy efficiency program for the region as a whole. Costs included in the TRC are incremental costs of purchasing and installing the efficient equipment, above the cost of standard equipment and overhead cost associated with implementing the program. Benefits include cost savings associated with not delivering energy to customers. These “avoided costs” include generation, transmission, and distribution costs.

Utility Cost Test (UCT): The UCT examines the costs and benefits of the energy efficiency program from the perspective of the utility company. Costs include overhead (administration, marketing, EM&V) and incentive costs. Benefits include cost savings associated with not delivering energy to customers. These “avoided costs” include generation, transmission, and distribution costs.

Appendix B. Portfolio Cost-Effectiveness

This appendix provides an overview of each programs' participation, verified reduction in peak load, verified kWh savings, annual admin costs, total program costs, as well as a summary of the cost effectiveness analysis.

B.1 Cost Effectiveness Summary

This appendix covers all verified electricity and peak demand savings, and associated program costs incurred in the implementation of PSO's 2013 energy efficiency and demand response portfolio from January 1, 2013 through December 31, 2013.

The cost-effectiveness of PSO's 2013 programs was calculated based on reported total spending, verified energy savings, and verified demand reduction for each of the energy efficiency and demand response programs. All spending estimates were provided by PSO. The methods used to calculate cost-effectiveness are informed by the California Standard Practice Manual.[36]

The demand reduction (kW) and energy savings (kWh) presented throughout this appendix represent net savings at the generator by applying program level net-to-gross (NTG) ratios and adjusting for line losses. Program level NTG ratios for the 2013 programs were estimated by ADM as part of the portfolio impact evaluation. Verified savings estimates at the meter were adjusted to account for line losses using a line loss adjustment factor of 1.056. For gas savings estimates, a 1.014 gas loss factor was included.

In order to calculate the cost-effectiveness of each program, measure lives were assigned on a measure-by-measure basis. When available, measure life values came from the *Oklahoma Deemed Savings Documents* (OKDSD). When not available in the OKDSD, measure life values came from the Arkansas TRM.[37] Additionally, assumptions regarding incremental/full measure costs were necessary. Often, these costs were taken directly from the VisionDSM portfolio tracking database or project specific invoices. When not available, ADM relied on PSO's 2009 Energy Efficiency Plan, 2012 Annual Report, and ADM estimates based on relevant industry sources.

Avoided energy, capacity, transmission/distribution, and CO2 costs used to calculate cost-effectiveness were provided by PSO and are found in Section B.4 of this appendix. Residential and commercial rates used to estimate certain cost-effectiveness tests were also provided by PSO.

[36] California Standard Practice Manuel: Economic Analysis of Demand Side Management Programs, October 2001. Available at: http://www.cpuc.ca.gov/NR/rdonlyres/004ABF9D-027C-4BE1-9AE1-CE56ADF8DADC/0/CPUC_STANDARD_PRACTICE_MANUAL.pdf

[37] http://www.apscservices.info/EEInfo/TRM.pdf

Table B-1 lists each program included in this analysis, along with the final verified savings estimates, total expenditures, Utility Cost Test (UCT)[38] results, and Total Resource Cost Test (TRC) results. Results from the UCT and TRC are focused on in this summary for the following reasons:

- The UCT results are a direct input to the shared savings component of the Demand Side Management Cost Recovery Rider (DSM Rider) as described in Oklahoma Corporate Commission PUD 201200128.[39]
- Oklahoma Administrative Code (OAC) 165:35-41-2 lists the goals of energy efficiency and demand response programs as (1) minimize the long-term cost of utility service, and (2) avoid or delay the need for new generation, transmission, and distribution investment. The TRC test best reflects these goals, as it looks at benefits and costs from the perspective of all utility customers in the utility's service territory (participants and non-participants).

In addition to UCT and TRC results, results from the Ratepayer Impact Measure (RIM), Participant Cost Test (PCT) and Societal Cost Test (SCT) are included in the body of this appendix.

Based on verified program impacts and spending during PY2013, PSO's overall portfolio is cost-effective based on both the UCT and TRC.

Table B-1:Cost-Effectiveness by Program, 2013 (Impacts are Net, at Generator)

Program	Verified Peak Demand Reduction (kW)	Verified Annual Energy Savings (kWh)	Annual Gas Savings (Therms)	Total Program Expenditures	TRC (b/c ratio)	UCT (b/c ratio)
High Performance Business	2,767	20,326,563	0	$6,352,105	1.29	2.20
Home Weatherization	1,492	5,416,466	334,990	$3,138,669	2.14	1.55
Energy Saving Products and Services	6,737	46,452,780	9,096	$4,418,045	3.97	3.11
High Performance Homes	1,224	3,307,219	207,470	$4,415,459	1.01	0.80
Education	0	0	0	$1,629,846	0.00	0.00
Total – EE Programs	***12,220***	***75,503,028***	***551,556***	***$19,954,124***	**1.76**	**1.81**
Business Demand Response	43,068	671,953	0	$2,381,055	0.80	0.53
Total – DR Programs	**43,068**	**671,953**	**0**	***$2,381,055***	**0.80**	**0.53**
Total - Overall Portfolio	***55,288***	***76,174,982***	***551,556***	***$22,335,179***	**1.69**	**1.68**

[38] The UCT is also referred to as the Program Administrator Cost Test (PACT).

[39] Cause No. PUD 201200128, Direct Testimony of Tamara Brown.

B.2 Energy Efficiency Programs

PSO's energy efficiency portfolio in 2013 consisted of five programs with a verified net peak demand reduction of 12,220 kWh and verified net annual energy savings of 75,503,028 kWh (including line-loss estimates of 5.6%). Total spending in 2013 equaled $19,954,124. Table B-2 provides a summary of program participation and verified net impacts for each of the energy efficiency programs. Table B-3 provides a summary of program costs in 2013.

Table B-2: Energy Efficiency Programs – Verified Impacts (Net, at Generator)

Program	Number of Participants in 2013	Verified Peak Demand Reduction (kW)	Verified Annual Energy Savings (kWh)	Gas Savings (Therms)
High Performance Business	248	2,767	20,326,563	0
Home Weatherization	1,652	1,492	5,416,466	334,990
Energy Saving Products & Services[40]	320,837	6,737	46,452,780	9,096
High Performance Homes	1,489	1,224	3,307,219	207,470
Education[41]	0	0	0	0
Total – EE Programs	***324,226***	***12,220***	***75,503,028***	***551,556***

[40] The Energy Saving Products & Services Program consists of downstream rebates for appliances and HVAC equipment as well as upstream CFL/LED bulb discounts. For the downstream portion of the program, determining the number of participants is straight forward. For the upstream bulb discounts, the number of bulb packages sold is listed instead of number of participants.

[41] The Education Program provides an educational experience for fifth grade students attending schools in PSO's service territory. A self-install energy efficiency kit is provided to students, but no energy impacts are claimed by PSO. There were 121 educational events in 2013.

Table B-3: Energy Efficiency Programs – Reported Costs

Program	Annual Non-EM&V Admin Costs ($)[42]	Annual EM&V Admin Costs ($)	Annual Cash Inducement Costs ($)[43]	Annual Non-Cash Inducement Costs ($)[44]
High Performance Business	$317,295	$286,701	$1,913,532	$3,834,577
Home Weatherization	$132,255	$118,862	$2,753,371	$134,181
Energy Saving Products & Services	$151,892	$162,085	$2,107,888	$1,996,180
High Performance Homes	$183,330	$172,982	$2,493,284	$1,565,863
Education	$97,361	$0	$1,532,462	$24
Total – EE Programs	**$882,133**	**$740,630**	**$10,800,537**	**$7,530,824**

In the tables that follow, total costs and benefits, and cost-effectiveness test results are provided for each energy efficiency program in the PY2013 portfolio.

B.2.1 High Performance Business Program

Table B-4: High Performance Business Benefit/Cost Tests

Metric	Utility Cost Test	Total Resource Cost Test	Ratepayer Impact Measure	Societal Cost test	Participant Cost Test
Benefit/Cost Ratio	2.20	1.29	0.73	1.54	1.87
Net Benefits ($000s)	$7,644.31	$3,283.16	($5,217.98)	$6,033.79	$5,907.09
Total Benefits ($000s)	$13,996.41	$14,524.06	$13,996.41	$17,274.69	$12,709.41
Total Costs ($000s)	$6,352.10	$11,240.90	$19,214.39	$11,240.90	$6,802.33

B.2.2 Home Weatherization Program

Table B-5: Home Weatherization Benefit/Cost Tests

Metric	Utility Cost Test	Total Resource Cost Test	Ratepayer Impact Measure	Societal Cost test	Participant Cost Test
Benefit/Cost Ratio	1.55	2.14	0.59	2.60	>1
Net Benefits ($000s)	$1,733.24	$3,570.92	($3,410.80)	$5,037.25	$6,967.35
Total Benefits ($000s)	$4,871.90	$6,709.59	$4,871.90	$8,175.92	$6,967.35
Total Costs ($000s)	$3,138.67	$3,138.67	$8,282.71	$3,138.67	$0.00

[42] Non-EM&V Admin Costs include PSO staff labor costs and overhead costs.

[43] Cash inducement costs refer to customer rebate costs.

[44] Non-cash inducement costs include third party implementation costs and advertising costs.

B.2.3 Energy Saving Products and Services Program

Table B-6: Energy Saving Products and Services Benefit/Cost Tests

Metric	Utility Cost Test	Total Resource Cost Test	Ratepayer Impact Measure	Societal Cost test	Participant Cost Test
Benefit/Cost Ratio	3.11	3.97	0.61	4.42	15.71
Net Benefits ($000s)	$9,338.59	$10,364.33	($8,908.24)	$11,937.55	$17,312.74
Total Benefits ($000s)	$13,756.63	$13,851.05	$13,756.63	$15,424.27	$18,489.31
Total Costs ($000s)	$4,418.04	$3,486.72	$22,664.87	$3,486.72	$1,176.56

B.2.4 High Performance Homes Program

Table B-7: High Performance Homes Benefit/Cost Test

Metric	Utility Cost Test	Total Resource Cost Test	Ratepayer Impact Measure	Societal Cost test	Participant Cost Test
Benefit/Cost Ratio	0.80	1.01	0.46	1.24	1.83
Net Benefits ($000s)	($870.14)	$53.29	($4,173.11)	$1,128.37	$2,350.98
Total Benefits ($000s)	$3,545.32	$4,819.72	$3,545.32	$5,894.80	$5,195.24
Total Costs ($000s)	$4,415.46	$4,766.43	$7,718.42	$4,766.43	$2,844.26

B.2.5 Education Program

PSO's Education program seeks to generate minimal energy and demand savings for residential customers by providing elementary school students with easy self-install energy efficiency measures, such as LEDs and Advanced Power Strips. The purpose of the Education program is to provide PSO residential customers with an educational experience on how to make their homes more efficient. A lesson plan is provided to the classroom teacher, which engages the students in learning about energy efficiency while also practicing mathematics and science. The students are then provided the take-home energy efficiency kit. PSO spent $1,629,846 on this program in 2013. Energy savings are achieved when these measures are installed in homes, however PSO does not claim any kW or kWh savings associated with these kits.

Table B-8: Education Benefit/Cost Test

Metric	Utility Cost Test	Total Resource Cost Test	Ratepayer Impact Measure	Societal Cost test	Participant Cost Test
Benefit/Cost Ratio	0.00	0.00	0.00	0.00	>1
Net Benefits ($000s)	($1,629.85)	($97.38)	($1,629.85)	($97.38)	$1,532.46
Total Benefits ($000s)	$0.00	$0.00	$0.00	$0.00	$1,532.46
Total Costs ($000s)	$1,629.85	$97.38	$1,629.85	$97.38	$0.00

B.3 Demand Response Programs

PSO's demand response portfolio in 2013 consisted of one demand response program with a verified net peak demand reduction of 50.3 MW and verified net annual energy savings of 672 MWh. [45] Total spending in 2013 equaled $2,381,055. Table B-9 provides a summary of program participation and verified net impacts for the 2013 demand response portfolio. Table B-10 provides a summary of 2013 program costs.

Table B-9: Demand Response Programs – Verified Impacts (Net, at Generator)

Program	Number of Participants in 2013	Verified Peak Demand Reduction (kW)	Verified Annual Energy Savings (kWh)	Gas Savings (Therms)
Business Demand Response	61	50,317	671,953	0
Total – DR Programs	**61**	**50,317**	**671,953**	**0**

Table B-10: Demand Response Programs – Reported Costs

Program	Annual Non-EM&V Admin Costs ($)	Annual EM&V Admin Costs ($)	Annual Cash Inducement Costs ($)	Annual Non-Cash Inducement Costs ($)
Business Demand Response	$56,059.08	$89,745.93	$1,596,512.99	$638,737.21
Total – DR Programs	**$56,059.08**	**$89,745.93**	**$1,596,512.99**	**$638,737.21**

In the table that follows, total costs and benefits, and full cost-effectiveness test results are provided for the Business Demand Response program.

[45] The verified peak demand reduction for the Business Demand Response program includes an adjustment for line-losses and an adjustment for the minimum reserve capacity required by the Southwest Power Pool (13.6%).

B.3.1 Business Demand Response Program

Table B-11: Business Demand Response Benefit/Cost Test

Metric	Utility Cost Test	Total Resource Cost Test	Ratepayer Impact Measure	Societal Cost test	Participant Cost Test
Benefit/Cost Ratio	0.53	0.80	0.51	0.81	2.04
Net Benefits ($000s)	($1,116.99)	($318.74)	($1,196.44)	($304.85)	$834.07
Total Benefits ($000s)	$1,264.06	$1,264.06	$1,221.32	$1,277.95	$1,632.32
Total Costs ($000s)	$2,381.06	$1,582.80	$2,417.76	$1,582.80	$798.26

B.4 Avoided Costs

ADM was provided the avoided cost data shown in Table B-12 from PSO that incorporates the market prices that PSO could expect to sell energy at in the Southwest Power Pool (SPP).

Table B-12: Avoided Costs Provided by PSO[46]

Year	SPP - Energy ($/MWh)		SPP Capacity		T&D Costs	CO2	Natural Gas[47]
	On-Peak	Off-Peak	$/MW-day	$/kW-yr	$/kW-yr	($/metric tonne)	($/Mcf)
2013	50.19	34.31	25.00	9.13	16.23	0.00	4.99
2014	55.01	38.26	25.00	9.13	16.45	0.00	5.02
2015	58.96	41.26	359.22	131.11	16.66	0.00	5.05
2016	64.46	45.04	365.81	133.52	16.88	0.00	5.08
2017	65.91	46.93	371.74	135.69	17.10	0.00	5.11
2018	66.66	48.22	376.99	137.60	17.32	0.00	5.14
2019	67.43	49.34	381.51	139.25	17.54	0.00	5.17
2020	66.87	48.80	385.29	140.63	17.77	0.00	5.20
2021	68.52	50.78	388.27	141.72	18.00	0.00	5.23
2022	75.69	59.13	390.42	142.50	18.24	15.08	5.26
2023	76.53	60.17	391.71	142.98	18.47	15.28	5.29
2024	78.76	62.40	392.10	143.12	18.71	15.48	5.32
2025	80.50	63.83	391.54	142.91	18.96	15.67	5.35
2026	81.13	64.33	389.61	142.21	19.20	15.88	5.52
2027	83.15	66.12	386.65	141.13	19.45	16.08	5.68
2028	84.15	67.56	392.45	143.25	19.71	16.29	5.85
2029	85.57	69.56	398.34	145.39	19.96	16.50	6.01
2030	86.60	70.45	403.92	147.43	20.22	16.72	6.18
2031	87.82	71.78	406.39	148.33	20.48	16.94	6.34
2032	89.04	73.10	408.87	149.24	20.75	17.16	6.51
2033	90.26	74.43	411.34	150.14	21.02	17.38	6.67
2034	91.48	75.76	413.82	151.04	21.29	17.60	6.84
2035	92.70	77.08	416.30	151.95	21.57	17.84	7.00
2036	93.92	78.41	418.77	152.85	21.84	18.06	7.17
2037	95.14	79.73	421.25	153.76	22.11	18.29	7.33
2038	96.36	81.06	423.72	154.66	22.38	18.51	7.50

[46] Avoided energy and capacity costs were provided by PSO through 2030. The values shown for 2031 through 2038 were escalated by the average escalation factor between 2025 and 2030. Avoided T&D and CO2 costs were provided through 2035. The values shown for 2036-2038 were escalated by the average escalation factor between 2030 and 2035.

[47] Natural gas avoided costs were not provided by PSO. The 2013 $/Mcf figure was estimated based on the average 2012 cost listed on the website of the gas utility serving PSO's service territory. Natural gas price forecasts for 2025 and 2040 were taken from the U.S. Energy Information Administration's *Annual Energy Outlook 2014.* Avoided costs between these years were linearly interpolated.

Appendix C. Identification of Program Implementers

Table C-1 identifies program implementation contractors, their associated contact information, and the 2013 programs they were involved in.

Table C-1: Program Implementer Identification

Program(s)	Implementation Contractor	Contact	Contact Title	Contact Address	Contact Phone	Contact Email
High Performance Business, High Performance Homes	ICF International	David Pickles	Senior Vice President	7160 N. Dallas Parkway, Suite 340, Plano, TX 75024	469-467-4410	david.pickles@icfi.com
Home Weatherization	Titan ES, LLC	Bradley Cocking	President	9700 S. Pole Rd., Oklahoma City, OK 73160	405-632-1700	bcockings@titanes.us
	Rebuilding Tulsa Together	Jennifer Barcus-Schafer	Chief Executive Officer	P.O. Box 52201, Tulsa, OK 74152	918-742-6241	jennifer.barcus_shafer@rebuildingtogethertulsa.org
Energy Saving Products and Services	ICF International	David Pickles	Senior Vice President	7160 N. Dallas Parkway, Suite 340, Plano, TX 75024	469-467-4410	david.pickles@icfi.com
	Applied Proactive Technologies, Inc.	Chris Seymour	Program Manager	146 Chestnut St., Springfield, MA 01103	413-731-6546	christopher.seymour@appliedproactive.com
Education, Business Demand Response	PSO	Eric Raines	Consumer Programs Manager	212 E. 6th St. Tulsa, OK 74119	918-599-2801	edraines@aep.com
Program Marketing Services	VI Marketing and Branding	Judi Startzman	Vice President of Strategic Marketing	125 Park Avenue, Suite 200, Oklahoma City, OK 73102	405-525-0055	jstartzman@thevibrand.com

Appendix D. Training and Customer Outreach

During 2013, PSO conducted a number of service provider recruitment and training events. Additionally, PSO sponsored various customer outreach events and stakeholder presentations. Table D-1 summarizes the in-store retail lighting promotional events; Table D-2 summarizes service provider recruitment events; Table D-3 lists customer outreach events (other than lighting program promotions); Table D-4 shows stakeholder presentations; and Table D-5 summarizes the service provider training sessions.

Table D-1: Summary of In-Store Retail Lighting Promotional Events

Date	Event Name	Location	Sponsored By
4 /19/13	Lighting Program Promotion	Lawton	PSO/APT
4 /19/13	Lighting Program Promotion	TULSA	PSO/APT
4 /21/13	Lighting Program Promotion	OWASSO	PSO/APT
5 /17/13	Lighting Program Promotion	Tulsa	PSO/APT
5 /18/13	Lighting Program Promotion	Tulsa	PSO/APT
5 /24/13	Lighting Program Promotion	Duncan	PSO/APT
6 /14/13	Lighting Program Promotion	TULSA	PSO/APT
6 /14/13	Lighting Program Promotion	Lawton	PSO/APT
6 /14/13	Lighting Program Promotion	Tulsa	PSO/APT
6 /15/13	Lighting Program Promotion	Lawton	PSO/APT
6 /15/13	Lighting Program Promotion	TULSA	PSO/APT
6 /16/13	Lighting Program Promotion	TULSA	PSO/APT
7 /5 /13	Lighting Program Promotion	Elk City	PSO/APT
7 /6 /13	Lighting Program Promotion	Lawton	PSO/APT
7 /12/13	Lighting Program Promotion	OWASSO	PSO/APT
7 /12/13	Lighting Program Promotion	Duncan	PSO/APT
7 /13/13	Lighting Program Promotion	Broken Arrow	PSO/APT
7 /19/13	Lighting Program Promotion	Tulsa	PSO/APT
7 /21/13	Lighting Program Promotion	Tulsa	PSO/APT
8 /2 /13	Lighting Program Promotion	Lawton	PSO/APT
8 /3 /13	Lighting Program Promotion	Lawton	PSO/APT
8 /9 /13	Lighting Program Promotion	TULSA	PSO/APT
8 /9 /13	Lighting Program Promotion	Hobart	PSO/APT
8 /10/13	Lighting Program Promotion	OWASSO	PSO/APT
8 /17/13	Lighting Program Promotion	TULSA	PSO/APT
8 /25/13	Lighting Program Promotion	TULSA	PSO/APT
9 /6 /13	Lighting Program Promotion	Duncan	PSO/APT
9 /7 /13	Lighting Program Promotion	Lawton	PSO/APT
9 /13/13	Lighting Program Promotion	Tulsa	PSO/APT
9 /13/13	Lighting Program Promotion	Elk City	PSO/APT
9 /14/13	Lighting Program Promotion	Broken Arrow	PSO/APT
9 /20/13	Lighting Program Promotion	Tulsa	PSO/APT

Date	Event Name	Location	Sponsored By
9 /22/13	Lighting Program Promotion	Coweta	PSO/APT
10/5 /13	Lighting Program Promotion	Lawton	PSO/APT
10/11/13	Lighting Program Promotion	Lawton	PSO/APT
10/18/13	Lighting Program Promotion	Bartlesville	PSO/APT
10/18/13	Lighting Program Promotion	Tulsa	PSO/APT
10/19/13	Lighting Program Promotion	Broken Arrow	PSO/APT
10/19/13	Lighting Program Promotion	Tulsa	PSO/APT
11/2 /13	Lighting Program Promotion	Lawton	PSO/APT
11/8 /13	Lighting Program Promotion	Lawton	PSO/APT
11/15/13	Lighting Program Promotion	TULSA	PSO/APT
11/15/13	Lighting Program Promotion	Owasso	PSO/APT
11/15/13	Lighting Program Promotion	Elk City	PSO/APT
11/16/13	Lighting Program Promotion	OWASSO	PSO/APT
11/16/13	Lighting Program Promotion	McAlester	PSO/APT
11/21/13	Lighting Program Promotion	Lawton	PSO/APT
11/21/13	Lighting Program Promotion	Owasso	PSO/APT
11/22/13	Lighting Program Promotion	Lawton	PSO/APT
11/22/13	Lighting Program Promotion	Tulsa	PSO/APT
11/25/13	Lighting Program Promotion	Lawton	PSO/APT
11/26/13	Lighting Program Promotion	Lawton	PSO/APT
12/13/13	Lighting Program Promotion	TULSA	PSO/APT
12/13/13	Lighting Program Promotion	Lawton	PSO/APT
12/14/13	Lighting Program Promotion	Lawton	PSO/APT
12/14/13	Lighting Program Promotion	Owasso	PSO/APT
12/20/13	Lighting Program Promotion	TULSA	PSO/APT
12/22/13	Lighting Program Promotion	TULSA	PSO/APT
8 /3 /13	Lighting Program Promotion	Lawton	PSO/APT
8 /9 /13	Lighting Program Promotion	TULSA	PSO/APT
8 /9 /13	Lighting Program Promotion	Hobart	PSO/APT
8 /10/13	Lighting Program Promotion	OWASSO	PSO/APT
8 /17/13	Lighting Program Promotion	TULSA	PSO/APT
8 /25/13	Lighting Program Promotion	TULSA	PSO/APT
9 /6 /13	Lighting Program Promotion	Duncan	PSO/APT
9 /7 /13	Lighting Program Promotion	Lawton	PSO/APT
9 /13/13	Lighting Program Promotion	Tulsa	PSO/APT
9 /13/13	Lighting Program Promotion	Elk City	PSO/APT
9 /14/13	Lighting Program Promotion	Broken Arrow	PSO/APT
9 /20/13	Lighting Program Promotion	Tulsa	PSO/APT
9 /22/13	Lighting Program Promotion	Coweta	PSO/APT

Table D-2: Service Provider Recruitment Events

Date	Event Name	Location	Sponsored By	# of Attendees
01/07/2013	HPNH Recruitment	Tulsa	ICF/PSO	unknown
01/07/2013	WHA Focus Group	Tulsa	ICF/PSO	unknown
01/08/2013	WHA Focus Group	Lawton	ICF/PSO	unknown
01/22/2013	IPA Contractor Recruitment	Tulsa	ICF/PSO	unknown
01/23/2013	IPA Contractor Recruitment	Lawton	ICF/PSO	unknown
02/04/2013	New Homes Recruitment	Tulsa	ICF/PSO	unknown
02/05/2013	WHA Recruitment	Tulsa	ICF/PSO	unknown
02/06/2013	Tulsa WHA Recruitment	Tulsa	ICF/PSO	unknown
02/06/2013	HPNH Recruitment	Tulsa	ICF/PSO	unknown
02/07/2013	Lawton WHA Recruitment	Lawton	ICF/PSO	unknown
02/07/2013	HPNH Recruitment	Lawton	ICF/PSO	unknown
02/21/2013	Tulsa IPA Recruitment	Lawton	ICF/PSO	unknown
02/22/2013	Lawton IPA Recruitment	Tulsa	ICF/PSO	unknown
03/07/2013	Tulsa Home Builders Show	Tulsa	ICF/PSO	unknown
03/22/2013	Lawton Home Builders Show	Lawton	ICF/PSO	unknown
03/28/2013	EE Programs Overview - Green County AEE	Tulsa	ICF/PSO	17
08/15/2013	EE Programs Overview - Contractors and Staff	Vinita	ICF/PSO	5
10/29/2013	IPA & WHA Focus Group	Tulsa	ICF/PSO	unknown
10/30/2013	IPA & WHA Focus Group	Tulsa	ICF/PSO	unknown
11/06/2013	EE Programs Overview - GUY Engineering	Tulsa	ICF/PSO	15

Table D-3: Customer Outreach Events

Date	Event Name	Location	Sponsored By	# of Attendees
01/03/2013	EE Programs Overview - Sustainable Tulsa	Tulsa	PSO/ICF	30
01/08/2013	HPB Overview - OK Manufacturing Alliance	Broken Arrow	PSO/ICF	15
01/14/2013	HPB Overview - Sand Springs City Council	Sand Springs	PSO/ICF	10
01/24/2013	HPB & Peak Performers Overview - IFMA Meeting	Tulsa	PSO/ICF	45
02/11/2013	EE Programs Overview - Indian Nations Meeting	Okmulgee	PSO/ICF	unknown
03/13/2013	General Overview of HPB - North Tulsa Rotary Club	Tulsa	PSO/ICF	unknown
03/15/2013	HPB & Peak Performers Overview - Port of Catoosa	Catoosa	PSO/ICF	15
04/04/2013	Efficiency Outreach Presentation - Wright City	Wright City	PSO/Titan ES	25
04/04/2013	HPB Overview - N. Tulsa Rotary Club	Tulsa	PSO/ICF	8
04/12/2013	HPB Overview - Tulsa County Commissioners	Tulsa	PSO/ICF	7
04/22/2013	EE Programs Overview - MetLife Earth Day	Tulsa	PSO/ICF	35
04/23/2013	HPB & Peak Performers Overview - PSO Customer	Tulsa	PSO/ICF	120

Date	Event Name	Location	Sponsored By	# of Attendees
05/07/2013	EE Programs Overview - SPIHA	Quapaw	PSO/ICF	unknown
05/09/2013	HPB & Peak Performers Overview - BOMA	Tulsa	PSO/ICF	42
05/23/2013	HPB Overview - GSHP Pres. Assoc. Energy Eng.	Tulsa	PSO/ICF	20
06/01/2013	Efficiency Outreach Community Meeting	Wright City	PSO/Titan ES	unknown
06/03/2013	PSO Programs Overview - Residential	Tulsa	PSO/ICF	unknown
06/03/2013	Efficiency Outreach - Community Outreach Event	Grandfield	PSO/Titan ES	unknown
06/26/2013	Riverside Plant EE Programs Overview	Jenks	PSO/ICF	unknown
07/09/2013	EE Programs Overview - Tulsa Chamber Event	Tulsa	PSO/ICF	75
07/14/2013	Life Senior Services - PSO Programs	Tulsa	PSO/ICF	unknown
07/31/2013	Master Energy Planning: Municipal	Tulsa	PSO/ICF	unknown
08/01/2013	Master Energy Planning: Education	Tulsa	PSO/ICF	unknown
08/13/2013	HPB overview - Customers, Service Providers, Employees	Bartlesville	PSO/ICF	10
08/14/2013	HPB overview - Customers, Service Providers, Employees	Chouteau	PSO/ICF	8
08/15/2013	HPB Program Overview - B2B Sustainable Tulsa	Tulsa	PSO/ICF	50
08/16/2013	EE programs - Customers, Service Providers, Employees	Grove	PSO/ICF	10
08/20/2013	HPB Program Overview - Tulsa Business Builders	Tulsa	PSO/ICF	25
09/10/2013	HPB overview - Tulsa Chamber Networking Event	Tulsa	PSO/ICF	75
09/10/2013	HPB Program Overview - Port of Catoosa Lighting	Tulsa	PSO/ICF	20
09/17/2013	HPB & BDR Overview - OK Municipal League Conf.	Tulsa	PSO/ICF	400
09/20/2013	HPB & BDR Overview - OK Dept. of Envir. Quality	OKC	PSO/ICF	65
09/25/2013	Lighting Technology Seminar (am)	Tulsa	PSO/ICF	unknown
09/25/2013	Lighting Technology Seminar (pm)	Tulsa	PSO/ICF	unknown
10/03/2013	Efficiency Outreach - Community Outreach Event	Okemah	PSO	30
10/09/2013	HPB & BDR Overview - OK Manu. Alliance Conf.	Midwest City	PSO/ICF	200
10/25/2013	HPB & BDR Overview - Municipal Customers	Claremore	PSO/ICF	25
10/28/2013	HPB Overview - International Facilities Mgmt. Assoc.	Tulsa	PSO/ICF	70
10/31/2013	HPB Overview - Thermal Storage - Assoc. Energy Eng.	Tulsa	PSO/ICF	20
11/01/2013	HPB Overview - School Superintendents	Kiamichi	PSO/ICF	15
11/05/2013	Peak Performers 2013 Results	Tulsa	PSO	unknown
11/05/2013	HPB Check Presentation - OSU Tulsa	Tulsa	PSO/ICF	30
11/07/2013	EE programs overview - Jay Chamber of Commerce	Jay	PSO/ICF	20
11/12/2013	Peak Performers 2013 Results - Awards Luncheon	Lawton	PSO	26
11/14/2013	Efficiency Outreach - Community Outreach Event	Coalgate	PSO/Titan ES	12
11/14/2013	Peak Performers 2013 Results - Awards Luncheon	Krebs	PSO	16
11/21/2013	Master Energy Planning for Educational Facilities	Tulsa	PSO/ICF	unknown

Table D-4: Stakeholder Presentations

Date	Event Name	Location	Sponsored By	# of Attendees
01/17/2013	Customer Stakeholder Meeting on HPB	Tulsa	PSO	9
02/13/2013	EE Programs Overview - OCC Staff	Tulsa	PSO	8
03/12/2013	EE Programs Overview - OCC Staff	Tulsa	PSO	15
10/04/2013	HPB Overview - OCC Tour	Tulsa	PSO	10

Table D-5: Service Provider Training

Date	Event Name	Location	Sponsored By	# of Attendees
02/13/2013	HPNH Implementation Rollout	Tulsa	PSO/ICF	unknown
02/14/2013	HPNH Implementation	Lawton	PSO/ICF	unknown
02/19/2013	HPB Service Provider Training	Sand Springs	PSO/ICF	unknown
03/13/2013	HPB Service Provider Training	McAlester	PSO/ICF	15
03/13/2013	HPB Service Provider Training	Sand Springs	PSO/ICF	50
03/14/2013	HPB Service Provider Training	Lawton	PSO/ICF	10
04/10/2013	AMSCO HVAC Training	Tulsa	PSO/ICF	unknown
04/30/2013	HPB Service Provider Training	Bartlesville	PSO/ICF	12
05/01/2013	HPB Service Provider Training	Clinton	PSO/ICF	10
05/10/2013	EE Programs Overview	Sand Springs	PSO/ICF	2
05/30/2013	ICF New Homes Orientation	Vinita	PSO/ICF	unknown
06/13/2013	Manual J Training	Broken Arrow	PSO/ICF	unknown
06/14/2013	Manual J Training	Lawton	PSO/ICF	unknown
06/19/2013	HPB Service Provider Training	Tulsa	PSO/ICF	unknown
06/19/2013	HPB Service Provider Training	Antlers	PSO/ICF	unknown
06/19/2013	HPB Service Provider Training	Idabel	PSO/ICF	unknown
07/10/2013	Full Retrocommissioning Services Training	Tulsa	PSO/ICF	unknown
07/10/2013	HPB Service Provider Training	Tulsa	PSO/ICF	unknown
09/24/2013	HPB Service Provider Training - Lunch & Learn	McAlester	PSO/ICF	unknown
10/22/2013	HPB Service Provider Training	Tulsa	PSO/ICF	unknown

Appendix E. Marketing Synopsis

The following pages of this appendix provide examples of marketing materials used to promote PSO's Demand Side Management portfolio in 2013.

POWERFORWARD
From Public Service Company of Oklahoma

2013 Power Forward with PSO Marketing

PowerForwardWithPSO.com

AEP PUBLIC SERVICE COMPANY OF OKLAHOMA
A unit of American Electric Power

POWERFORWARD
From Public Service Company of Oklahoma

Residential

Efficiency Outreach (Weatherization)

Community Event
April 4, 6 p.m.
City Hall / Wright City
205 W 10th St.
Wright City, OK 74766

Your home is more than just a house. It's a place of comfort and relaxation. Make your home more comfortable AND energy-efficient with free efficiency upgrades from PSO.

Apply for PSO's ***EFFICIENCY OUTREACH*** program today, and you may qualify for attic insulation, air sealing, caulking and weather-stripping ALL COMPLETELY FREE.

How does it work?

- Homeowners with a household income of less than $35,000 annually may be
- Once accepted, a PSO contractor, Titan ES will perform an energy assessmen
- Based on the results of the assessment, PSO may pay for free energy upgrad
- The program helps lower your energy bills and makes your home more comf
- It's easy and completely FREE from PSO.
- The program applies to single family homes only and does not include mobil

For more information, call 877.293.0890.
Visit *PowerForwardWithPSO.com* for information about other energy-savin

POWERFORWARD

PUT OUT THE WELCOME MAT FOR EFFICIENCY.

Start saving with tools from PSO.

/ ONLINE ENERGY CHECKUP

The Online Energy Checkup is a great first step toward energy savings, and it's FREE. Create an easy-to-read graph of home energy use and set goals to reduce monthly bills.

/ INDIVIDUAL PROJECT APPROACH

PSO offers valuable incentives for individual home efficiency projects. Earn rebates on central air conditioning, heat pumps, insulation and much more.

/ EFFICIENCY OUTREACH

If your household income is below $35,000, you may qualify for free efficiency upgrades through Efficiency Outreach from PSO.

Certain restrictions apply.
Visit PowerForwardWithPSO.com for full details.

High Performance New Homes

THIS HOUSE WAS BUILT FOR EFFICIENCY.

/ Ask about it inside.

PowerForwardWithPSO.com

MAKE YOURSELF AT HOME IN A HIGH PERFORMANCE NEW HOME CERTIFIED BY PSO.

PSO is a proud ENERGY STAR partner.

ASK ABOUT ENERGY STAR CERTIFIED HOMES

POWER FORWARD WITH PSO.

POWERFORWARD

Visit PowerForwardWithPSO.com or call 1.888.776.1366 to learn more.

POWERFORWARD

HOME SWEET HIGH PERFORMANCE HOME.

Your Guide to High Performance New Homes Powered by PSO.

PUBLIC SERVICE COMPANY OF OKLAHOMA

PowerForwardWithPSO.com

AEP PUBLIC SERVICE COMPANY OF OKLAHOMA
A unit of American Electric Power

POWERFORWARD
From Public Service Company of Oklahoma

High Performance Homes
(Whole House and/or Individual Project Approach)

PUT OUT THE WELCOME MAT FOR EFFICIENCY.

Start saving with tools from PSO.

At PSO, we're committed to helping our customers save. Whatever your budget, we have tools to improve home comfort and help reduce energy costs around the house. From whole-house efficiency upgrades to online energy checkups, we make it easy to save energy and money.

To get started, check out this easy-to-use guide and visit us online at *PowerForwardWithPSO.com*.

/ ONLINE ENERGY CHECKUP

The Online Energy Checkup is a great first step toward energy savings, and it's FREE. Create an easy-to-read graph of home energy use and set goals to reduce monthly bills.

/ INDIVIDUAL PROJECT APPROACH

PSO offers valuable incentives for individual home efficiency projects. Earn rebates on central air conditioning, heat pumps, insulation and much more.

/ EFFICIENCY OUTREACH

If your household income is below $35,000, you may qualify for free efficiency upgrades through Efficiency Outreach from PSO.

Certain restrictions apply. Visit PowerForwardWithPSO.com for full details.

/ WHOLE HOUSE APPROACH

Enhance comfort, enjoy cleaner indoor air, and increase your home's value through PSO's Whole House Approach. Complete three or more eligible efficiency upgrades to earn **incentives up to $5,000.**

Get full details and a list of eligible improvements at *PowerForwardWithPSO.com*.

/ HIGH PERFORMANCE NEW HOMES

Whether you're building or shopping fo
new home, make sure it's a High Perforn
New Home. PSO-certified High Perforn
New Homes incorporate advanced ene
efficiency measures that cut energy us
improve comfort, and maximize resale

Check out our website for a list of PSO-ce
homebuilders in your area.

POWERFORWARD
From Public Service Company of Oklahoma

Individual Project Approach

If you're a homeowner living in the PSO service area, you're eligible for a variety of rebates, including:

- Central Air Conditioner: up to $650
- Air Source Heat Pump: up to $650
- Electronically Commutated Blower Motor: up to $75
- Geothermal Heat Pump: up to $300 per ton and an additional corresponding SEER incentive amount.
- Attic Insulation: $350
- ENERGY STAR® Certified Windows: $15 per window, $30 per glass door; up to $500

THERE'S NO PLACE LIKE A HIGH PERFORMANCE HOME.

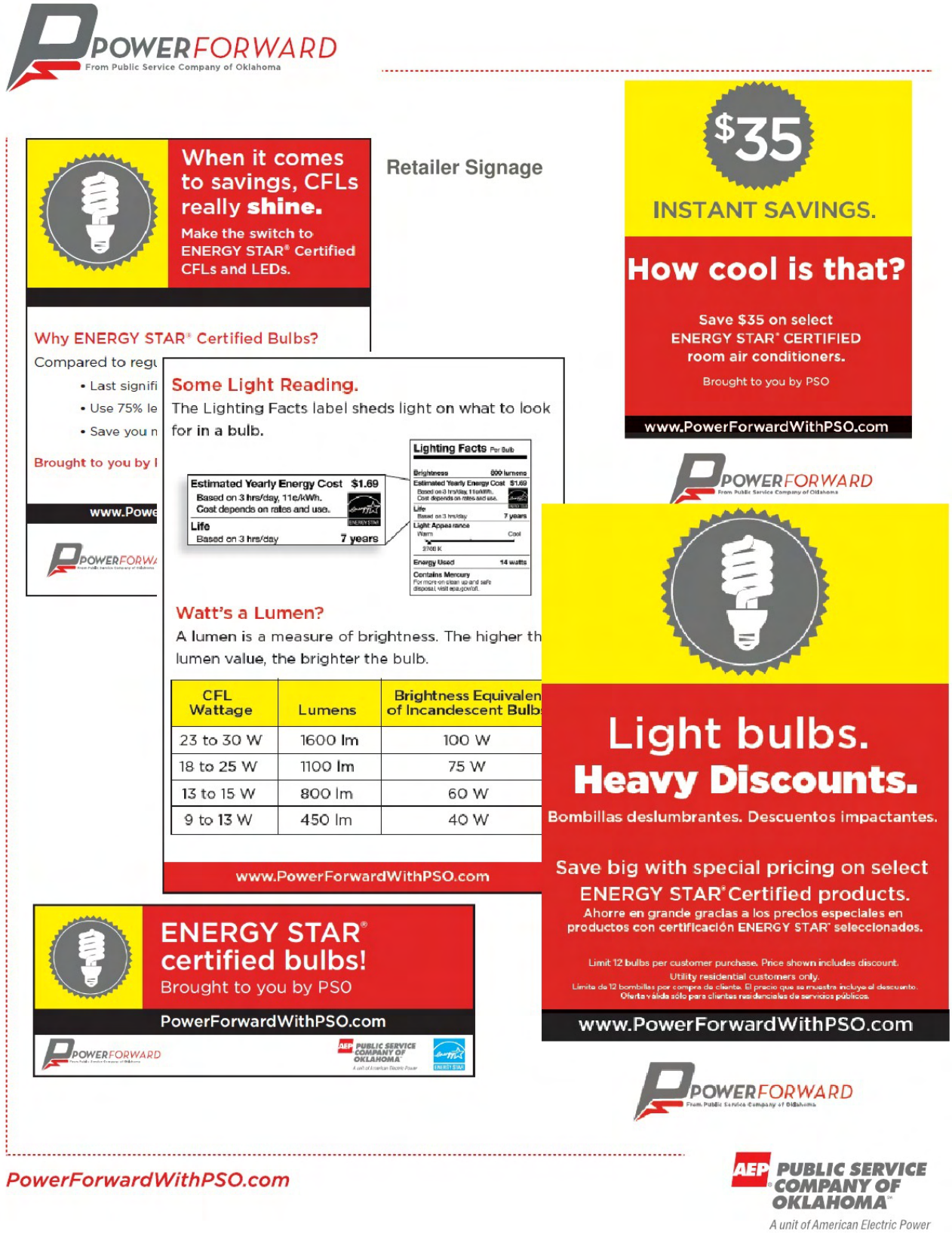
Get cash back from PSO for making energy-saving upgrades.

Improve your home's comfort by making it energy-efficient with PSO's ***HIGH PERFORMANCE HOMES*** Program.

Apply today to receive financial incentives for improving your home's efficiency. You'll receive expert advice from energy-efficiency specialists on how to lower your energy bills for good.

PowerForwardWithPSO.com

AEP PUBLIC SERVICE COMPANY OF OKLAHOMA
A unit of American Electric Power


POWERFORWARD
From Public Service Company of Oklahoma
Retailer Signage
When it comes to savings, CFLs really shine.
Make the switch to ENERGY STAR® Certified CFLs and LEDs.
Why ENERGY STAR® Certified Bulbs?
Compared to regu
• Last signifi
• Use 75% le
• Save you n
Brought to you by
www.Powe
Some Light Reading.
The Lighting Facts label sheds light on what to look for in a bulb.
Estimated Yearly Energy Cost $1.69
Based on 3 hrs/day, 11¢/kWh.
Cost depends on rates and use.
Life
Based on 3 hrs/day 7 years
Lighting Facts Per Bulb
Brightness 800 lumens
Estimated Yearly Energy Cost $1.69
Life 7 years
Light Appearance
Warm Cool
2700 K
Energy Used 14 watts
Contains Mercury
Watt's a Lumen?
A lumen is a measure of brightness. The higher th
lumen value, the brighter the bulb.
CFL Wattage | Lumens | Brightness Equivalen of Incandescent Bulb
23 to 30 W | 1600 lm | 100 W
18 to 25 W | 1100 lm | 75 W
13 to 15 W | 800 lm | 60 W
9 to 13 W | 450 lm | 40 W
www.PowerForwardWithPSO.com
$35
INSTANT SAVINGS.
How cool is that?
Save $35 on select ENERGY STAR® CERTIFIED room air conditioners.
Brought to you by PSO
www.PowerForwardWithPSO.com
POWERFORWARD
From Public Service Company of Oklahoma
Light bulbs.
Heavy Discounts.
Bombillas deslumbrantes. Descuentos impactantes.
Save big with special pricing on select ENERGY STAR® Certified products.
Ahorre en grande gracias a los precios especiales en productos con certificación ENERGY STAR® seleccionados.
Limit 12 bulbs per customer purchase. Price shown includes discount.
Utility residential customers only.
Límite de 12 bombillas por compra de cliente. El precio que se muestra incluye el descuento.
Oferta válida sólo para clientes residenciales de servicios públicos.
www.PowerForwardWithPSO.com
ENERGY STAR® certified bulbs!
Brought to you by PSO
PowerForwardWithPSO.com
POWERFORWARD
AEP PUBLIC SERVICE COMPANY OF OKLAHOMA
A unit of American Electric Power
POWERFORWARD
From Public Service Company of Oklahoma
PowerForwardWithPSO.com
AEP PUBLIC SERVICE COMPANY OF OKLAHOMA
A unit of American Electric Power

POWERFORWARD
From Public Service Company of Oklahoma

Monthly Newsletter
Watt, Why & How

PSO Watt, Why & How E-newsletter
JULY 2013

/ FORWARD REWARDS

Think insulation just keeps you warm during winter? Think again. Find out how attic insulation keeps you cool in the searing Oklahoma heat – and how you can receive insulation incentives from PSO.

HOUSEHOLD HIGHLIGHTS

Delicious recipes. Family fun. Inspired household tips.

Did you know your cooking style impacts household energy costs? Oven and stovetop cooking aren't just energy-intensive. They release heat into your home, placing extra strain on your air conditioner. Use the microwave, toaster oven, crockpot or grill to trim the fat from your energy bill.

LIGHTEN YOUR LOAD

Summer is prime time to get efficient. And you don't have to make expensive upgrades to save. Simply setting your thermostat to 78 degrees or higher can have a major impact on energy costs.

Click here to check out more low-cost tips. They'll help you beat the summer heat while ash.

/ ENERGY IN ACTION

PowerForwardWithPSO.com is now live! It's your go-to resource for energy-saving tips, home efficiency incentives and lighting discounts. Find trusted service providers in your area and get advice for using energy wisely. Don't wait. Check it out today!

POWERFORWARD

AEP PUBLIC SERVICE COMPANY OF OKLAHOMA
A unit of American Electric Power

PowerForwardWithPSO.com

AEP PUBLIC SERVICE COMPANY OF OKLAHOMA
A unit of American Electric Power

POWERFORWARD
From Public Service Company of Oklahoma

Social Media

Public Service Company of Oklahoma (PSO) shared a link.
August 25

Where do you need to insulate next to save money? A) Drafty windows and doors B) Tough to reach crawlspaces C) Attic D) Water heater E) Other (comment) http://ow.ly/nsme0

My Home
ow.ly

PSO offers tips, tools and incentives to help you Power Forward to savings and efficiency. We offer builder incentives for energy-efficient home...

Public Service Company of Oklahoma (PSO)
Tuesday

Congratulations to Airco Service for earning the 2012 Century Club Award from the U.S. Department of Energy for their contribution to the Home Performance with ENERGY STAR program and for improving the energy efficiency of over 100 homes. PSO is proud to partner with Airco. Congrats!

Public Service Company of Oklahoma (PSO)
June 7

Did you know we partner with local builders like Concept Builders, Inc. to help customers save energy and money? PSO's High Performance New Homes Program certifies new homes that are more durable, comfortable and energy-efficient than homes built to current state building code.

Public Service Company of Oklahoma (PSO)
20 hours ago

We're proud to work with companies like Overholt Heating & Air, Inc. to save you energy and money.
http://bit.ly/PowerForwardWithPSO

Shannon Overholt recently shared, "It is great to have a partner like AEP/PSO, who recognizes that improve... See More

Public Service Company of Oklahoma (PSO)
September 12

Join us for PSO discounts on lighting tomorrow between 10am and 2pm at Sam's, 44th & Sheridan in Tulsa or at Walmart on County Road in Elk City. BIG DISCOUNTS . . . don't miss it! ^MK

Public Service Company of Oklahoma (PSO) shared a link.
September 13

Have you seen Buster? http://ow.ly/ohuSH

Power Forward with PSO
ow.ly

With energy efficiency incentives from PSO, you don't have to sweat it. Find incentives in your area at PowerForwardwithPSO.com.

Public Service Company of Oklahoma (PSO)
11 hours ago via HootSuite

Still working on your 2012 taxes? Some energy-efficiency upgrades qualify for federal tax credits. Details: http://ow.ly/jVqKj

Federal Tax Credits for Energy Efficiency
energystar.gov
ENERGY STAR products are independently certified to save energy without sacri...

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From Public Service Company of Oklahoma

Commercial

SAVING.
IT'S ALL IN A DAY'S WORK.

Cut costs, earn incentives, and get more

PSO. YOUR PARTNER IN POWER.

POWERFORWARD

For more information, call 1.888.776.1366.
Or visit us at PowerForwardWithPSO.com.

PUT BUSINESS EFFICIENCY TO WORK.

Improve comfort and savings with business efficiency options from PSO.

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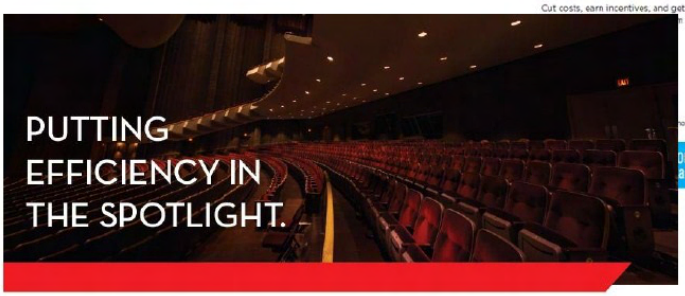

PUTTING EFFICIENCY IN THE SPOTLIGHT.

The story of **Tulsa's Performing Arts Center** began in 1973 with a challenge from civic leaders John H. Williams and Leta Chapman. If voters would fund half the price tag of construction, Williams and Chapman promised to raise the remaining funds. The plan was a roaring success. The Tulsa Performing Arts Center opened its doors on March 19th, 1977, with a concert by jazz legend Ella Fitzgerald. Today, more than 250,000 visitors fill its halls each year.

A HIGHER DEGREE OF EFFICIENCY

Located in the heart of a bustling metropolis, **The University of Tulsa** is home to nearly 4,600 students and more than 1,320 full-time faculty and staff. Its vibrant, 200-acre campus houses dorms, classrooms, cutting-edge laboratories and a plethora of cultural and academic facilities. At the size of a small city, improving energy efficiency is an ongoing priority for campus managers and university planners.

PUTTING THE BRAKES ON SPIRALING COSTS.

Founded in 1940 by Ed Babb, **Ebsco Spring Company** began as a humble factory in downtown Tulsa. More than 70 years later, the company is a leading manufacturer of industrial springs. Ebsco serves a breathtaking array of industries including aerospace, defense, robotics, agriculture and more. But as the company grew, its energy costs grew with it. To help contain costs and demonstrate environmental stewardship, company management decided it was time to get serious about efficiency.

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From Public Service Company of Oklahoma

Peak Performers

Consumer Programs Ad To Appear At Businesses Across Service Area

WE SAVED THE WORLD FROM

EVIL ROBOTS

Not really. But as a PSO ***PEAK PERFORMER,*** we're keeping electric rates low.

PSO Peak Performing Businesses save energy to help keep rates low for everyone. You may notice:

- / Dimmed lights
- / Altered temperature settings
- / And other adjustments

To learn more, visit *PowerForwardWithPSO.com.*

POWERFORWARD

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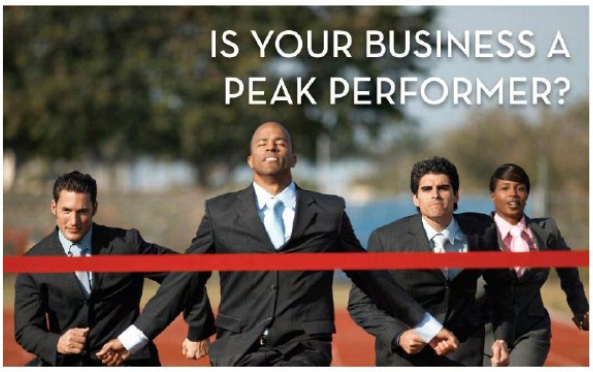

To offset the need for new power plants, PSO rewards participating businesses for voluntarily reducing electricity use during periods of high demand. These businesses are known as ***PEAK PERFORMERS.***

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The savings we realized and the reduction of the electricity demand were definitely more that we expected.

David Ysebaert
President & Chief Executive Officer
Explorer Pipeline

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From Public Service Company of Oklahoma

"The Choctaw Nation is committed to going green in order to be good stewards of our environment, and in the long run, we feel that PSO's Peak Performers program can be part of that 'going green' effort."

Doug Wood
Energy Manager
Choctaw Nation

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Media
Residential Digital Ads

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Digital Ads

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Print Ads

HOUSE MAKING YOU SWEAT?
IT'S PAYBACK TIME.

Keep cool this summer with efficiency incentives up to $5,000 from PSO. Get serious cash back on energy-saving home improvements, including:

/ AC
/ Insulation
/ Windows
/ Doors
/ And More

GET CASH BACK TODAY AND SAVINGS FOR YEARS TO COME.

Find your incentives at PowerForwardWithPSO.com.
888-776-1366

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GET INCENTIVES THAT WORK. AT WORK.

Reduce overhead with efficiency incentives from PSO. Save cash with PSO incentives for:

/ Lighting
/ Hotel and Kitchen Equipment
/ HVAC VFDs
/ Custome Incentives
/Controls
/ Retro-Commissioning Services
/ And More

Plus, earn cash incentives through PSO's Peak Performers.

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WITH PSO, THERE'S MORE THAN ONE WAY
TO BUNDLE UP
THIS WINTER.

This winter, consider bundling up your home with incentives from PSO. Added insulation will give you extra layers of warmth, and save you a bundle on your heating costs. And when you bundle insulation with additional efficiency upgrades, you could qualify for a whopping $5000 in incentives by taking PSO's Whole House Approach.

To learn more about these cozy incentives, call 888-776-1366 or visit PowerForwardWithPSO.com today.

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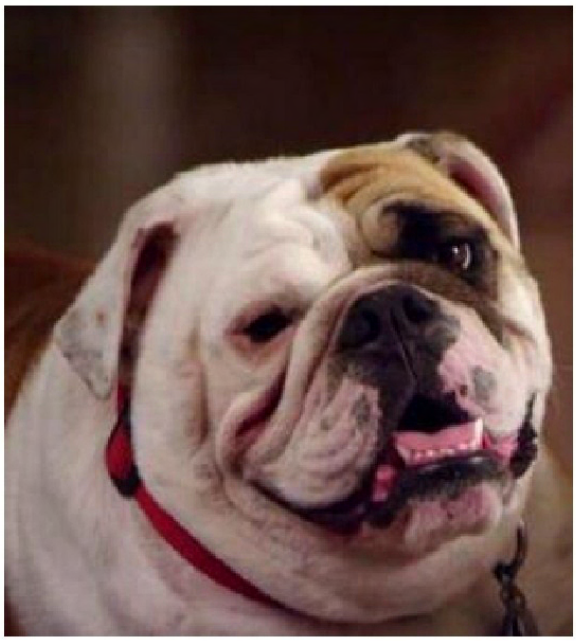
TV & Radio



Power Forward with PSO YouTube

13599 PSO - No Joke - Commercial Incentives.mp3

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