Southwestern Public Service Company

2017 Energy Efficiency and Load Management Annual Report

Prepared in Compliance with the Efficient Use of Energy Act and 17.7.2 NMAC (Energy Efficiency Rule)

May 15, 2018

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Glossary of Acronyms and Definition

Acronym/Defined Term	Definition
2017 Annual Report	SPS's 2017 Energy Efficiency and Load Management Annual Report
2017 Plan	SPS's 2017 Energy Efficiency and Load Management Plan
AAU	Attitude, Awareness and Usage Study
CFL	Compact Fluorescent Light
Commission	New Mexico Public Regulation Commission
DR	Demand Response
DSM	Demand-Side Management – refers to the energy efficiency and load management programs collectively
ECM	Electronically Commutated Motor
EE	Energy Efficiency
EE/LM	Energy Efficiency and Load Management
EUEA	New Mexico Efficient Use of Energy Act, as amended (NMSA 1978 §§62-17-1 through 62-17-11)
Evaluator	Independent Program Evaluator, the third-party contractor that will conduct all measurement & verification of the programs
Evergreen Economics	Evergreen Economics, the third-party selected as the Independent Program Evaluator for the measurement and verification of all New Mexico utility energy efficiency and load management programs

<u>**Acronym/Defined Term**</u>	<u>**Definition**</u>
GWh	Gigawatt hour
HER	Home Energy Reports
HVAC	High Voltage Alternating Current
ICO	Interruptible Credit Option
kW	Kilowatt
kWh	Kilowatt-hour
LED	Light Emitting Diode
M&V	Measurement and Verification
PY	Plan Year
Rule	Energy Efficiency Rule (17.7.2 NMAC), as amended
SPS	Southwestern Public Service Company, a New Mexico Corporation
Staff	Commission's Utility Division Staff
Stipulation	Settlement Agreement between the parties to Case No. 16-00110-UT
UCT	Utility Cost Test - the cost-effectiveness standard implemented on July 1, 2013. Also known as the Program Administrator Test
Xcel Energy	Xcel Energy Inc.

Document Layout

Southwestern Public Service Company's ("SPS") 2017 Energy Efficiency and Load Management ("EE/LM") Annual Report ("2017 Annual Report") includes the following sections:

- Section I provides the Executive Summary consisting of an Introduction, Background, and Summary of Results;
- Section II provides the reporting requirements as required by 17.7.2.14 NMAC;
- Section III provides the program descriptions including an explanation of deviations from goal and changes during 2017, organized into the Residential, Business, and Planning & Research Segments;
- Section IV provides compliance requirements set forth in the Stipulation Agreement in Case No. 16-00110-UT;[1] and
- Appendix A provides the Measurement and Verification ("M&V") Report of SPS's 2017 program year prepared by Evergreen Economics ("Evergreen").

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[1] *In the Matter of Southwestern Public Service Company's Energy Efficiency Compliance Application that Requests Authorization to: (1) per Approved Variance, continue its: (A) 2017 Energy Efficiency and Load Management Plan Programs for Plan Year ("PY") 2018; (B) 2017 Energy Savings Goal for Plan Year 2018; (C) Energy Efficiency Tariff Rider to Recover the Three Percent Funding Level for Plan Year 2018 and Reconciliation of 2016 Expenditures and collections; and (D) 2017 financial Incentive for Plan Year 2018 and Recover the incentive Through Its Energy Efficiency Tariff Rider; and (2) Recover the 2016 Reconciled Financial Incentive Through its Energy Efficiency Rider,* Case No. 17-00159-UT, Final Order Approving Certification of Stipulation (Dec. 13, 2017).

Section I. Executive Summary

Introduction

In accordance with the Efficient Use of Energy Act ("EUEA"), as amended by Senate Bill 418 (2007), House Bill 305 (2008), and House Bill 267 (2013), and the New Mexico Public Regulation Commission's ("Commission") Energy Efficiency ("EE") Rule (17.7.2 NMAC, "Rule"), SPS respectfully submits for Commission review its 2017 Annual Report. The EUEA and its associated Rule require public utilities to offer cost-effective energy efficiency and load management programs and authorizes them to receive cost recovery for qualified expenditures. Further, 17.7.2.8.A NMAC requires SPS to file with the Commission on May 15 of each year, a report on its energy efficiency and load management programs during the prior calendar year. The specific reporting requirements of the Rule and Revised Rule are discussed in Section II.

Within this 2017 Annual Report, SPS provides the expenditures and savings results for nine energy efficiency and load management direct impact programs in the Residential Segment (including Low-Income) and Business Segment (including Large Customer). In addition, the 2017 Annual Report includes a summary of the Planning and Research Segment, which supports the direct impact programs. The M&V Report for SPS's 2017 savings is included as Appendix A.

Background

SPS filed its 2017 Energy Efficiency and Load Management Plan ("2017 Plan") on May 2, 2016 (Case No. 16-00110-UT). SPS, the Commission's Utility Division Staff ("Staff"), and the other parties to the case agreed to a stipulation ("Stipulation") or did not oppose the Stipulation, which was approved by the Commission on November 9, 2016. The Stipulation included the following revisions to the originally proposed 2017 Plan: review the potential for incremental participation in the Residential Energy Feedback program, removal of the Refrigerator Recycling program from the Residential Segment, removal of the Saver's Switch for Business program from the Business Segment, removal of the Consumer Education and C&I Benchmarking programs from the Indirect Segment, and reductions to several program budgets as part of the settlement agreement to reduce spending consistent with revised annual collections.

Summary of Results

In compliance with 17.7.2.14.C NMAC, Table 1 below shows SPS's program goals, budgets, and Utility Cost Test ("UCT") ratios approved by the Commission on November 9, 2016.

In 2017, SPS achieved verified net electric savings of 8,476 kilowatts ("kW") and 33,191,039 kilowatt-hours ("kWh") at the customer, for a total cost of $8,342,728 (see Table 1 below.) This equals 113% of SPS's 2017 approved energy goal, while spending 92% of the approved budget. The portfolio was cost-effective with a UCT ratio of 2.29.

As shown in Table 1, most of the direct impact energy efficiency programs were cost-effective under the UCT. Three of the programs did not pass the UCT test in 2017. While each of the products listed below is discussed in more detail later in the Status Report, a summary of the primary reasons for individual programs falling below 1.0 on the UCT follows.

- Residential Cooling: The program received a low UCT in 2017 due to low participation in the program. Efficiency measures such as mini-split heat pumps, air conditioners, and conventional heat pumps launched in 2017, but the market has been slow in responding to the additional measures. In 2018, SPS will launch a comprehensive effort to train high voltage alternating current ("HVAC") contractors about existing customer rebates and encourage them to help customers apply for the rebates. SPS feels confident that participation will increase along with UCTs for 2018.

- Interruptible Credit Option ("ICO"): ICO didn't have any participants in 2017 and therefore achieved a UCT ratio of 0.0. Increasing participation will continue to be a challenge in the current economic climate, but given that it has a relatively small budget, offering the program is a valuable option for customers if economic conditions do change.

- Smart Thermostat Pilot: For 2017, this program achieved a UCT of .74. This was due to the pilot not achieving the participation target of 1,000 demand responses ("DR") enrollments for 2017. The Pilot also experienced high M&V costs to complete the complex EE & DR evaluation of this technology, further increasing the negative impact of pilot-specific costs that are expected to be lower for a steady-state program.

SPS works in good faith to comply with the EUEA and to offer cost-effective energy efficiency and load management programs to all of its customers. Each year, SPS evaluates the performance and progress of each of its programs to determine whether they are in the best interests of the portfolio and customers.

Table 1: Estimated and Actual Program Data for 2017

Program	2017 Estimated								2017 Reported and Verified							
	Participants	Budget	Peak Demand Savings (Customer kW)	Annual Energy Savings (Customer kWh)	Peak Demand Savings (Generator kW)	Annual Energy Savings (Generator kWh)	Utility Avoided Cost	Utility Cost Test	Participants	Expenditures	Peak Demand Savings (Net Customer kW)	Annual Energy Savings (Net Customer kWh)	Peak Demand Savings (Net Generator kW)	Annual Energy Savings (Net Generator kWh)	Utility Avoided Cost	Utility Cost Test
Residential Segment																
Residential Energy Feedback	18,090	$133,045	421	2,999,949	502	3,401,303	$ 156,898	1.18	21,462	$133,596	941	3,762,044	1,123	4,265,356	$ 233,035	1.74
Residential Cooling	250	$145,908	58	264,154	69	299,494	$ 213,871	1.47	28	$48,008	4	26,384	5	29,914	$ 18,122	0.38
Home Energy Services: Residential & Low Income	1,848	$2,534,220	524	5,083,668	625	5,763,796	$ 3,683,200	1.45	8,288	$2,351,880	641	8,403,339	765	9,527,595	$ 5,203,829	2.21
Home Lighting & Recycling	188,000	$2,044,918	1,378	9,905,728	1,644	11,230,984	$ 5,082,781	2.49	256,639	$1,859,661	1,460	9,300,382	1,742	10,544,651	$ 5,686,070	3.06
Residential Saver's Switch	4,203	$203,250	3,653	35,241	4,359	39,956	$ 292,055	1.44	4,360	$251,420	3,739	36,431	4,462	41,305	$ 738,323	2.94
School Education Kits	2,500	$163,417	25	850,672	30	964,480	$ 331,635	2.03	2,685	$157,626	41	1,656,045	49	1,877,602	$ 545,328	3.46
Residential Smart Thermostats	1,000	$82,557	782	8,858	933	10,043	$ 98,529	1.19	532	$99,799	377	0	450	0	$ 74,182	0.74
Residential Segment Total	**215,891**	**$5,307,315**	**6,839**	**19,148,270**	**8,161**	**21,710,057**	**$ 9,858,969**	**2.12**	**293,994**	**$4,901,989**	**7,203**	**23,184,625**	**8,595**	**26,286,423**	**$ 12,498,889**	**2.55**
Business Segment																
Business Comprehensive	735	$3,374,020	1,593	10,288,294	1,778	11,146,581	$ 6,799,361	2.02	270	$3,159,228	1,273	10,006,414	1,421	10,841,185	$ 6,595,459	2.09
Interruptible Credit Option	2	$45,569	789	7,000	881	7,584	$ 268,425	5.89	0	$48	0	0	0	0	$ -	0.00
Business Segment Total	**737**	**$3,419,589**	**2,382**	**10,295,294**	**2,659**	**11,154,165**	**$ 7,067,786**	**2.17**	**270**	**$3,159,277**	**1,273**	**10,006,414**	**1,421**	**10,841,185**	**$ 6,595,459**	**2.09**
Planning & Research Segment																
Market Research		$57,484								$35,112						
Measurement & Verification		$12,000								$6,402						
Planning & Administration		$279,649								$205,304						
Product Development		$39,581								$34,645						
Planning & Research Segment Total		**$388,714**								**$281,463**						
2017 TOTAL	**216,628**	**$9,115,618**	**9,222**	**29,443,564**	**10,820**	**32,567,411**	**16,926,754**	**2.00**	**294,264**	**$8,342,728**	**8,476**	**33,191,039**	**10,017**	**37,127,608**	**19,094,348**	**2.29**

Table 2: Variance Comparison of 2017 Estimated and Reported/Verified Data

Program	2017 Estimated and Reported/Verified Variances							
	Participants	Expenditures	Peak Demand Savings (Net Customer kW)	Annual Energy Savings (Net Customer kWh)	Peak Demand Savings (Net Generator kW)	Annual Energy Savings (Net Generator kWh)	Utility Avoided Cost	Utility Cost Test
Residential Segment								
Residential Energy Feedback	119%	100%	224%	125%	224%	125%	149%	148%
Residential Cooling	11%	33%	7%	10%	7%	10%	8%	26%
Home Energy Services: Residential & Low Income	448%	93%	122%	165%	122%	165%	141%	153%
Home Lighting & Recycling	137%	91%	106%	94%	106%	94%	112%	123%
Residential Saver's Switch	104%	124%	102%	103%	102%	103%	253%	204%
School Education Kits	107%	96%	164%	195%	164%	195%	164%	170%
Smart Thermostat Pilot	53%	121%	48%	0%	48%	0%	75%	62%
Residential Segment Total	136%	92%	105%	121%	105%	121%	127%	120%
Business Segment								
Business Comprehensive	37%	94%	80%	97%	80%	97%	97%	103%
Interruptible Credit Option	0%	0%	0%	0%	0%	0%	0%	0%
Business Segment Total	37%	92%	53%	97%	53%	97%	93%	96%
Planning & Research Segment								
Market Research		61%						
Measurement & Verification		53%						
Planning & Administration		73%						
Product Development		88%						
Planning & Research Segment Total		72%						
2017 TOTAL	136%	92%	92%	113%	93%	114%	113%	114%

As shown in Tables 1 and 2 (above), SPS met or came close to meeting most of its program forecasts for 2017. Notably, SPS exceeded its energy and demand savings forecasts while remaining within its Commission-approved funding level. While program performance varied, the reasons for which are discussed further in Section III of this report, the majority of programs were within 25% of their budgets. The Residential Energy Feedback, Home Energy Services, and School Education Kit Programs far exceeded their savings forecasts.

Section II: 17.7.2.14 NMAC Reporting Requirements

17.7.2.14.C NMAC requires that annual reports include specific details on the programs offered during the report year. Specifically, 17.7.2.14.C states:

C. Annual reports shall include the following for each measure and program:

(1) documentation of program expenditures;
(2) estimated and actual customer participation levels;
(3) estimated and actual energy savings;
(4) estimated and actual demand savings;
(5) estimated and actual monetary costs of the public utility;
(6) estimated and actual avoided monetary costs of the public utility;
(7) an evaluation of its cost-effectiveness; and
(8) an evaluation of the cost-effectiveness and pay-back periods of self-directed programs.

In addition, 17.7.2.14.D NMAC requires that the annual report also include:

(1) the most recent M&V report of the independent program evaluator, which includes documentation, at both the portfolio and individual program levels, of expenditures, savings, and cost-effectiveness of all energy efficiency measures and programs and load management measures and programs, expenditures, savings and cost-effectiveness of all self-direct programs, and all assumptions used by the evaluator;
(2) a listing of each measure or program expenditure not covered by the independent M&V report and related justification as to why the evaluation was not performed;
(3) a comparison of estimated energy savings, demand savings, monetary costs, and avoided monetary costs to actual energy savings, demand savings, actual monetary costs, and avoided monetary costs for each of the utility's approved measure or programs by year;
(4) a listing of the number of program participants served for each of the utility's approved measures of programs by year;
(5) a listing of the calculated economic benefits for each of the utility's approved measures or programs by year;
(6) information on the number of customers applying for and participating in self-direct programs, the number of customers applying for and receiving exemptions, M&V of self-direct program targets, payback periods and achievements, customer expenditures on qualifying projects, oversight expenses incurred by the utility representative or administrator; and
(7) any other information required by the Commission.

The following table provides direction as to where the supporting data and narratives for each of these requirements can be found in this report.

Table 3: Location of Reporting Requirements

Reporting Requirement	Location in Annual Report
17.7.2.14.C(1)	Tables 1 & 2
17.7.2.14.C(2)	Tables 1 & 2
17.7.2.14.C(3)	Tables 1 & 2
17.7.2.14.C(4)	Tables 1 & 2
17.7.2.14.C(5)	Tables 1 & 2
17.7.2.14.C(6)	Tables 1 & 2
17.7.2.14.C(7)	Tables 1 & 2
17.7.2.14.C(8)	N/A
17.7.2.14.D(1)	Appendix A
17.7.2.14.D(2)	Appendix A and Section III
17.7.2.14.D(3)	Table 2
17.7.2.14.D(4)	Table 2
17.7.2.14.D(5)	Table 2
17.7.2.14.D(6)	N/A
17.7.2.14.D(7)	N/A

Section III: Segment and Program Descriptions

Residential Segment

SPS has approximately 88,000 customers in its Residential Segment in New Mexico. The service area is relatively rural, with only a few small cities, including Clovis, Roswell, Artesia, Carlsbad, Portales, and Hobbs.

In 2017, SPS offered seven residential programs with opportunities for all residential customers, including low-income customers, to participate. In total, SPS spent $4,901,989 on these programs and achieved 7,203 kW and 23,184,625 kWh net savings at the customer level.

Overall, the Residential Segment of programs was cost-effective with a UCT of 2.55. The segment achieved 121% of the annual kWh goal with significant contributions from the School Education Kit and Home Energy Services programs. All of the programs under the Residential Segment are discussed in more detail below.

Residential Energy Feedback

The Residential Energy Feedback Program provides participating customers with different forms of feedback regarding their energy consumption. The feedback communication strategies and associated tips and tools result in a decrease in energy usage by encouraging changes in the behavior of participating customers. Furthermore, the program attempts to build a persistent increase in, or earlier adoption of, energy efficient technologies and energy efficient practices.

The program year began with 14,001 participants and ended with 21,462, due to a Refill group of 9,205 customers in the third quarter and an annual attrition rate of 8.1%. Attrition occurs primarily for two reasons; customers who move out of their residence and those that chose to opt-out of the program. Participants consist of the Legacy Group which entered the program in early 2012, a 2015 Refill Group that started receiving Home Energy Reports ("HER") in the summer of 2015 and a 2017 Refill Group that began receiving HERs in the summer of 2017. Participants receive their HER approximately once a quarter, however, the cadence varies based on the third-party implementers design. Each report provides actionable energy saving tips and information on the customer's energy usage. For comparison purposes, the customer's energy consumption is benchmarked with that of 100 similar customers. Accessible through My Account, the My Energy online tool provides the same information that customers receive in the HER, with a more robust set of customization options and energy savings tools. These tools are available to all customers served by SPS, and in 2017 over 500 customers took advantage.

Table 4: 2017 Program Achievements

Program	Actual Participants	Forecasted Participants	Actual Spend	Budgeted Spend	Peak Demand Savings kW (Net Customer)	Peak Demand Goal kW (Net Customer)	Annual Energy Savings kWh (Net Customer)	Energy Savings Goal kWh (Net Customer)	Utility Cost Test
Residential Energy Feedback	21,462	18,090	$ 133,596	$ 133,045	941	421	3,762,044	2,999,949	1.74

Deviations from Goal

The Residential Energy Feedback Program surpassed its estimated savings impact goals in 2017, and remains cost-effective under the UCT. Participants in the 2015 refill group continued to save a lower than expected amount of energy due to the statistical noise present when attempting to measure savings. Only fifteen customers elected to opt-out of the program, which is significantly lower than the thirty-seven who chose to opt-out in 2016. Overall attrition is approximately 7%, most of which is the result of move-outs.

Changes in 2017

For 2017, the company desired to improve savings from any newly added participants; however, one challenge the Company is facing is adding a group large enough from which statistically significant savings can be measured. As part of the Stipulation requirement to look into increasing participation into the program, SPS worked together with the third-party implementer and designed a plan to combine the smaller refill groups planned into a single, larger group of approximately 9,200 new participants. The combined group proved large enough and produced meaningful savings in 2017.

Residential Cooling

The Residential Cooling Program provides a cash rebate to electric customers who purchase and permanently install high-efficiency evaporative cooling, high efficiency air conditioners, air source heat pumps, mini-split heat pumps or electronically commutated motors ("ECM") in air conditioning equipment for residential use in New Mexico. ICF International joined forces with Xcel Energy in 2016 to promote the evaporative cooler and ECM rebates in a cooperative effort with rebates from New Mexico Gas Company. Due to the lack of participation in 2016 and 2017, the cooperative program effort ended in 2017.

Table 5: 2017 Program Achievements

Program	Actual Participants	Forecasted Participants	Actual Spend	Budgeted Spend	Peak Demand Savings kW (Net Customer)	Peak Demand Goal kW (Net Customer)	Annual Energy Savings kWh (Net Customer)	Energy Savings Goal kWh (Net Customer)	Utility Cost Test
Residential Cooling	28	250	$ 48,008	$ 145,908	4	58	26,384	264,154	0.38

Deviations from Goal

In 2017, the Residential Cooling Program spent a little over 30% of its forecasted budget primarily due to lack of participation in the program. However, SPS continued to conduct outreach, including on-line media ads, bill inserts, and radio ads. Weaker than expected participation is likely attributable to the following issues:

- A low level of customer awareness about rebates and how to apply for them;
- The HVAC contractor community has been slow to recommend high efficiency equipment;
- Homeowner's Associations place restrictions on roof-mounted evaporative coolers;
- New home construction uses refrigerated air systems, which makes retrofitting for evaporative coolers costly and technically difficult;
- Premium systems are not stocked by any retailers or contractors in the service territory; and
- Introduction of the ECM rebates into the marketplace took some time due to the requirement that qualified contractors had to be informed of the rebates and how they worked.

In an effort to increase participation in 2018, SPS plans to:

- utilize available marketing and advertising dollars;
- continue trade incentives;
- coordinate with local retailers to further increase participation;
- utilize and update the online rebate application for evaporative coolers, ECM's, and mini-split heat pumps; and
- launch an effort to encourage local HVAC contractors to persuade customers to install efficient measures and submit the rebate forms.

Changes in 2017
High efficiency air conditioners, air source heat pumps, and mini-split heat pumps were measures added to the program in 2017.

Home Energy Services
The Home Energy Services Program provides incentives to energy efficiency service providers for the installation of a range of upgrades that save energy and reduce costs for existing households. Qualifying customers receive attic insulation, air infiltration reduction, duct leakage repairs, and high-efficiency central air conditioners.

The primary objective of this program is to achieve cost-effective reductions in energy consumption in residential and low-income homes. Additional objectives of the program are to:

- encourage private sector delivery of energy efficiency products and services;
- utilize a whole-house approach to efficiency upgrades; and
- significantly reduce barriers to participation by streamlining program procedures.

SPS partners with third-party contractors to deliver these services to qualifying residential customers. Contractors must apply to the program and be approved in order to participate. SPS requires contractors to receive pre-approval for targeted multifamily sites prior to installation of any energy efficiency components for which an incentive will be requested.

Table 6: 2017 Program Achievements

Program	Actual Participants	Forecasted Participants	Actual Spend	Budgeted Spend	Peak Demand Savings kW (Net Customer)	Peak Demand Goal kW (Net Customer)	Annual Energy Savings kWh (Net Customer)	Energy Savings Goal kWh (Net Customer)	Utility Cost Test
Home Energy Services: Residential & Low Income	8,288	1,848	$ 2,351,880	$ 2,534,220	641	524	8,403,339	5,083,668	2.21

Deviations from Goal

The Home Energy Services Program exceeded its energy savings goals for 2017. The program was also highly cost-effective. SPS spent just over $1 Million on the Low-Income portion of the program, which is approximately 12% of the total portfolio spend and in excess of the minimum requirement of 5%. The Residential portion of the program also performed well, achieving savings of almost 4 MWh at the customer level.

Changes in 2017

None.

Home Lighting and Recycling

The Home Lighting and Recycling Program helps customers save energy and money by offering energy efficient light emitting diode ("LED") bulbs at discounted prices at participating retailers. SPS works with retailers and manufacturers to buy down the prices of bulbs. LED bulbs receive a buy-down discount up to $5, but unit prices vary. This provides an inexpensive way for customers to reduce their energy usage and impact on the environment.

SPS marketed the program extensively through a variety of advertising and promotions, including television, radio, on-line, publications, bill inserts, community events, and point-of-purchase displays. Some of the specific promotions included:

- SPS participated in many community events and implemented bulb giveaways at various events including the Eastern New Mexico State Fair and the Clovis Christmas Lights Parade.
- SPS continued to partner with Domino's Pizza to deliver free energy-efficient bulbs with each pizza order for a limited time period. This was a unique promotion in that it delivered bulbs directly to customers' homes and was an extremely low-cost way to reach consumers.

- SPS offered a home delivery bulb drop promotion where two free LEDs were delivered to a majority of the SPS territory along with an educational postcard that talks about what to look for when buying an LED.

Table 7: 2017 Program Achievements

Program	Actual Participants	Forecasted Participants	Actual Spend	Budgeted Spend	Peak Demand Savings kW (Net Customer)	Peak Demand Goal kW (Net Customer)	Annual Energy Savings kWh (Net Customer)	Energy Savings Goal kWh (Net Customer)	Utility Cost Test
Home Lighting & Recycling	256,639	188,000	$ 1,859,661	$ 2,044,918	1,460	1,378	9,300,382	9,905,728	3.06

Deviations from Goal

In 2017, the Home Lighting and Recycling Program fell short of its energy and demand savings goals as the 2017 program evaluation resulted in a lower net to gross ratio than anticipated for the program. This resulted in a savings decrease of about 20% from the year prior. Budget savings were attributed to the continued reduction in the price of LED bulbs and the lower cost of incentives.

Changes in 2017

SPS discontinued offering discounts on the purchase of compact fluorescent bulbs as of January 1, 2017 and solely focused on promoting ENERGY STAR® LEDs.

Residential Saver's Switch

Residential Saver's Switch is a demand response program that offers bill credits as an incentive for residential customers to allow SPS to control operation of customers' central air conditioners and electric water heaters on days when the SPS system is approaching its peak. This program is generally utilized on hot summer days when SPS's load is expected to reach near-peak capacity. Saver's Switch helps reduce the impact of escalating demand and price for peak electricity.

When the program is activated, a control signal is sent to interrupt the air conditioning load during peak periods, typically in the afternoons on weekdays. For air conditioners, SPS utilizes a cycling strategy to achieve a 50% reduction in load. For enrolled electric water heaters, the entire load is shed for the duration of the control period. Due to limitations in available over-the-air control systems, the program is currently available only in the cities of Portales, Hobbs, Clovis, Roswell, Artesia, and Carlsbad.

The 2017 program year was the eighth operational year for the Saver's Switch program. In 2017, there were no control events.

Table 8: 2017 Program Achievements

Program	Actual Participants	Forecasted Participants	Actual Spend	Budgeted Spend	Peak Demand Savings kW (Net Customer)	Peak Demand Goal kW (Net Customer)	Annual Energy Savings kWh (Net Customer)	Energy Savings Goal kWh (Net Customer)	Utility Cost Test
Residential Saver's Switch	4,360	4,203	$ 251,420	$ 203,250	3,739	3,653	36,431	35,241	2.94

Deviations from Goal

In 2017, the growth of the residential DR portfolio was directed to the Smart Thermostat Pilot. As a result, the participant population was largely unchanged, with a small number of additions and a roughly equal number of cancellations.

Changes in 2017

None.

School Education Kits

The School Education Kits Program provides classroom and in-home activities that enable students and parents to install energy efficiency and water conservation products in their homes. The program is targeted at fifth grade students. A third-party contractor fully implemented the School Education Kits program, including recruiting and training teachers, providing all materials, and tracking participation by schools and teachers. Energy savings are based on the number of measures that are installed in the homes of the students. Students complete surveys to determine the measure installation rates.

Table 9: 2017 Program Achievements

Program	Actual Participants	Forecasted Participants	Actual Spend	Budgeted Spend	Peak Demand Savings kW (Net Customer)	Peak Demand Goal kW (Net Customer)	Annual Energy Savings kWh (Net Customer)	Energy Savings Goal kWh (Net Customer)	Utility Cost Test
School Education Kits	2,685	2,500	$ 157,626	$ 163,417	41	25	1,656,045	850,672	3.46

Deviations from Goal

The program exceeded its kWh savings goal in 2017. Installation rates improved dramatically due to changes made to the student survey. Compact Fluorescent Light ("CFL") light bulbs were replaced in the kits with more popular LED bulbs resulting in additional claimed savings. Participation exceeded goal as well, while the program finished the year under-budget.

Changes in 2017

CFL light bulbs were replaced with LED bulbs in the kits, and student surveys were revised to allow customers to report their measure installation activities more accurately.

Smart Thermostat Pilot

The Smart Thermostat Pilot is designed to evaluate if Wi-Fi connected communicating, smart thermostats can save residential customers energy by installing a smart thermostat device and connecting it to the manufacturer's cloud service. In addition to EE benefits, the Pilot also plans to evaluate DR capacity from smart thermostats in the residential market. SPS offers customers smart thermostats and installation at no cost.

Table 10: 2017 Program Achievements

Program	Actual Participants	Forecasted Participants	Actual Spend	Budgeted Spend	Peak Demand Savings kW (Net Customer)	Peak Demand Goal kW (Net Customer)	Annual Energy Savings kWh (Net Customer)	Energy Savings Goal kWh (Net Customer)	Utility Cost Test
Residential Smart Thermostat	532	1,000	$ 99,799	$ 82,557	377	782	0	8,858	0.74

Deviations from Goal
The pilot did not reach the target goal of 1,000 DR Participants in 2017. New thermostat installations stopped at the end of 2016 and the pilot did not add any additional participants in 2017. The pilot dispatched eight test DR events during 2017 instead of the target goal of ten test events, primarily due to outdoor temperatures preventing suitable testing conditions.

Changes in 2017
None.

Business Segment

SPS's Business Segment in New Mexico consists of nearly 24,000 commercial, industrial, and agricultural customer premises. In 2017, SPS offered two business programs with opportunities for all commercial and industrial customers to participate.

In total, SPS spent $3,159,277 on these programs and achieved 1,273 kW and 10,006,414 kWh savings at the net customer level.

Overall, the Business Segment of programs was cost-effective with a UCT of 2.09. Achievements were 97% of the annual kWh goal. All of the programs under the Business Segment are discussed in more detail below.

Business Comprehensive
The Business Comprehensive Program bundles traditional prescriptive and custom products in a way that is more easily understood by customers. Business Comprehensive encompasses the Recommissioning, Computer Efficiency, Cooling Efficiency, Custom Efficiency, Large Customer Self-Direct, Lighting Efficiency, and Motor & Drive Efficiency products. Customers can choose to participate in any or all of the individual program components.

Table 11: 2017 Program Achievements

Program	Actual Participants	Forecasted Participants	Actual Spend	Budgeted Spend	Peak Demand Savings kW (Net Customer)	Peak Demand Goal kW (Net Customer)	Annual Energy Savings kWh (Net Customer)	Energy Savings Goal kWh (Net Customer)	Utility Cost Test
Business Comprehensive	270	735	$ 3,159,228	$ 3,374,020	1,273	1,593	10,006,414	10,288,294	2.09

Deviations from Goal

The Business Comprehensive Program achieved 97% of its savings goal. The program saw greater outreach in the oil and gas sector and the first participation in the Building Tune-Up program. Four municipalities participated in the benchmarking and master planning sessions. SPS's Custom program closed several projects that began in previous years. The Motors program saw a resurgence of pump off controllers and several large custom Variable Frequency Drive projects.

Changes in 2017

SPS introduced a commercial refrigeration effort to reach out to grocery, convenience stores, liquor stores and customers who have commercial refrigeration equipment. Customers will receive a no-cost energy assessment with recommendations for saving on energy and money. The Lighting Efficiency program added tiered rebates for non-DLC listed products to qualify as prescriptive. The program also decreased LED T8 Tube rebates to account for the product price decrease in the market. LED costs are coming down in price and will continue decrease over the few years.

Interruptible Credit Option

The ICO Program was developed to offer significant savings opportunities to SPS business customers who can reduce their electric demand for specific periods of time when notified. In return for participating, customers receive a monthly credit on their demand charges.

Table 12: 2017 Program Achievements

Program	Actual Participants	Forecasted Participants	Actual Spend	Budgeted Spend	Peak Demand Savings kW (Net Customer)	Peak Demand Goal kW (Net Customer)	Annual Energy Savings kWh (Net Customer)	Energy Savings Goal kWh (Net Customer)	Utility Cost Test
Interruptible Credit Option	0	2	$ 48	$ 45,569	0	789	0	7,000	0.00

Deviations from Goal

The ICO Program did not have any participants during 2017. This program is best suited for SPS's largest customers, most of whom are in the oil and gas industries. Due to the current economic conditions, most of these large customers have not seen a benefit to the program as they either continue production or cease operations entirely due to depressed market prices.

Changes in 2017:

None.

Planning & Research Segment

The Planning and Research Segment consists of internal utility functions (not customer-facing), which support the direct impact programs. The overall purpose of the Planning and Research Segment is to:

- provide strategic direction for SPS's EE/LM programs;
- ensure regulatory compliance with energy efficiency legislation and rules;
- guide SPS internal policy issues related to energy efficiency;
- train SPS Marketing staff for compliance and cost-effectiveness;
- evaluate program technical assumptions, program achievements, and marketing strategies;
- provide oversight of all evaluation, measurement, and verification planning and internal policy guidance;
- provide segment and target market information;
- analyze overall effects to both customers and the system of SPS's energy efficiency portfolio;
- measure customer satisfaction with SPS's energy efficiency efforts; and
- develop new conservation and load management programs.

The segment includes EE/LM-related expenses for Demand Side Management ("DSM") Planning & Administration, Market Research, M&V, and Product Development. Each Planning and Research program is discussed below.

Planning & Administration

The Planning and Administration area manages all EE/LM regulatory filings (including this Annual Report), directs and carries out benefit-cost analyses, provides tracking results of energy conservation achievements and expenditures, and analyzes and prepares cost recovery reports. Planning and Administration, which includes outside legal assistance, coordinates and participates in all DSM-related rulemaking activities and litigated hearings. This area also supports the DSM component of resource planning and provides planning and internal policy guidance to meet all EE/LM regulatory requirements. These functions are needed to ensure a cohesive and high-quality energy efficiency portfolio that meets legal requirements as well as the expectations of SPS's customers, regulators, and Commission Staff.

Deviations from Goal
None.

Changes in 2017
None.

Market Research

The Market Research group spearheads energy efficiency-related research efforts that are used to inform SPS on EE/LM decision-makings. In 2017, the Market Research group oversaw the SPS portion of several Xcel Energy-wide subscriptions such as SPS's E-Source Membership, and the Dun & Bradstreet list purchase.

Deviations from Goal

SPS spent less than the forecasted budget due to the discontinuation of the Attitudes, Awareness and Usage ("AAU") Study.

Changes in 2017

SPS discontinued the AAU Study it previously conducted in all states. The Market Research group is working with the third-party who conducts the study, to redesign and relaunch a new version of the AAU Study in 2018.

Measurement & Verification

The M&V budget funds the internal staff from the Planning and Administration area who oversee M&V planning, data collection, and internal policy guidance. In addition, this area coordinates the day-to-day activities providing necessary information and program tracking data to the Evaluator, as well as serving on the Commission's Evaluation Committee.

17.7.2.14.D(1) NMAC requires that utilities submit the most recent M&V Report conducted by the approved Evaluator with its Annual Report. The 2017 M&V Report is provided as Appendix A of this document. In compliance with the reporting requirements, the 2017 M&V Report includes:

- expenditure documentation, at both the total portfolio and individual program levels;
- measured and verified savings;
- evaluation of cost-effectiveness of all of SPS's EE/LM programs;
- deemed savings assumptions and all other assumptions used by the Evaluator;
- description of the M&V process, including confirmation that:
  - measures were actually installed;
  - installations meet reasonable quality standards; and
  - measures are operating correctly and are expected to generate the predicted savings.

Deviations from Goal

SPS spent less than the forecasted indirect M&V budget. However some programs, including the Business Comprehensive Custom program, saw an increase in evaluation spending due to additional M&V reviews conducted.

Changes in 2017
All New Mexico gas and electric utilities have contracted with Evergreen as the Statewide Evaluator for PY 2017 and 2018 programs.

Product Development

Product Development identifies, assesses, and develops new energy efficiency and load management products and services. The product development process starts with ideas and concepts from customers, regulators, energy professionals, interest groups, and SPS staff. These ideas are then carefully screened and only ideas with the most potential are selected for the development process.

Deviations from Goal
SPS spent less than the forecasted budget due to lower than expected consulting costs.

Changes in 2017
None.

Section IV: 2017 Incentive Mechanism True-Up

In Case No. 16-00110-UT, SPS indicated that it would provide the reconciliation of its 2017 PY incentive in its annual report. The Commission authorized SPS to collect a baseline financial incentive of $619,862. Interest was to be symmetrically applied to the over- or under-collected monthly balance, applied at the customer deposit interest rate. In 2017, SPS collected $625,366, compared to the baseline financial incentive of $619,862. Interest of $176.42 was applied, for a net over-recovery balance of $5,680.42.

Next, SPS compared its baseline incentive to its Commission-approved earned incentive. SPS exceeded its 2017 achievement goal of 29.444 giga-watt hour ("GWh") by 3.747 GWh, resulting in an earned incentive of $648,120. When compared to the collected amount ($625,366, excluding interest), SPS needs to collect an additional $22,754 related to the 2017 incentive.

Appendix A: Measurement & Verification Report:

SPS 2017 Program Year

Provided by Evergreen Economics

Evaluation of the 2017 Southwestern Public Service Company's Energy Efficiency and Demand Response Programs

Final Report

April 27, 2018

Table of Contents

Executive Summary

This report presents the independent evaluation results for the Southwestern Public Service Company (SPS) energy efficiency and demand response programs for program year 2017 (PY2017).

The SPS programs and evaluation requirements were first established in 2005 by the New Mexico legislature's passage of the 2005 Efficient Use of Energy Act (EUEA).[1] The EUEA requires public utilities in New Mexico, in collaboration with other parties, to develop cost-effective programs that reduce energy demand and consumption. Utilities are required to submit their proposed portfolio of programs to the New Mexico Public Regulation Commission (NMPRC) for approval. As a part of its approval process, the NMPRC must find that the program portfolio is cost effective based on the Utility Cost Test (UCT).

An additional requirement of the EUEA is that each program must be evaluated at least once every three years. As part of the evaluation requirement, SPS must submit to the NMPRC a comprehensive evaluation report prepared by an independent program evaluator. As part of the reporting process, the evaluator must measure and verify energy and demand savings, determine program cost effectiveness, assess how well the programs are being implemented, and provide recommendations for program improvements as needed.

For PY2017, the following SPS programs were evaluated:

- Business Comprehensive
- Home Lighting & Recycling
- Energy Feedback
- Residential Cooling
- School Education Kits
- Smart Thermostat Pilot (Saver's Stat)

For each of the evaluated programs, the evaluation team estimated realized gross and net impacts (kWh and kW) and calculated program cost effectiveness using the UCT. A brief

[1] NMSA §§ 62-17-1 *et seq* (SB 644). Per the New Mexico Public Regulation Commission Rule Pursuant to requirements of the EUEA, the NMPRC issued its most recent *Energy Efficiency Rule* (*17.7.2 NMAC*) effective January 1, 2015 that sets forth the NMPRC’s policy and requirements for energy efficiency and load management programs. This Rule can be found online at http://164.64.110.239/nmac/parts/title17/17.007.0002.htm

process evaluation was also conducted for the Business Comprehensive and Residential Cooling programs.

The remaining programs that were not evaluated in 2017 are still summarized in this report. The accomplishments for the non-evaluated programs are reported using the following parameters:

- Gross impacts (kWh, kW) were calculated using the SPS *ex ante* values for annual savings;
- Net impacts were calculated from the gross impacts using the existing *ex ante* net-to-gross (NTG) ratio; and
- Cost effectiveness calculations were calculated using the *ex ante* net impact values and cost data as reported by SPS.

The analysis methods used for the evaluated PY2017 programs are summarized as follows:

Business Comprehensive. The measures eligible for the Business Comprehensive program are primarily prescriptive in nature, but the program also includes custom projects. Gross impacts were estimated based on a review of the deemed savings values combined with engineering desk reviews of a statistically representative sample of projects covering a range of project sizes and major measure types. A phone survey of participating customers was used to verify installation and to collect information needed for a self-report analysis of free ridership to determine net impacts.

Home Lighting & Recycling. For the LED measures promoted by the program, deemed savings values included in SPS's tracking data (and used for the *ex ante* impacts) were compared with the values contained in the New Mexico Technical Reference Manual (TRM) and the SPS Technical Assumptions documents. If the values did not match, they were carefully reviewed to determine if the values were reasonable and the source appropriately documented. Net impacts were estimated using the lighting elasticity model.

Energy Feedback. This program provides participating customers with information on their energy consumption by providing a comparison with a matched set of similar households. The feedback on energy use, combined with tips for reducing energy use, is designed to create sustained reductions in consumption. Net impacts were estimated using a billing regression and data from both the participants and control group customers.

Residential Cooling. The overall Residential Cooling program provides rebates for a variety of cooling measures for residential customers. For PY2017, the evaluation focused only on the sub-program component that provided rebates for electronically commutated motors (ECMs) installed on residential HVAC systems. The *ex ante* deemed savings values were reviewed and compared with the TRM and other source material as part of the gross impact analysis. A phone survey was conducted for a very small sample of participating customers, and in-depth interviews with participating contractors were also completed.

School Education Kits. The School Education Kits program provides energy efficient measures to students along with energy saving tips. The measures distributed to students through this program have deemed savings values that were reviewed as part of the evaluation and compared with the SPS Technical Assumptions documents. A survey conducted with students as part of the program was also incorporated into the evaluation.

Smart Thermostat Pilot (Saver's Stat). This residential pilot program involved installing a smart thermostat and connecting it to the participant's air conditioning unit. The pilot was designed to reduce air conditioning runtime by duty cycling and by raising the thermostat's set point and to test whether or not this would result in energy savings. A billing analysis using data from both treatment and matched control groups was conducted to estimate program impacts.

Table 1 summarizes the PY2017 evaluation methods.

Table 1: Summary of PY2017 Evaluation Methods by Program

Program	Deemed Savings Review	Phone Verification	Engineering Desk Reviews	Elasticity Model	Billing Regression
Business Comprehensive	◆	◆	◆	□	□
Home Lighting & Recycling	◆	□	□	◆	□
Energy Feedback		□	□		□◆
Residential Cooling	◆	◆	◆		
School Education Kits	◆				
Saver's Stat Pilot	◆			□	◆

The results of the PY2017 impact evaluation are shown in Table 2 (kWh) and Table 3 (kW), with the programs evaluated in 2017 highlighted in blue. A summary of the NTG ratios by program is shown in Table 4. For the non-evaluated programs, the totals are based on the *ex ante* savings and NTG values from the SPS tracking data.

Table 2: PY2017 Savings Summary - kWh[2]

Program	# of Projects	Expected Gross kWh Savings	Engineering Adjustment Factor	Realized Gross kWh Savings	NTG Ratio	Realized Net kWh Savings
Business Comprehensive						
Computer Efficiency	71	80,725	0.8348	67,390	0.8800	59,303
Cooling Efficiency	22	279,699	1.0422	291,503	0.7017	204,548
Custom Efficiency	40	6,750,787	0.9990	6,744,227	0.7017	4,732,424
Lighting Efficiency	126	2,805,318	0.9163	2,570,404	0.7017	1,803,653
Motors Efficiency	10	3,356,867	1.0053	3,374,625	0.7017	2,367,975
Retrocommissioning	1	1,042,797	1.0051	1,048,140	0.8000	838,512
Home Lighting & Recycling	256,639	13,099,130	1.0000	13,099,130	0.7100	9,300,382
Energy Feedback	21,462	3,698,071	N/A	N/A	1.0173	3,762,044
Residential Cooling						
EC Motor Furnace Fan	27	36,275	1.0102	36,644	0.6600	24,185
Premium Evap	1	3,332	1.0000	3,332	0.6600	2,199
School Education Kits	2,685	1,656,045	1.0000	1,656,045	1.0000	1,656,045
Home Energy Services	8,288	8,644,521	1.0000	8,644,521	0.9721	8,403,339
Saver's Switch	4,360	36,431	1.0000	36,431	1.0000	36,431
Smart Thermostat Pilot (Saver's Stat)	532	N/A	1.0000	0	1.0000	0
Total		**41,489,998**				**33,191,039**

[2] All kWh savings shown in this table and throughout the report are at the customer level.

Table 3: PY2017 Savings Summary - kW[3]

Program	# of Projects	Expected Gross kW Savings	Engineering Adjustment Factor	Realized Gross kW Savings	NTG Ratio	Realized Net kW Savings
Business Comprehensive						
Computer Efficiency	71	10	0.8005	8	0.8800	7
Cooling Efficiency	22	124	1.1712	146	0.7017	102
Custom Efficiency	40	877	0.9923	870	0.7017	611
Lighting Efficiency	126	332	0.9007	299	0.7017	210
Motors Efficiency	10	473	0.9897	468	0.7017	328
Retrocommissioning	1	6	3.0745	19	0.8000	16
Home Lighting and Recycling	256,639	2,056	1.0000	2,056	0.7100	1,460
Energy Feedback	21,462	908	N/A	N/A	1.0356	941
Residential Cooling						
EC Motor Furnace Fan	27	3	1.0313	3	0.6600	2
Premium Evap	1	2	1.0000	2	0.6600	2
School Education Kits	2,685	41	1.0000	41	1.0000	41
Home Energy Services	8,288	659	1.0000	659	0.9721	641
Saver's Switch	4,360	3,739	1.0000	3,739	1.0000	3,739
Smart Thermostat Pilot (Saver's Stat)	532	N/A	1.0000	377	1.0000	377
Total		**9,230**				**8,476**

[3] All kW savings shown in this table and throughout the report are peak coincident kW at the customer level.

Table 4: PY2017 NTG Ratios

Program	Net-to-Gross Ratio
Business Comprehensive	0.7099
Home Lighting & Recycling	0.7100
Energy Feedback	1.0173
Residential Cooling	0.6600
School Education Kits	1.0000
Home Energy Services	0.9721
Saver's Switch	1.0000
Saver's Stat	1.0000
Overall Portfolio	**0.8042**

Using net realized savings from this evaluation and cost information provided by SPS, the evaluation team calculated the ratio of benefits to costs for each of SPS's programs and for the portfolio overall. The evaluation team calculated cost effectiveness using the UCT, which compares the benefits and costs to the utility or program administrator implementing the program.[4] The evaluation team conducted this test in a manner consistent with the California Energy Efficiency Policy Manual.[5] The results of the UCT are shown below in Table 5. All programs except Residential Cooling and Saver's Stat had a UCT of greater than 1.00, and the portfolio overall was found to have a UCT ratio of 2.29.

[4] The Utility Cost Test is sometimes referred to as the Program Administrator Cost Test, or PACT.
[5] Version 5. 2013.
http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/Utilities_and_Industries/Energy_-_Electricity_and_Natural_Gas/EEPolicyManualV5forPDF.pdf

Table 5: PY2017 Cost Effectiveness

Program	Utility Cost Test (UCT)
Business Comprehensive	2.09
Home Lighting & Recycling	3.06
Energy Feedback	1.74
Residential Cooling	0.38
School Education Kits	3.46
Home Energy Services	2.21
Saver's Switch	2.94
Saver's Stat	0.74
Overall Portfolio	**2.29**

Based on the data collection and analysis conducted for this evaluation, the evaluation team found that, overall, SPS is operating high quality programs that are achieving significant energy and demand savings and producing satisfied participants.

The impact evaluation—which included engineering desk reviews for a sample of Business Comprehensive and Residential Cooling projects, deemed savings reviews for Home Lighting & Recycling and School Education Kits, an elasticity model for Home Lighting & Recycling, and statistical models for Energy Feedback and Saver's Stat—resulted in relatively high realized gross savings. Adjustments to savings based on the Business Comprehensive desk reviews were due to three main factors: conflict between the New Mexico TRM and SPS Technical Assumptions for lighting operating hours, unclear *ex ante* savings calculations and values for some prescriptive projects, and savings adjustments made based on post-installation inspections or other QA/QC activities that did not get carried through to the final reported savings. The evaluation team has provided a number of recommendations to improve savings values that include consolidation of the SPS Technical Assumptions and the TRM, documenting calculations and adjustments to project savings, including post-installation adjustments in final savings, and other minor improvements to savings assumptions or algorithms. A few recommendations related to data tracking were also made, including the addition of effective useful life in the Home Lighting & Recycling data and careful tracking of the overlap between Home Energy Report participants and My Energy participants for the Energy Feedback program.

In terms of cost effectiveness, the UCT test was used and found all SPS programs except for Residential Cooling and Saver's Stat to be cost effective. The portfolio overall was found to be cost effective. If SPS or the NMPRC desires other cost effectiveness tests to be used in the future, the evaluation team would suggest that SPS track measure costs for all programs so that the Total Resource Cost (TRC) test could be calculated in future program years.

The process evaluation activities, which included surveys with Business Comprehensive and Residential Cooling participants as well as interviews with Residential Cooling contractors, found very high levels of satisfaction across various aspects of the programs. Very few instances of dissatisfaction were reported, and the program processes generally appear to be working well for participants.

1 Introduction

This report presents the independent evaluation results for the Southwestern Public Service Company (SPS) energy efficiency and demand response programs for program year 2017 (PY2017).

The SPS programs and evaluation requirements were first established in 2005 by the New Mexico legislature's passage of the 2005 Efficient Use of Energy Act (EUEA).[6] The EUEA requires public utilities in New Mexico, in collaboration with other parties, to develop cost-effective programs that reduce energy demand and consumption. Utilities are required to submit their proposed portfolio of programs to the New Mexico Public Regulation Commission (NMPRC) for approval. As a part of its approval process, the NMPRC must find that the program portfolio is cost effective based on the Utility Cost Test.

An additional requirement of the EUEA is that each program must be evaluated at least once every three years. As part of the evaluation requirement, SPS must submit to the NMPRC a comprehensive evaluation report prepared by an independent program evaluator. As part of the reporting process, the evaluator must measure and verify energy and demand savings, determine program cost effectiveness, assess how well the programs are being implemented, and provide recommendations for program improvements as needed.

Within this regulatory framework, the Evergreen evaluation team was chosen to be the independent evaluator for SPS in May 2017, and a project initiation meeting was held with SPS staff on September 14, 2017. The Evergreen evaluation team consisted of the following firms:

- **Evergreen Economics** was the prime contractor and managed all evaluation tasks and deliverables;
- **EcoMetric** provided engineering capabilities and led the review of SPS's savings estimates;
- **Demand Side Analytics** conducted the impact evaluation of the smart thermostat pilot program (Saver's Stat); and
- **Research & Polling** fielded all the phone surveys.

[6] NMSA §§ 62-17-1 *et seq* (SB 644). Per the New Mexico Public Regulation Commission Rule Pursuant to requirements of the EUEA, the NMPRC issued its most recent *Energy Efficiency Rule* (*17.7.2 NMAC*) effective January 1, 2015 that sets forth the NMPRC's policy and requirements for energy efficiency and load management programs. This Rule can be found online at http://164.64.110.239/nmac/parts/title17/17.007.0002.htm

For PY2017, the following SPS programs were evaluated:

- Business Comprehensive
- Home Lighting & Recycling
- Energy Feedback
- Residential Cooling
- School Education Kits
- Smart Thermostat Pilot (Saver's Stat)

For each of the evaluated programs, the evaluation team estimated realized gross and net impacts (kWh and kW) and calculated program cost effectiveness using the Utility Cost Test (UCT). Brief process evaluations were also conducted for the Business Comprehensive and Residential Cooling programs.

The remaining programs that were not evaluated in 2017 are still summarized in this report. The accomplishments for the non-evaluated programs are reported using the following parameters:

- Gross impacts (kWh, kW) were calculated using the SPS *ex ante* values for annual savings;
- Net impacts were calculated from the gross impacts using the existing *ex ante* net-to-gross ratio; and
- Cost effectiveness calculations were calculated using the *ex ante* net impact values and cost data as reported by SPS.

The remainder of this report is organized as follows. The *Evaluation Methods* chapter describes the various analysis methods and data collection activities that were conducted for the PY2017 evaluation. The *Impact Evaluation Results* chapter follows and presents the energy and demand savings by program. *The Cost Effectiveness Results* are summarized in the next chapter, followed by a chapter presenting the *Process Evaluation Results.* The main report concludes with a chapter on evaluation *Conclusions and Recommendations.* Additional technical details on the evaluation methods and results are included in several appendices.

2 Evaluation Methods

The analysis methods used for the evaluated PY2017 programs are summarized as follows:

Business Comprehensive. The measures eligible for the Business Comprehensive program are primarily prescriptive in nature, but the program also includes custom projects. Gross impacts were estimated based on a review of the deemed savings values combined with engineering desk reviews of a statistically representative sample of projects covering a range of project sizes and major measure types. A phone survey of participating customers was used to verify installation and to collect information needed for a self-report analysis of free ridership to determine net impacts.

Home Lighting & Recycling. For the LED measures promoted by the program, deemed savings values included in SPS's tracking data (and used for the *ex ante* impacts) were compared with the values contained in the New Mexico Technical Reference Manual (TRM) and the SPS Technical Assumptions documents. If the values did not match, they were carefully reviewed to determine if the values were reasonable and the source appropriately documented. Net impacts were estimated using the lighting elasticity model.

Energy Feedback. This program provides participating customers with information on their energy consumption by providing a comparison with a matched set of similar households. The feedback on energy use, combined with tips for reducing energy use, is designed to create sustained reductions in consumption. Net impacts were estimated using a billing regression and data from both the participants and control group customers.

Residential Cooling. The overall Residential Cooling program provides rebates for a variety of cooling measures for residential customers. For PY2017, the evaluation focused only on the sub-program component that provided rebates for electronically commutated motors (ECMs) installed on residential HVAC systems. The *ex ante* deemed savings values were reviewed and compared with the TRM and other source material as part of the gross impact analysis. A phone survey was conducted for a very small sample of participating customers, and in-depth interviews with participating contractors were also completed.

School Education Kits. The School Education Kits program provides energy efficient measures to students along with energy saving tips. The measures distributed to students through this program have deemed savings values that were reviewed as part of the evaluation and compared with the SPS Technical Assumptions documents. A survey conducted with students as part of the program was also incorporated into the evaluation.

Smart Thermostat Pilot (Saver's Stat). This residential pilot program involved installing a smart thermostat and connecting it to the participant's air conditioning unit. The pilot was designed to reduce air conditioning runtime by duty cycling and by raising the thermostat's set point and to test whether or not this would result in energy savings. A billing analysis using data from both treatment and matched control groups was conducted to estimate program impacts.

Table 6 summarizes the PY2017 evaluation methods. Additional detail on each of these evaluation methods is included in the remainder of this chapter.

Table 6: Summary of PY2017 Evaluation Methods by Program

Program	Deemed Savings Review	Phone Survey	Engineering Desk Reviews	Elasticity Model	Billing Regression
Business Comprehensive	◆	◆	◆	☐	☐
Home Lighting & Recycling	◆	☐	☐	◆	☐
Energy Feedback		☐	☐		☐◆
Residential Cooling	◆	◆	◆		
School Education Kits	◆				
Saver's Stat Pilot	◆			☐	◆

2.1 Phone Surveys

Participant phone surveys were fielded in early 2018 for participants in the Business Comprehensive and Residential Cooling programs. The surveys averaged about 20 minutes in length and covered the following topics:

- Verification of measures included in SPS's program tracking database;
- Satisfaction with the program experience;
- Survey responses for use in the free ridership calculations;
- Participation drivers and barriers; and
- Customer characteristics.

Additional interviews were also conducted by engineers if additional information was needed for the individual project desk reviews.

Given the low number of participants, the original goal was to complete as many surveys as possible, and a census of participants was contacted for both programs. Ultimately, 44 phone surveys were completed for both programs combined. Table 7 shows the distribution of completed surveys.

Table 7: Business Comprehensive and Residential Cooling Program Phone Survey Summary

Program	Number of Customers with Valid Contact Info	Target Number of Completes	Completed Surveys
Business Comprehensive	91	75	42
Residential Cooling	20	15	2
Total	**111**	**90**	**44**

The final survey instrument for Business Comprehensive is included in Appendix A and for Residential Cooling is included in Appendix B.

2.2 Engineering Desk Reviews

In order to verify gross savings estimates, the evaluation team conducted engineering desk reviews for a sample of the projects in the Business Comprehensive and Residential Cooling programs. The goal of the desk reviews was to verify equipment installation, operational parameters, and estimated savings.

Both prescriptive and custom projects received desk reviews that included the following:

- Review of project description, documentation, specifications, and tracking system data;
- Confirmation of installation using invoices and/or post-installation reports; and
- Review of post-installation reports detailing differences between installed equipment and documentation, and subsequent adjustments made by the program implementer.

For projects in the Residential Cooling program and the Business Comprehensive projects that relied on deemed savings values for prescriptive measures, the engineering desk reviews included the following:

- Review of measures available in the New Mexico TRM and the SPS Technical Assumptions documents to determine the most appropriate algorithms which apply to the installed measure;

- Recreation of savings calculations using TRM/Technical Assumptions algorithms and inputs as documented by submitted specifications, invoices, and post-installation inspection reports; and
- Review of TRM/Technical Assumptions algorithms to identify candidates for future updates and improvements.

For the custom projects included in the Business Comprehensive program, the engineering desk reviews included the following:

- Review of engineering analyses for technical soundness, proper baselines, and appropriate approaches for the specific applications;
- Review of methods of determining demand (capacity) savings to ensure they are consistent with program and/or utility methods for determining peak load/savings;
- Review of input data for appropriate baseline specifications and variables such as weather data, bin hours, and total annual hours to determine if they are consistent with facility operation; and
- Consideration and review for interactive effects between affected systems.

In support of the engineering desk reviews, primary data were collected for select projects through engineering in-depth interviews. These interviews involved speaking with project contacts to confirm equipment installation and operational parameters, in order to determine if additional adjustments to the savings calculations were necessary.

2.3 Billing Regression

A billing regression model was used to evaluate two different SPS programs in 2017: the Energy Feedback program and the Saver's Stat pilot. The general framework for the billing regression model is to estimate post-participation energy consumption while controlling for the timing of the measures installation and changes in weather over the analysis period. The model framework was tailored to match the individual programs, as discussed below.

2.3.1 Energy Feedback

For the Energy Feedback program, a billing regression was used to estimate energy savings based on an analysis of customer bills before and after they received the energy feedback reports. The billing regression uses a fixed effects specification and includes variables for monthly energy consumption, weather (heating and cooling degree days) and monthly dummy variables to control for other external influences on energy use. The analysis dataset is a randomized control trial (RCT) design that includes both a participating (treatment) group and a matched control group of customers. Since data on the control are included in the model, the resulting impact estimates are interpreted as net impacts.

Specific modeling details are included in the following *Impact Evaluation Results* chapter.

2.3.2 Smart Thermostat Pilot (Saver's Stat)

Saver's Stat is a smart thermostat pilot offered to residential customers. To facilitate load control, participants must have a communicating smart thermostat installed in their home and connected to a central air conditioning unit. This device is capable of receiving internet-based signals that aim to diminish air conditioning runtime by one of two methods. The first dispatch method is an approximation of duty cycling by keeping the compressor off for 15 minutes of each 30-minute period (i.e., cycling 50 percent of the time). The second dispatch method is enabled by raising the thermostat's set point, thereby reducing the need for the compressor to run, until the indoor temperature rises to the new set point. For Saver's Stat, temperature offset-based dispatches raised thermostat set points by 4 degrees Fahrenheit during events.

There were eight Saver's Stat events during the summer 2017 demand response season, which began June 1st and ended September 30th. Table 8 provides summary information on these eight 2017 events.

Table 8: 2017 Saver's Stat Event Summary

Date	Day of Week	Start Time (MDT)	End Time (MDT)	Daily High at KROW (F)	Avg Temp 3-7 p.m. at KROW (F)	Daily Avg Humidity at KROW (F)
June 16	Friday	3:00 p.m.	7:00 p.m.	106	103	31%
June 22	Thursday	3:00 p.m.	7:00 p.m.	107	102	51%
June 28	Wednesday	3:00 p.m.	7:00 p.m.	103	102	46%
June 29	Thursday	3:00 p.m.	7:00 p.m.	105	102	40%
August 10	Thursday	3:00 p.m.	7:00 p.m.	96	93	58%
September 15	Friday	3:00 p.m.	7:00 p.m.	94	90	46%
September 20	Wednesday	3:00 p.m.	7:00 p.m.	95	91	40%
September 21	Thursday	3:00 p.m.	7:00 p.m.	97	91	43%

To evaluate impacts for these eight events, the evaluation team used runtime interval data collected by the smart thermostats. Runtime intervals were converted to loads by applying connected load measurements from the 2016 evaluation to the runtime data. The interval loads were further combined with National Oceanic and Atmospheric Administration (NOAA) weather station data for Roswell Airport (KROW), near the center of the SPS territory. While the thermostats also collect local, more granular outdoor weather data, the Roswell weather data were used for the *ex post* impact analysis to allow for consistency with the *ex ante* peak impact estimate.

To estimate demand reductions on event days, the approach was based on runtime data obtained from participant thermostats. The raw data were recorded by the device manufacturer for active devices (those connected during a given interval) in five-minute intervals and showed the number of compressor runtime seconds in each interval. Runtime intervals were converted to kW by applying average compressor data collected during the 2016 Saver's Stat evaluation.[7] This detailed five-minute interval data were converted to average runtime per hour and were used for the load impact analysis.

To estimate impacts, loads from non-event days were used to develop event-day baseline estimates specific to each event day. *Ex post* impacts are simply the difference between observed hourly loads and the estimated baseline. Baseline accuracy was assessed using the following steps.

1. Identify event-like days and narrow dataset to these days;
2. Remove these days one at a time to create training datasets;
3. Use regression analysis to estimate reference loads;
4. Compare estimated reference loads to actual loads on validation days;
5. Compute metrics of bias, accuracy, and precision; and
6. Assess estimation method based on performance across key metrics.[8]

The final model is shown below and was selected for its performance in predicting loads on event-like days. This model was selected among 17 candidate models, which in addition to the terms below included various combinations of terms addressing maximum temperature, heat accumulation (average early morning temperature), average and hourly humidity, and monthly variation.

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[7] 2.938 kW for duty cycling devices and 2.757 kW for temperature offset devices. See Table 7-2 Smart Thermostat Event Summary in the 2016 Energy Efficiency and Load Management Annual Report. http://192.234.137.143/staticfiles/xe-responsive/Company/Rates%20&%20Regulations/Regulatory%20Filings/2016-Energy-Efficiency-and-Load-Management-Annual-Report-(Case%20No.%2017-00159-UT).pdf

[8] The following algorithm was used to identify the best performing baseline model: select the model with the best fit (lowest root mean square error) among the three models with the least bias (lowest absolute percent bias).

$$kW_{Post,t} = \alpha + \beta_1 kW_{14} + \beta_2 temp_{16-19} + \beta_3 temp_t + \varepsilon_t$$

Where:

$kW_{Post,t}$ = Estimated post period kW in period t

kW_{14} = Load in pre-event hour 14 (1 PM to 2 PM)

$temp_{16-19}$ = Average temps during event hours 16 thru 19

$temp_t$ = Average temps during hour t

ε_t = Random error term

Additional detail on the analysis methods used for the Saver's Stat pilot is included in Appendix D.

2.4 Net Impact Analysis

2.4.1 Self-Report Approach

The evaluation team estimated net impacts for the Business Comprehensive program using the self-report approach. This method uses responses to a series of carefully constructed survey questions to learn what participants would have done in the absence of the utility's program. The goal is to ask enough questions to paint an adequate picture of the influence of the program activities (rebates and other program assistance) within the confines of what can reasonably be asked during a phone survey.

With the self-report approach, specific questions that are explored include the following:

- What were the circumstances under which the customer decided to implement the project (i.e., new construction, retrofit/early replacement, replace-on-burnout)?
- To what extent did the program accelerate installation of high efficiency measures?
- What were the primary influences on the customer's decision to purchase and install the high efficiency equipment?
- How important was the program rebate on the decision to choose high efficiency equipment?
- How would the project have changed if the rebate had not been available (e.g., would less efficient equipment have been installed, would the project have been delayed, etc.)?
- Were there other program or utility interactions that affected the decision to choose high efficiency equipment (e.g., was there an energy audit done, has the customer participated before, is there an established relationship with a utility account representative, was the installation contractor trained by the program)?

The method used for estimating free ridership (and ultimately the net-to-gross [NTG] ratio) using the self-report approach is based on the 2017 Illinois Statewide Technical Reference Manual.[9] For the SPS programs, questions regarding free ridership were divided into several primary components:

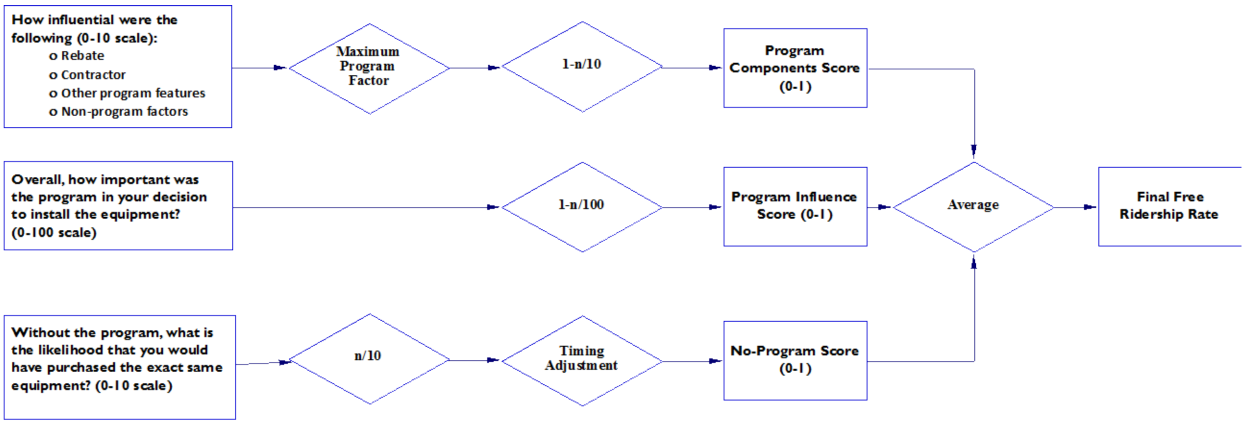
- A ***Program Component*** series of questions that asked about the influence of specific program activities (rebate, customer account rep, contractor recommendations, other assistance offered) on the decision to install energy efficient equipment;
- A ***Program Influence*** question, where the respondent was asked directly to provide a rating of how influential the overall program was on their decision to install high efficiency equipment; and
- A ***No-Program Component*** series of questions, based on the participant's intention to carry out the energy-efficient project without program funds or due to influences outside of the program.

Each component was assessed using survey responses that rated the influence of various factors on the respondent's equipment choice. Since opposing biases potentially affect the main components, the *No-Program* component typically indicates higher free ridership than the *Program Component/Influence* questions. Therefore, combining these opposing influences helps mitigate the potential biases. This framework also relies on multiple questions that are crosschecked with other questions for consistency. This prevents any single survey question from having an excessive influence on the overall free ridership score.

Figure 1 provides a simplified version of the scoring algorithm. In some cases, multiple questions were asked to assess the levels of efficiency and purchase timing in absence of the program. For each of the scoring components, the question responses were scored so that they were consistent and resulted in values between 0 and 1. Once this was accomplished, the three question components were averaged to obtain the final free ridership score.

[9] The full Illinois TRM can be found at http://www.ilsag.info/il_trm_version_6.html

Figure 1: Self-Report Free Ridership Scoring Algorithm



Source: Adapted by Evergreen Economics from the 2017 Illinois TRM.

More detail on each of the three question tracks is provided below.

Program Component Questions

The ***Program Component*** battery of questions was designed to capture the influence of the program on the equipment choice. These questions were also designed to be as comprehensive as possible so that all possible channels through which the program is attempting to reach the customer were included.

The type of questions included in the Program Component question battery included the following:

- How influential were the following on your decision to purchase your energy efficient equipment?
    - Rebate amount
    - Contractor recommendation
    - Utility advertising/promotions
    - Technical assistance from the utility (e.g., energy audit)
    - Recommendation from utility customer representative (or program implementer)
    - Previous participation in a utility efficiency program

As shown at the top of Figure 1, the question with the highest value response (i.e., the program factor that had the greatest influence on the decision to install a high efficiency measure) was the one that was used in the scoring algorithm as the Program Component score.

Program Influence Question

A separate ***Program Influence*** question asked the respondent directly to rate the combined influence of the various program activities on their decision to install energy efficient equipment. This question allowed the respondent to consider the program as a whole and incorporated other forms of assistance (if applicable) in addition to the rebate. Respondents were also asked about potential non-program factors (condition of existing equipment, corporate policies, maintenance schedule, etc.) to put the program in context with other potential influences.

The Program Influence question also provided a consistency check so that the stated importance of various program factors could be compared across questions. If there appeared to be inconsistent answers across questions (rebate was listed as very important in one question but not important in a different question, for example), then the interviewer asked follow-up questions to confirm responses. The verbatim responses were recorded and were reviewed by the evaluation team as an additional check on the free ridership results.

No-Program Questions

A separate battery of ***No-Program*** component questions was designed to understand what the customer might have done if the SPS rebate program had not been available. With these questions, we attempted to measure how much of the decision to purchase the energy efficient equipment was due to factors that were unrelated to the rebate program or other forms of assistance offered by SPS.

The types of questions asked for the No-Program component included the following:

- If the program had not existed, would you have
  - Purchased the exact same equipment?
  - Chosen the same energy efficiency level?
  - Delayed your equipment purchase?
- Did you become aware of the utility rebate program before or after you chose your energy efficient equipment?

The question regarding the timing of awareness of the rebate was used in conjunction with the importance rating the respondent provided in response to the earlier questions. If the respondent had already selected the high efficiency equipment prior to learning about the rebate **and** said that the rebate was the most important factor, then a downward adjustment was made on the influence of the rebate in calculating the Program Component score.

The responses from the No-Program questions were analyzed and combined with a timing adjustment to calculate the No-Program score, as shown in Figure 1. The timing adjustment was made based on whether or not the respondent would have delayed their equipment purchase if the rebate had not been available. If the purchase would have been delayed by one year or more, then the No-Program score was set to zero, thereby minimizing the level of free ridership for this algorithm component only.

Free Ridership and NTG Calculation

The values from the Program Component score, the Program Influence score, and the No-Program score were averaged in the final free ridership calculation; the averaging helped reduce potential biases from any particular set of responses. The fact that each component relied on multiple questions (instead of a single question) also reduced the risk of response bias. As discussed above, additional survey questions were asked about the relative importance of the program and non-program factors. These responses were used as a consistency check, which further minimized potential bias.

Once the self-report algorithm was used to calculate free ridership, the total NTG ratio was calculated using the following formula:

$$Net\text{-}to\text{-}Gross\ Ratio = (1 - Free\ Ridership\ Rate)$$

2.4.2 Elasticity Model

The evaluation team used an elasticity model to estimate free ridership (and ultimately net impacts) for SPS's Home Lighting & Recycling program. The elasticity model approach was used for two primary reasons:

1. Customer-specific purchase information is not tracked for the bulbs bought through the program. This is common for upstream programs, where the rebate is provided to the retailer rather than the customer. To promote sales, ease of use for the customer is emphasized over burdening the customer with requests for additional information.
2. The elasticity model is based on observed market behavior and utilizes all the light bulb sales data from the program. This is in contrast to the alternative net impact methods (either phone surveys or store intercept surveys) that only cover a small portion of program bulb sales. Since all the sales data are used in the model, the results will be more representative. The data also reflect actual market decisions (revealed preferences) rather than the hypothetical purchase scenarios that would be obtained using the surveys (stated preferences).

The purpose of the elasticity model is to estimate how sensitive customers are to price changes for the energy efficient lighting options rebated through the program. By calculating the price elasticity, we create an estimate of how much demand will change with a change in price. Once this relationship is established, we can estimate how much the price reduction through the program is influencing overall lighting sales.

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A variety of different model specifications were explored, and the final elasticity model is as follows:

$$Bulbs_{i,t,s} = InvoicePeriod_{i,t,s} * e^{(\alpha + \beta_1 Price_{i,t,s} + \beta_2 Watts_i + \beta_3 Char_i + \varepsilon_{i,t,s})}$$

Where :

$Bulbs_{i,t,s}$ = **Number of bulbs sold by product type i, during period t, at store s**

$Price_{i,t,s}$ = **Rebated price for product type i, during period t, at store s**

$Watts_i$ = **Wattage for bulb type i**

$Char_i$ = **Indicator variables describing particular characteristics of bulb type i**

$InvoicePeriod_{i,t,s}$ = **Number of days each bulb type i was offered for sale during period t at store s**

With this model specification and *Price* as an independent variable, the coefficient estimate on the *Price* variable multiplied by the average price of a rebated bulb is an elasticity. In this case, the elasticity reflects the percentage change in lighting demand due to a 1 percent change in lighting price. A value less than 1.0 percent indicates that lighting purchases are relatively insensitive to price changes, while a value greater than 1.0 indicates that customers are sensitive to prices and therefore the program will have a greater impact in the lighting market (i.e., lower free ridership).

Once the elasticity is estimated, the net program bulb sales are estimated using the following steps:

1. The total number of bulbs sold through the program is totaled from the program sales data (**Gross Program Sales**).
2. The average price per bulb ***without*** the rebate is calculated from the sales data (i.e., the rebate cost is added back to the bulb price).
3. The elasticity value is used to estimate how much bulb sales would decrease if the price were increased by the amount of the rebate (mimicking the sales if the rebate had not been available). The change in bulb sales due to the price increase is the

Net Program Sales, as this is the amount of total bulb sales that are being driven by the rebate.

4. The **Free Rider Sales** are calculated by subtracting **Net Program Sales** from **Gross Program Sales.**
5. The free ridership rate and final NTG ratio are calculated using the following equation:

$$Free\ Ridership\ Rate = \frac{Free\ Rider\ Sales}{Gross\ Program\ Sales}$$

$$Net\text{-}to\text{-}Gross\ Ratio = (1 - Free\ Ridership\ Rate)$$

There are several important advantages to using the elasticity model rather than a phone survey to estimate net impacts:

- **The elasticity model is based on real world behavior.** The model is estimated based on market data from actual lighting purchases, which is the best indicator of customers' sensitivity to price. This is preferable to a self-report survey where we would first need to locate lighting purchasers in the general population and then ask them what type of lighting purchases they would have made if the price had not been reduced. These hypothetical 'stated preference' data are generally less preferred than actual market data (but sometimes are the only data available).
- **A larger sample size is available at lower cost.** Because the model can be estimated based on data that are already tracked by the program, an additional customer survey is not needed. This reduces the cost of the evaluation significantly. Similarly, because we can use the entire lighting dataset (not just a subset of those customers surveyed), the evaluation has a larger amount of data that should lead to more accurate estimates of net impacts.
- **The elasticity model approach has been applied successfully in other territories.** This approach is gaining wider use in other regions, for the reasons given above. This has allowed the elasticity model to be tested and refined over time.

The Uniform Methods Project (UMP)[10] discusses the elasticity model as an appendix to its larger chapter on recommended methods for estimating net impacts.[11]

[10] The UMP is sponsored by the National Renewable Energy Lab and provides documentation of current energy efficiency program evaluation practices. The purpose of the UMP is to promote consistent and straightforward methods for estimating gross and net savings based on current best practices.

2.5 Realized Gross and Net Impact Calculation

The final step in the impact evaluation process is to calculate the realized gross and net savings, based on the program-level analysis described above. The **Gross Realized Savings** are calculated by taking the original *ex ante* savings values from the participant tracking databases and adjusting them using an **Installation Adjustment** factor (based on the count of installed measures verified through the phone surveys) and an **Engineering Adjustment** factor (based on the engineering analysis, desk reviews, etc.):

Gross Realized Savings =

(*Ex Ante* Savings)*(Installation Adjustment)*(Engineering Adjustment Factor)

Net realized savings is then determined by multiplying the Gross Realized Savings by the net-to-gross ratio:

Net Realized Savings = (Net-to-Gross Ratio)*(Gross Realized Savings)

2.6 Cost Effectiveness

The cost effectiveness of the SPS programs was tested using the Utility Cost Test (UCT). In the UCT, the benefits of a program are considered to be the present value of the net energy saved, and the costs are the present value of the program's administrative costs plus incentives paid to customers. In order to perform the cost effectiveness analysis, the evaluation team obtained the following from SPS:

- Avoided cost of energy (costs per kWh over a 20+ year time horizon);
- Avoided cost of capacity (estimated cost of adding a kW/year of generation, transmission, and distribution to the system);

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[11] See https://www.nrel.gov/docs/fy17osti/68578.pdf for the full UMP net impacts discussion. The discussion of elasticity model is included in Appendix A. Daniel Voilette and P. Rathbun. "Chapter 21: Estimating Net Savings – Common Practices." *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures.* Prepared for the National Renewable Energy Laboratory (NREL), October 2017.

- Avoided cost of CO_2 (estimated monetary cost of CO_2 per kWh generated);
- Avoided transmission and distribution costs (estimated cost of transmission and distribution per kW-year);
- Discount rate (percentage used to calculate the net-present value of future savings);
- Line loss factor (percentage used to adjust avoided cost for line losses);
- Any assumed non-energy benefits, expressed in monetary terms or as a percentage of savings for each measure or program; and
- Administrative costs (all non-incentive expenditures associated with program delivery).

In response to this data request, SPS provided its annual average avoided costs, discount rate, line loss factors, and program administrative costs. SPS has different avoided costs of capacity and line loss factors for energy efficiency and load management (demand) programs. Per the guidance of SPS, the cost effectiveness analysis assumes that the Saver's Stat and Saver's Switch programs are characterized as load management, while all others are characterized as energy efficiency programs.

For all programs, the energy savings, incremental measure costs, and effective useful life values were taken from the final PY2017 tracking data submitted by SPS. NTG ratios and engineering adjustment factors were applied in order to use net verified impacts in the analysis.

SPS also provided the evaluation team with measure-specific net present values for the avoided cost per kWh saved over each measure's life. These values took into account measure load shapes, hourly avoided energy costs, measure effective useful lives, the SPS discount rate, and line loss factors.

Additionally, Section 17.7.2.9.B(4) of the New Mexico Energy Efficiency Rule allows utilities to claim utility system economic benefits for low income programs equal to 20 percent of the calculated energy benefits. We applied the 20 percent adder to the benefits calculated for the Low Income Home Energy Services and Low Income Kits programs as well as low-income bulb giveaway events in the Home Lighting & Recycling program.

The evaluation team input the savings and cost data into a cost effectiveness model that calculated the benefits, costs, and benefit-cost ratio for each measure, project, or program entered, and rolled up the data into program-level UCT values.

3 Impact Evaluation Results

The results of the PY2017 impact evaluation are shown in Table 9 (kWh) and Table 10 (kW), with the programs evaluated in 2017 highlighted in blue. A summary of the NTG ratios by program is shown in Table 11. For the non-evaluated programs, the totals are based on the *ex ante* savings and net-to-gross (NTG) values from the SPS tracking data.

As noted previously, each program is required to be evaluated a minimum of once every three years. For 2017, the evaluated programs covered 79 percent of the *ex ante* kWh savings and 52 percent of the *ex ante* kW savings.

Table 9: PY2017 Savings Summary – kWh[12]

Program	# of Projects	Expected Gross kWh Savings	Engineering Adjustment Factor	Realized Gross kWh Savings	NTG Ratio	Realized Net kWh Savings
Business Comprehensive						
Computer Efficiency	71	80,725	0.8348	67,390	0.8800	59,303
Cooling Efficiency	22	279,699	1.0422	291,503	0.7017	204,548
Custom Efficiency	40	6,750,787	0.9990	6,744,227	0.7017	4,732,424
Lighting Efficiency	126	2,805,318	0.9163	2,570,404	0.7017	1,803,653
Motors Efficiency	10	3,356,867	1.0053	3,374,625	0.7017	2,367,975
Retrocommissioning	1	1,042,797	1.0051	1,048,140	0.8000	838,512
Home Lighting & Recycling	256,639	13,099,130	1.0000	13,099,130	0.7100	9,300,382
Energy Feedback	21,462	3,698,071	N/A	N/A	1.0173	3,762,044
Residential Cooling						
EC Motor Furnace Fan	27	36,275	1.0102	36,644	0.6600	24,185
Premium Evap	1	3,332	1.0000	3,332	0.6600	2,199
School Education Kits	2,685	1,656,045	1.0000	1,656,045	1.0000	1,656,045
Home Energy Services	8,288	8,644,521	1.0000	8,644,521	0.9721	8,403,339
Saver's Switch	4,360	36,431	1.0000	36,431	1.0000	36,431
Smart Thermostat Pilot (Saver's Stat)	532	N/A	1.0000	0	1.0000	0
Total		**41,489,998**				**33,191,039**

[12] All kWh savings shown in this table and throughout the report are at the customer level.

Table 10: PY2017 Savings Summary – kW[13]

Program	# of Projects	Expected Gross kW Savings	Engineering Adjustment Factor	Realized Gross kW Savings	NTG Ratio	Realized Net kW Savings
Business Comprehensive						
Computer Efficiency	71	10	0.8005	8	0.8800	7
Cooling Efficiency	22	124	1.1712	146	0.7017	102
Custom Efficiency	40	877	0.9923	870	0.7017	611
Lighting Efficiency	126	332	0.9007	299	0.7017	210
Motors Efficiency	10	473	0.9897	468	0.7017	328
Retrocommissioning	1	6	3.0745	19	0.8000	16
Home Lighting and Recycling	256,639	2,056	1.0000	2,056	0.7100	1,460
Energy Feedback	21,462	908	N/A	N/A	1.0356	941
Residential Cooling						
EC Motor Furnace Fan	27	3	1.0313	3	0.6600	2
Premium Evap	1	2	1.0000	2	0.6600	2
School Education Kits	2,685	41	1.0000	41	1.0000	41
Home Energy Services	8,288	659	1.0000	659	0.9721	641
Saver's Switch	4,360	3,739	1.0000	3,739	1.0000	3,739
Smart Thermostat Pilot (Saver's Stat)	532	N/A	1.0000	377	1.0000	377
Total		**9,230**				**8,476**

[13] All kW savings shown in this table and throughout the report are peak coincident kW at the customer level.

Table 11: PY2017 NTG Ratios

Program	Net-to-Gross Ratio
Business Comprehensive	0.7099
Home Lighting & Recycling	0.7100
Energy Feedback	1.0173
Residential Cooling	0.6600
School Education Kits	1.0000
Home Energy Services	0.9721
Saver's Switch	1.0000
Saver's Stat	1.0000
Overall Portfolio	**0.8042**

Details on the individual program impacts are summarized below, with additional details on the analysis methods and results for some programs included as appendices where noted.

3.1 Business Comprehensive Program

3.1.1 Business Comprehensive Gross Impacts

The *ex ante* 2017 impacts for the Business Comprehensive program are summarized in Table 12. In total, the Business Comprehensive program accounted for approximately 35 percent of *ex ante* energy impacts in SPS's overall portfolio.

Table 12: Business Comprehensive Savings Summary

Sub-Program	# of Projects	Expected Gross kWh Savings	Expected Gross kW Savings
Computer Efficiency	71	80,725	10
Cooling Efficiency	22	279,699	124
Custom Efficiency	40	6,750,787	877
Lighting Efficiency	126	2,805,318	332
Motors Efficiency	10	3,356,867	473
Retrocommissioning (RCx)	1	1,042,797	6
Total	**270**	**14,316,193**	**1,822**

The majority of the gross impact evaluation activities were devoted to engineering desk reviews of a sample of projects. For the desk reviews, the sample frame included projects in the Computer, Cooling, Custom, Lighting, Motors and Retrocommissioning (RCx) sub-programs. The sample was stratified to cover a range of different measure types so that no single measure (often lighting) would dominate the desk reviews. The sample was also stratified based on total energy savings within each sub-program. In some cases, very large projects were assigned to a "certainty" stratum and were automatically added to the sample (rather than randomly assigned). This allowed for the largest projects to be included in the desk reviews and maximized the amount of savings covered in the sample. Overall, the sampling strategy ensured that a mix of projects in terms of both project size and measure type would be included in the desk reviews.

The final sample design is shown in Table 13. The resulting sample achieved a relative precision of 90/9.2 overall, with precision ranging from 90/7.5 to 90/16 for the individual sub-programs. A census was achieved for both the Motors and Retrocommissioning sub-programs.

Table 13: Business Comprehensive Desk Review Sample

Sub-Program	Stratum	Count*	Average kWh	Total kWh Savings	% of Savings	Final Sample
Computers	Certainty	1	32,034	32,034	0.2%	1
Computers	1	4	6,500	26,001	0.2%	3
Computers	2	8	2,836	22,690	0.2%	4
Cooling	Certainty	1	110,731	110,731	0.8%	1
Cooling	1	2	41,158	82,315	0.6%	2
Cooling	2	19	4,561	86,653	0.6%	4
Custom	Certainty	1	2,054,442	2,054,442	14.4%	1
Custom	1	2	714,847	1,429,693	10.0%	2
Custom	2	3	642,261	1,926,782	13.5%	3
Custom	3	40	33,497	1,339,870	9.4%	3
Lighting	Certainty	1	496,481	496,481	3.5%	1
Lighting	1	6	111,422	668,530	4.7%	5
Lighting	2	15	47,242	708,626	4.9%	2
Lighting	3	26	20,488	532,676	3.7%	2
Lighting	4	71	5,620	399,005	2.8%	3
Motors	Certainty	10	335,687	3,356,867	23.4%	10
RCx	Certainty	1	1,042,797	1,042,797	7.3%	1
Total		**211**		**14,316,193**	**100.0%**	**48**

*The count shown here is based on the evaluation team's definition of a "project" in the tracking data for sampling purposes, and differs slightly from the count shown in the impact summary tables. The sample is stratified by sub-program and energy savings, therefore this difference in count does not affect the validity of the sample design.

As discussed in the *Evaluation Methods* chapter, gross realized impacts for the Business Comprehensive program were determined by performing engineering desk reviews on the sample of projects.

For prescriptive projects, the evaluation team found multiple measures that existed in both the New Mexico TRM and the SPS Technical Assumptions, with some differing approaches and assumptions in each document. In cases where these sources were not consistent, the evaluation team examined both sources to determine which approach we believed offered greater detail and accuracy. Other incentivized measures existed only in the SPS Technical Assumptions, and so these algorithms were reviewed for accuracy and adjusted as necessary to verify savings estimates.

For custom projects, savings analyses were recreated when possible (e.g., simple spreadsheet calculations). For more complex analyses (e.g., whole building energy simulations), the evaluation team reviewed the calculation methods and input values. When applicable, approaches and assumptions used in custom analyses were compared to those contained in the TRM.

A sub-sample of projects receiving desk reviews was selected to receive engineering in-depth interviews. Custom projects and projects with high levels of savings were identified as candidates for these interviews. Reviewing engineers attempted to contact selected participants by phone and email to confirm installation of incentivized equipment and verify operational parameters integral to the calculation of estimated savings. Most of the participants contacted did not respond to our team's interview requests, and we were only able to complete two project interviews. Despite the limited responses, no major issues were identified during the interviews. The one adjustment made as a result of an interview was changing the hours of use for certain light fixtures in a custom lighting project, resulting in a slight decrease in *ex post* savings. (The *ex post* savings still remained higher than the *ex ante* savings, however.)

Table 14 and Table 15 show the results of the desk reviews and how the resulting engineering adjustments were used to calculate realized savings. For the Business Comprehensive program overall, these adjustments resulted in an engineering adjustment factor of 0.9846 for kWh and 0.9933 for kW.

Table 14: PY2017 Business Comprehensive Gross kWh Impact Summary

Sub-Program	# of Projects	Expected Gross kWh Savings	Engineering Adjustment Factor	Realized Gross kWh Savings
Computer Efficiency	71	80,725	0.8348	67,390
Cooling Efficiency	22	279,699	1.0422	291,503
Custom Efficiency	40	6,750,787	0.9990	6,744,227
Lighting Efficiency	126	2,805,318	0.9163	2,570,404
Motors Efficiency	10	3,356,867	1.0053	3,374,625
Retrocommissioning (RCx)	1	1,042,797	1.0051	1,048,140

Total	270	14,316,193	0.9846	14,096,289

Table 15: PY2017 Business Comprehensive Gross kW Impact Summary

Sub-Program	# of Projects	Expected Gross kW Savings	Engineering Adjustment Factor	Realized Gross kW Savings
Computer Efficiency	71	10	0.8005	8
Cooling Efficiency	22	124	1.1712	146
Custom Efficiency	40	877	0.9923	870
Lighting Efficiency	126	332	0.9007	299
Motors Efficiency	10	473	0.9897	468
Retrocommissioning (RCx)	1	6	3.0745	19
Total	**270**	**1,822**	**0.9933**	**1,810**

Engineering adjustment factors that varied significantly from 1 were predominately caused by three overarching reasons:

- **Conflicting lighting measure assumptions between the New Mexico TRM and the SPS Technical Assumptions.** Efficient lighting measures exist in both the New Mexico TRM and the SPS Technical Assumptions. While the SPS Technical Assumptions for lighting reference the TRM for many parameters, the assumptions used to analyze these measures are not completely consistent between these documents. As mentioned above, the evaluation team compared the TRM and the Technical Assumptions to determine the most accurate source of savings algorithms and assumptions. In cases where the TRM was determined to be more accurate than the Technical Assumptions, this resulted in lighting savings calculations that differed from those reported by SPS. The most notable calculation parameter affected by this was lighting operating hours.
- **Lack of transparency in calculations.** For multiple projects, the evaluation team followed the algorithms established in the SPS Technical Assumptions and input values substantiated by submitted project documentation but arrived at savings that differed from those reported by SPS. The project files submitted by SPS included documents such as applications, invoices, and product specifications, but did not include project-specific savings calculations. Therefore, when the evaluation team's savings estimates derived using the SPS Technical Assumptions' algorithms differed from those reported by SPS, the precise sources of these discrepancies (e.g.

selection of different inputs from tables) could not be identified. The reviewed measures with the greatest discrepancies were commercial cooling measures and computer efficiency measures.

  - For direct expansion cooling measures, the evaluation team calculated savings by inputting cooling capacity and efficiency values shown in project documentation (e.g. mechanical schedules) into the TRM algorithms, which match the algorithms documented in the SPS Technical Assumptions. For some projects, this resulted in savings values that matched the reported savings, while for other projects this resulted in savings values that deviated from the reported savings.
  - For computer efficiency measures, the evaluation team calculated savings using all available information from the submitted computer sales data and the SPS Technical Assumptions for Computer Efficiency. The resulting savings were generally in the same range as the reported savings, but did not match exactly.

- **Updates not carried through to the final reported savings.** A few of the projects reviewed included documentation mentioning changes that were made to the analyses (e.g., adjustments based on post-installation inspection findings). The final reported savings values for these projects did not appear to incorporate these changes, however, which led to the evaluation team calculating different savings values when accounting for these adjustments. These adjustments included post-retrofit lighting hours, baseline lighting fixture wattages, and lighting fixture quantities, and resulted in savings estimates both higher and lower than those originally reported by SPS, depending on the project.

In addition to these broader issues, two projects had specific reasons for engineering adjustment factors significantly different than 1:

- **OID3060677:** This project reported savings for retrocommissioning and maintenance measures. Savings were calculated using SPS' Recommissioning Energy Savings Calculation Tool, which performs spreadsheet-based calculations for a number of different measures. One of the measures implemented for this project was chilled water supply temperature reset. The *ex ante* calculations were based on a fixed chilled water supply temperature of 40°F. However, the project documentation stated that the baseline chilled water supply temperature was observed to vary between 38°F and 42°F. The evaluation team revised the calculations to vary the baseline chilled water temperature accordingly, which resulted in an increase in the estimated savings for this measure.
- **OID3067083:** This project reported savings for rooftop air conditioning units with economizers and CO_2-based demand-controlled ventilation (DCV). This project appeared to include rounding errors and a doubling of the economizer savings.

Additionally, our verified savings calculations accounted for interactions between the measures installed on the project (interactive effects), which were not accounted for in the original calculations. The original calculations were based on the SPS Technical Assumptions algorithms for economizers, which use an assumption for the unit's cooling efficiency instead of the actual value.

A summary of the individual desk review findings for each of the Business Comprehensive projects is included in Appendix E.

3.1.2 Business Comprehensive Net Impacts

Net impacts for the Business Comprehensive program were calculated using NTG ratios from the participant phone survey or *ex ante* values, depending on the sub-program. For the Cooling, Custom, Lighting and Motors sub-programs, the NTG ratio was developed using the self-report method described in the *Evaluation Methods* chapter using participant phone survey data. The resulting NTG ratio for these measures is 0.7017. For Computer Efficiency and Retrocommissioning measures, the *ex ante* NTG ratios of 0.88 and 0.80 were applied.

Table 16 and Table 17 summarize the PY2017 net impacts for the Business Comprehensive program using the NTG ratios described above. Net realized savings for the program overall are 10,006,414 kWh, and net realized demand savings are 1,273 kW.

Table 16: PY2017 Business Comprehensive Net kWh Impact Summary

Sub-Program	# of Projects	Realized Gross kWh Savings	NTG Ratio	Realized Net kWh Savings
Computer Efficiency	71	67,390	0.8800	59,303
Cooling Efficiency	22	291,503	0.7017	204,548
Custom Efficiency	40	6,744,227	0.7017	4,732,424
Lighting Efficiency	126	2,570,404	0.7017	1,803,653
Motors Efficiency	10	3,374,625	0.7017	2,367,975
Retrocommissioning (RCx)	1	1,048,140	0.8000	838,512
Total	**270**	**14,096,289**	**0.7099**	**10,006,414**

Table 17: PY2017 Business Comprehensive Net kW Impact Summary

Sub-Program	# of Projects	Realized Gross kW Savings	NTG Ratio	Realized Net kW Savings
Computer Efficiency	71	8	0.8800	7
Cooling Efficiency	22	146	0.7017	102
Custom Efficiency	40	870	0.7017	611
Lighting Efficiency	126	299	0.7017	210
Motors Efficiency	10	468	0.7017	328
Retrocommissioning (RCx)	1	19	0.8000	16
Total	**270**	**1,810**	**0.7035**	**1,273**

3.2 Home Lighting & Recycling Program

The residential lighting market in the U.S. has experienced significant change over the past decade as the Energy Independence and Security Act of 2007 (EISA) has led to the phase-out of (energy inefficient) incandescent bulbs and, more recently, as consumers have become more aware of LEDs and the purchase price of LEDs has become increasingly affordable. SPS's Home Lighting & Recycling program promotes adoption of LED lighting by providing incentives to customers to replace less efficient light bulbs with LED bulbs through in-store rebates at participating retailers in the SPS service territory (shown in Table 18).[14]

Table 18: Sales of Bulbs Through the SPS Home Lighting & Recycling Program, October 1, 2016 – November 30, 2017

Retailer Type	Bulbs Sold	Percent of Total
Warehouse	12,645	3.4%
Non-Warehouse	181,950	48.7%
Giveaway/Events	178,646	47.9%
Total	**373,241**	**100%**

Source: Analysis by Evergreen Economics of data provided by SPS.

[14] The Home Lighting & Recycling program no longer promotes CFL bulbs as of 2017. However, some CFL bulbs sold in 2016 were invoiced during the 2017 program year and appear in the 2017 tracking data. CFLs accounted for about 19 percent of light bulbs rebated through retail channels in the 2017 tracking data for the SPS Home Lighting & Recycling program. No CFLs were provided through giveaways or events.

While nearly 60 retail locations participated in the Home Lighting & Recycling program over the period analyzed, nearly half (47.9 percent) of the bulbs provided through the program were distributed through giveaways or events. A single retailer with multiple locations sold the most bulbs through the program of any retailer (25.5 percent of total volume). Table 19 shows summary statistics for the price per bulb before rebate and the rebate amounts.[15] On average, bulbs sold through the SPS Home Lighting & Recycling program had a pre-rebate price of $3.53 and median price of $2.49. Actual prices varied considerably, ranging from $1.24 to $52.97 per bulb. Rebates provided to consumers through the Home Lighting & Recycling program ranged from $0.50 to $8.00 with an average and median of $1.66 and $1.50, respectively. These rebates cut the price paid per bulb by between 7 percent and 89 percent of the pre-rebate bulb price. On average, the rebate reduced the price by 56 percent.

Table 19: Summary Statistics on Bulb Prices and Rebates, SPS Home Lighting & Recycling Program*

Statistic	Price Per Bulb Pre-Rebate	Rebate Per Bulb	Rebate as % of Bulb Price**
Mean	$3.53	$1.66	56%
Median	$2.49	$1.50	60%
Minimum	$1.24	$0.50	7%
Maximum	$52.97***	$8.00	89%
25th Percentile	$1.99	$1.00	40%
75th Percentile	$3.66	$2.00	75%

* Summary statistics weighted by bulb sales. Excludes bulbs distributed through giveaways/events.
** The *rebate as a percent of bulb price* was computed for each record in the tracking database.
***This maximum price is for a fixture, not a single bulb.

3.2.1 Home Lighting & Recycling Program Gross Impacts

For the Home Lighting & Recycling program, the gross impact analysis consisted of reviewing the per unit savings values used for all the individual lighting measures covered by the program and then comparing these values with those in the Deemed Savings Technical Assumptions for this program. For each record, we replicated savings based on the baseline wattage values and hours of use. The evaluation team found no incidents of deviation from the Technical Assumption documents. We found that the replicated savings matched the *ex ante* tracking data savings within 0.01 percent. Therefore, we are not recommending any changes to the *ex ante* savings values, and the engineering adjustment factor is equal to 1.00.

[15] Bulb price was included in the program tracking system data provided by SPS.

To facilitate evaluation of the Home Lighting & Recycling program in the future, the evaluation team recommends that effective useful life be included in the tracking data.

3.2.2 Home Lighting & Recycling Program Net Impacts

The evaluation team utilized an elasticity model to determine net impacts for the Home Lighting & Recycling program. As discussed in the *Evaluation Methods* chapter, the elasticity model estimates the relationship between price and the number of bulbs sold. Once this relationship is established, it can be used to estimate the share of total bulbs sold that should be attributed to the price reductions offered by the program including those bulbs distributed to customers through giveaways.

The quantity of bulbs sold is inversely related to price—as the price of bulbs increases, the number of bulbs sold decreases. As Table 20 shows, 79 percent of bulbs sold through SPS's Home Lighting & Recycling program were $2.00 or less, and another 11 percent were between $2.01 and $4.00. Only about 10 percent of bulbs sold through the program had a rebated cost greater than $4.00. This trend was explored in more detail using the elasticity model, described below.

Table 20: Bulb Sales by Rebated Price of Bulb*

Rebated Price of Bulb	Average Pre-Rebate Price Per Bulb	Average Rebated Price Per Bulb	Proportion of Bulbs Sold
$2.00 or less	$2.33	$0.90	79.1%
$2.01 - $4.00	$5.29	$3.04	11.2%
$4.01 - $6.00	$8.33	$5.20	2.5%
$6.01 - $8.00	$9.33	$7.11	4.1%
$8.01 - $10.00	$12.80	$9.39	1.1%
More than $10.00	$17.64	$14.38	2.1%

* Data includes only those bulbs sold and rebated through a retail outlet.

To develop the elasticity model, the evaluation team analyzed sales data for SPS's Home Lighting & Recycling program beginning in October 2016 and extending through November 2017 to understand the impact that direct (in-store) rebates have on the sale of residential LED lighting.[16] Since the customer receives the rebate at the time of purchase (as opposed to a mail-in rebate or a rebate on a future purchase), it acts to immediately lower the purchase price of the LED lighting.

To estimate the impact that price has on the sale of LED bulbs, the evaluation team specified and estimated a Poisson regression model. The Poisson model is preferable to

[16] The evaluation team conducted the NTG analysis on LED bulbs only.

standard ordinary least squares (OLS) regression because the response variable (i.e., bulb sales) only takes on non-negative (or positive) values. The OLS regression model is generally not an appropriate choice because it fails to account for the limited possible values of the response variable.[17] While there are other models that account for limitations of count data (e.g. negative binomial), the Poisson model is the most often-used approach.

The generalized log-linear Poisson model is specified as

$$Ln(\mu_i) \ = \ x_i'\beta$$

Where, μ_i is the mean of the individual bulb sales across retailers and sales periods. The empirical model the evaluation team estimated for the SPS Home Lighting & Recycling program is specified as:

$$Ln(Bulb\ Sales_{kit}) = \ \beta_0 \ + \ \beta_1(Rebated\ Price_{kit}) \ + \beta_k(Bulb\ Char_k)$$

Where,

$Ln(Bulb\ Sales_{kit})$ is the natural logarithm of the average number of bulb type k sold each day by retailer i in time period t.

$Rebated\ Price_{kit}$ is the price after rebate for bulb type k sold by retailer i in time period t.

$Bulb\ Char_k$ is an array of characteristics of the LED bulb, such as lumens and watts.

We estimated separate models for standard and specialty LED bulbs and for warehouse and non-warehouse retailers (four models in total). Our *a priori* assumption was that consumers are more sensitive to price when purchasing standard LED bulbs, which are applicable to a greater range of residential lighting fixtures and for which consumers may have a greater number of alternative lighting options (e.g. efficient incandescent, halogen, CFL). In comparison, as the name implies, there is a wide range of specialty LED bulbs available in the market, but not every specialty LED bulb is demanded by every consumer and, therefore, only those consumers who have a use for a specific specialty LED bulb will show any sensitivity to price.

We also estimated separate models for warehouse and non-warehouse retailers. Two retailers were categorized as warehouse, while all other retailers were categorized as non-warehouse. Warehouse and non-warehouse retailers differed with respect to average (before rebate) price per bulb—$3.22 for warehouse versus $3.56 for non-warehouse (10 percent higher price per bulb sold through non-warehouse retailers). Warehouse retailers

[17] The evaluation team did examine two alternative modeling approaches: fixed-effects and random-effects Poisson models. Results varied little between these models and the (standard) Poisson model.

also typically sell bulbs in larger packs than non-warehouse retailers, but carry a narrower selection of bulbs.

Table 21 shows the estimates of price elasticity of demand for each of the four regression models and for the program as a whole. The price elasticity of demand is a measure of the change in the demand for a good or service when the price of that good or service increases by a small amount (generally 1.0 percent). Price elasticities are assumed to be negative (i.e., as price goes up, demand for the good or service goes down); it is the magnitude of the elasticity (the "responsiveness") that is of primary interest.[18]

As Table 21 shows, the evaluation team found that the demand for LED bulbs is elastic for both standard and specialty bulbs sold through non-warehouse retailers (price elasticity of demand of -1.23 and -1.53, respectively). The evaluation team found that the demand for standard LED bulbs from warehouse retailers is highly elastic (estimated elasticity of -2.33) and that demand for specialty LED bulbs from warehouse retailers is price elastic (estimated elasticity of -1.14). Overall, when weighting by LED bulb sales from all retailers, the evaluation team estimated the price elasticity of demand for LED bulbs to be -1.30. Thus, a 10 percent decrease in the price of LED bulbs will result in a 13 percent increase in demand for LED bulbs, holding all else constant.

Table 21: Estimates of Price Elasticity of Demand and NTG Ratio

LED Bulb Type and Retailer	Elasticity at Mean Rebated Price	NTG Ratio at Mean Rebated Price
Standard Non-Warehouse	-1.23	0.52
Standard Warehouse	-2.33	0.67
Specialty Non-Warehouse	-1.53	0.50
Specialty Warehouse	-1.14	0.42
Giveaway and Events*	N/A	0.86
Home Lighting & Recycling Program	**-1.30**	**0.71**

* The evaluation team developed the estimated NTG ratio for bulbs distributed through giveaway and events based on the modeling results for standard non-warehouse and standard warehouse LED bulbs.

Table 21 also shows estimates of the NTG ratio for SPS's Home Lighting & Recycling program using the elasticity model. The estimates of the NTG ratio vary across the four combinations of bulb type and retailer. The highest NTG ratio estimate was for standard bulbs sold by warehouse retailers (0.67), and the lowest estimated NTG ratio was for

[18] If the price elasticity for a good is greater than 1.0 in absolute value, demand for that good is referred to as elastic (more responsive). Similarly, when the price elasticity is less than 1.0 in absolute value, demand for that product is referred to as inelastic. When the price elasticity of demand is equal to 1.0, demand for that product is referred to as unit elastic.

specialty bulbs sold at warehouse stores (0.42). To develop the estimated NTG ratio of bulbs distributed through giveaways and events, the evaluation team computed the weighted average NTG ratio for standard non-warehouse and standard warehouse LED bulbs assuming a rebated price of $0.01. The estimated NTG ratio of 0.86 seems reasonable and indicates that approximately 14 percent of recipients of the giveaway LED bulbs would have purchased the bulbs had they not received them through the program. For retail stores identified by SPS as serving a high proportion of low-income customers, the evaluation team also applied the giveaway NTG ratio of 0.86. For bulbs provided via low-income giveaway events, a NTG ratio of 1.00 was assigned. For the SPS Home Lighting & Recycling program overall, the evaluation team estimated the NTG ratio to be 0.71.

Figure 2 shows how expected rates of free ridership and NTG ratios vary by rebated bulb for each of the four combinations of bulb type and retailer.[19] As the rebated price of LEDs drop, the proportion of purchasers that free ride decreases and the NTG ratio increases. The trajectories differ for each combination of bulb type and retailer because the mix of bulb types and prices differ. In addition, it is likely that the characteristics of buyers differ between those who shop at warehouse and non-warehouse retailers.

It is important to note that the free ridership chart (upper panel of Figure 2) does not show the expected number of bulbs sold by rebated price, but rather the proportion of bulbs sold by rebated price that would have sold even without the rebate. As the rebated price decreases (moving from right to left along the horizontal axis), more and more consumers—who otherwise would not purchase LED bulbs—are motivated to purchase bulbs, resulting in a decreasing proportion of purchasers that are free riders.

The purpose of the rebates is to encourage those consumers who would not otherwise purchase an LED to make the purchase. However, since the rebate is available to all purchasers of the LED bulbs, even those who would have purchased the bulbs without the rebate receive the rebate. The larger the rebate, the greater the number of consumers who will purchase LED bulbs, leading to a lower rate of free ridership and a higher NTG ratio (lower panel of Figure 2).

[19] Excludes bulbs distributed through giveaways because there is no price sensitivity to measure.

Figure 2: Estimated Free Ridership and NTG Ratio by LED Bulb Type and Retailer

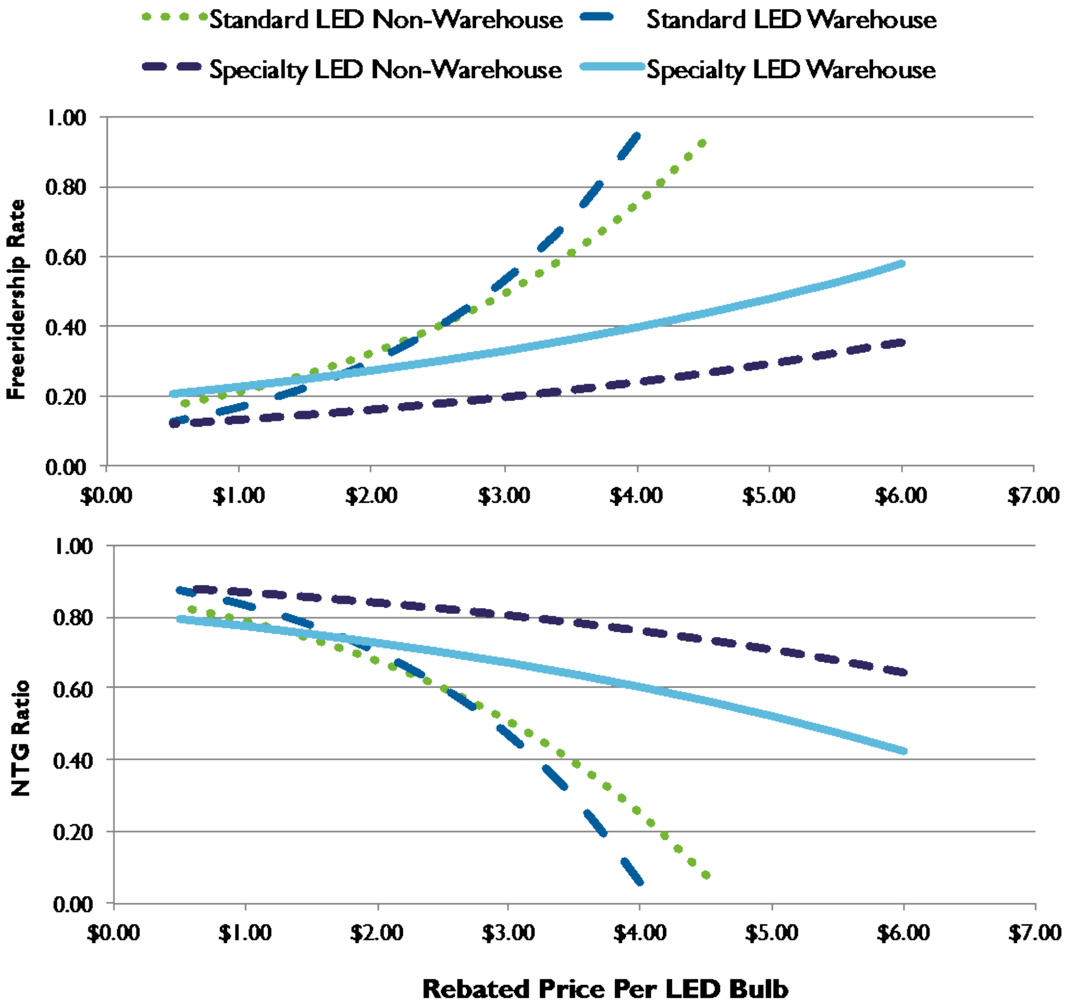


Table 22 summarizes the final gross and net impacts for the Home Lighting & Recycling program using the NTG ratio derived from the elasticity model. Using the overall NTG ratio of 0.71, the PY2017 net realized impacts for the Home Lighting & Recycling program are 9,300,382 kWh and 1,460 kW.

Table 22: Home Lighting & Recycling PY2017 Impact Summary

Home Lighting & Recycling	# of Participants	Expected Gross Savings	Engineering Adjustment Factor	Realized Gross Savings	NTG Ratio	Realized Net Savings
kWh Savings	256,639	13,099,130	1.0000	13,099,130	0.7100	9,300,382
kW Savings	256,639	2,056	1.0000	2,056	0.7100	1,460

3.3 Energy Feedback

The Energy Feedback program is designed as a randomized control trial for the purposes of measuring program savings. As part of this design, the program implementer randomly assigned customers to a treatment group that receives the Energy Feedback Home Energy Report, which compares the household energy use to similar customers and also provides tips on how to reduce energy consumption. Those customers not in the treatment group are randomly assigned to the control group and do not receive the report.

The Energy Feedback program also uses an opt-out approach to participation. Customers are randomly selected into the program and automatically begin receiving the Home Energy Reports. There are two ways that customers can leave the program. Customers can opt out at any time, or customers can cancel their electric service when they vacate the premises. Over time, this leads to some attrition in the program, which needs to be accounted for in savings estimation.

There were three deployment waves for the Energy Feedback program, each of which is tracked separately and has its own matched control group. Table 23 shows the participation numbers at the beginning of each wave, in January 2017, and in December 2017.

Table 23: Participation By Deployment Wave

Wave	Group	Participants – Start Date	Participants – January 1st 2017	Participants – December 31st 2017
Wave 1: 201203_E	Recipient	15,500	10,558	9,930
	Control	15,500	10,887	10,288
Wave 2: 201507_E	Recipient	5,250	3,675	3,176
	Control	5,250	3,698	3,195
Wave 3: 201705_E	Recipient	10,000	10,000 (May, 2017)	8,144
	Control	10,000	10,000 (May, 2017)	8,184
Total	**Recipient**	**30,750**	**24,233**	**21,250**
	Control	**30,750**	**24,585**	**20,667**

3.3.1 Fixed Effects Model Specification

We used a fixed effects regression model to estimate the Energy Feedback impacts, which is the standard approach used for these types of home energy report programs. The benefit of a fixed effects model is that it controls for unique characteristics within each household, such as general levels of electricity use and household occupancy, which would not otherwise be represented in the model. These types of time-invariant characteristics are the fixed effects that the model controls for with a household-specific constant term.

The final billing model using the fixed effects specification is provided below. Variations on this model were explored during the evaluation, including using a variety of interaction terms as additional explanatory variables. These alternative models all provided similar results and did not improve model performance. The final specification shown below was chosen as it estimated the model of best fit, allowed for the savings estimates to vary with weather conditions, and provided the most robust results. An identical model specification was used for each of the Energy Feedback deployment waves.

$$kWh_{it} = \alpha_i + \beta_1 Post_{it} + \beta_2(Treat_i * Post_{it}) + \beta_3 CDD_{it} + \beta_4 HDD_{it} + \beta_5(Treat_i * CDD_{it}) + \beta_6(Treat_i * HDD_{it}) + \beta_7(Post_{it} * CDD_{it}) + \beta_8(Post_{it} * HDD_{it}) + \beta_9(Post_{it} * Treat_i * CDD_{it}) + \beta_{10}(Post_{it} * Treat_i * HDD_{it}) + \beta_k Month_t + \varepsilon_{it}$$

Where:

kWh_{it} = Daily electricity usage by the i^{th} home in the t^{th} time period

$Post$ = Indicator variable for month in the post-participation period for the Pilot (1 in post, 0 otherwise)

$Treat$ = Indicator variable for treament group participants only

CDD_{it} = Cooling degree days for the the i^{th} home in the t^{th} time period

HDD_{it} = Heating degree days for the the i^{th} home in the t^{th} time period

$Month_t$ = Vector of monthly dummy variables for each month excluding December

α_i = Household specific fixed-effects constant

β = Coefficients to be estimated in the model

ε = Random error term

For each deployment wave, the post-program period was the 2017 calendar year. For the 2017 wave, the post-program period began in May 2017. The pre-program period varied for each wave, and was the calendar year prior to the original start date of each wave.[20]

Table 24 summarizes key dates and time periods for each deployment wave.

[20] For the 2017 wave, the pre-program period was set at May – December 2016 to match the same months in the 2017 post period.

Table 24: Deployment Wave Period

Wave	Start Month	Pre-Program Period	Post-Program Period
Wave 1: 201203_E	March 2012	Jan 1, 2011 – Dec 31, 2011	Jan 1, 2017 – Dec 31, 2017
Wave 2: 201507_E	July 2015	Jan 1, 2014 – Dec 31, 2014	Jan 1, 2017 – Dec 31, 2017
Wave 3: 201705_E	May 2017	May 1, 2016 – Dec 31, 2016	May 1, 2017 – Dec 31, 2017

3.3.2 Billing Regression Model Results

The following tables present the regression results and calculated savings for each of the three deployment waves. The coefficients of interest with respect to energy savings attributable to the Energy Feedback program are the coefficient on the *POST*TRXX* post-period participation indicator and the coefficients on the heating and cooling interactive terms (*POST*TRXX*CDD* and *POST*TRXX*HDD*).

The coefficient on the *POST*TRXX* interaction variable can be interpreted as the change in normalized monthly energy consumption attributable to a household being in the treatment group in the post-report period.

The coefficients on the *POST*TRXX*CDD* and *POST*TRXX*HDD* interaction variables can be interpreted as the change in normalized daily energy consumption for a treatment group household in the post-report period due to a one cooling or heating degree day increase.

Table 25 shows the detailed regression results for Wave 1, with the coefficients used to calculate impacts shaded in blue. Note that the coefficient estimate on the heating interactive terms (*POST*TRXX*HDD*) is not statistically significant and therefore was not ultimately used in the final savings calculation.

Table 25: Fixed Effects Regression Model Results (Wave 1)

Mean Daily Consumption (kWh)	52.81
Observations	1,611,124
Adjusted R-Squared	0.107

Variable	Coefficient Estimate	Standard Error	t-statistic	Significance Level
POST*TRXX	-0.997	0.419	-2.377	2%
POST*TRXX*CDD	0.0014	0.0008	1.625	10%
POST*TRXX*HDD	0.0001	0.001	0.208	83%
POST	7.317	0.302	24.234	<1%
HDD	0.030	0.001	54.401	<1%
CDD	0.043	0.001	68.531	<1%
POST *CDD	-0.032	0.001	-50.289	<1%
POST *HDD	-0.024	0.001	-45.849	<1%
TRXX*CDD	-0.001	0.001	-1.250	21%
TRXX*HDD	0.000	0.001	-0.570	56%
JAN	-6.507	0.129	-50.541	<1%
FEB	-17.929	0.153	-117.135	<1%
MAR	-26.156	0.189	-138.231	<1%
APR	-26.046	0.215	-121.166	<1%
MAY	-16.573	0.242	-68.362	<1%
JUN	-6.734	0.288	-23.351	<1%
JUL	-4.332	0.286	-15.171	<1%
AUG	-11.994	0.254	-47.134	<1%
SEP	-20.807	0.235	-88.509	<1%
OCT	-25.740	0.189	-136.523	<1%
NOV	-13.839	0.135	-102.586	<1%

Source: Analysis by Evergreen Economics of data provided by SPS.
Note: Cooling and heating degree days are based on a base temperature of 65° Fahrenheit.

Table 26 shows the detailed regression results for Wave 2. For this wave, none of the variables of interest (shaded in blue) have statistically significant coefficient estimates.

Consequently, savings were estimated to be zero for this wave (the same as in prior evaluations).

Table 26: Fixed Effects Regression Model Results (Wave 2)

Mean Daily Consumption (kWh)	58.97
Observations	621,228
Adjusted R-Squared	0.21

Variable	Coefficient Estimate	Standard Error	t-statistic	Significance Level
POST*TRXX	0.076	0.346	0.220	82%
POST*TRXX*CDD	-0.001	0.001	-1.324	19%
POST*TRXX*HDD	0.000	0.001	-0.858	39%
POST	3.894	0.251	15.527	<1%
HDD	0.041	0.000	86.883	<1%
CDD	0.031	0.001	43.085	<1%
POST*CDD	-0.012	0.001	-15.742	<1%
POST*HDD	-0.016	0.000	-38.313	<1%
TRXX*CDD	0.001	0.001	0.750	45%
TRXX*HDD	0.001	0.000	2.528	1%
JAN	-4.880	0.180	-27.050	<1%
FEB	-16.825	0.218	-77.004	<1%
MAR	-24.716	0.277	-89.175	<1%
APR	-23.755	0.321	-74.088	<1%
MAY	-11.180	0.362	-30.877	<1%
JUN	-2.699	0.427	-6.317	<1%
JUL	-0.855	0.425	-2.015	<1%
AUG	-6.827	0.383	-17.828	<1%
SEP	-16.334	0.352	-46.347	<1%
OCT	-23.946	0.276	-86.712	<1%
NOV	-13.213	0.190	-69.460	<1%

Source: Analysis by Evergreen Economics of data provided by SPS.
Note: Cooling and heating degree days are based on a base temperature of 65° Fahrenheit.

Table 27 shows the detailed regression results for Wave 3. As noted previously, the 2017 deployment wave did not begin until May 2017. To account for this, the model only includes months in the post-program period from May 2017 to December 2017, and months in the pre-program period from May 2016 to December 2016. The coefficient estimates for all three variables used in the savings calculation are statistically significant and of the expected sign (either negative or positive).

Table 27: Fixed Effects Regression Model Results (Wave 3)

Mean Daily Consumption (kWh)	37.15
Observations	359,689
Adjusted R-Squared	0.08

Variable	Coefficient Estimate	Standard Error	t-statistic	Significance Level
POST*TRXX	-1.150	0.299	-3.839	<1%
POST*TRXX*CDD	0.002	0.001	2.300	2%
POST*TRXX*HDD	0.002	0.001	2.435	2%
POST	2.733	0.225	12.125	<1%
HDD	0.012	0.000	25.608	<1%
CDD	0.012	0.000	26.116	<1%
POST*CDD	-0.016	0.001	-20.448	<1%
POST*HDD	-0.009	0.001	-15.306	<1%
TRXX*CDD	0.000	0.000	-0.636	52%
TRXX*HDD	0.000	0.000	-0.678	49%
MAY	-5.503	0.360	-15.299	<1
JUN	3.318	0.429	7.733	<1%
JUL	6.862	0.417	16.456	<1%
AUG	-1.071	0.374	-2.860	<1%
SEP	-9.514	0.347	-27.396	<1%
OCT	-14.461	0.271	-53.435	<1%
NOV	-7.867	0.191	-41.090	<1%

Source: Analysis by Evergreen Economics of data provided by SPS.
Note: Cooling and heating degree days are based on a base temperature of 65° Fahrenheit.

The average daily savings for the Energy Feedback treatment group was calculated using the model coefficient estimates from the program variables, combined with average weather values for heating and cooling days for the treatment/weather interaction terms. In equation form, savings were calculated as the following:

$$\text{Daily kWh Savings} = \beta_{POST*TRXX} + \beta_{POST*TRXX*CDD} * C_{bar} + \beta_{POST*TRXX*HDD} * H_{bar}$$

Where:

C_{bar} = Average daily cooling degree-days in the post program period

H_{bar} = Average daily cooling degree-days in the post program period

The final kWh net impact estimates along with a 95 percent confidence interval[21] for each wave are summarized in Table 28, with savings expressed as a percentage of average daily energy consumption provided in Table 29. Note that in cases where the coefficient estimate is not statistically significant for one of the program variables, that variable is not used in the final savings calculation. In the case of Wave 2, where all three of the program variables were not statistically significant, this resulted in a final savings value of zero for that group.

Table 28: Calculated Daily kWh Savings

Deployment Wave	β POST*TRXX	β POST*TRXX*CDD	β POST*TRXX*HDD	Mean CDD	Mean HDD	Total	95% CI
Wave 1: 201203_E	-0.997	0.000981	0.0001	265.57	150.3	0.74	±0.33
Wave 2: 201507_E*	0.076	-0.001401	-0.000492	136.24	263.47	N/A	
Wave 3: 201705_E	-1.150	0.002358	0.001856	168.33	157.64	0.46	±0.14

* The daily savings for Wave 201507_E are not statistically significant.

[21] We used the Delta method to calculate the standard errors for the savings estimates. Although it is a relatively straightforward matter to calculate point estimates for savings using the regression results, the Delta method allows one to calculate the standard error associated with each point estimate based on the variance-covariance matrix estimated in the billing regression.

Table 29: Calculated Daily kWh Savings

Deployment Wave	Mean Daily kWh	Daily Savings kWh	% Savings	95% CI
Wave 1: 201203_E	52.80	0.74	1.40%	±0.33%
Wave 2: 201507_E*	0	0	N/A	N/A
Wave 3: 201705_E	37.15	0.46	1.24%	±0.14%

* The daily savings for Wave 201507_E are not statistically significant.

3.3.3 Energy Feedback Net Impacts

Since billing data for both the treatment and non-participant control group are used to estimate the fixed effects model, the resulting model results can be used to calculate net impacts.

To calculate program level savings, the average daily savings estimates were aggregated to the monthly level (based on days in each month) and then multiplied by the total number of participants in each month (after accounting for attrition). The monthly values were then summed to get participation-weighted annual savings for PY2017.

Table 30 shows the annual net savings for PY2017 for both kWh and kW.

Table 30: PY2017 Energy Feedback Net Impact Summary

Deployment Wave	Average Monthly Participation	Net kWh Savings	Net kW Savings
Wave 1: 201203_E	10,243	2,757,168	609.72
Wave 2: 201507_E*	3,414	0	0
Wave 3: 201705_E	8,916	1,004,876	330.99
Total	**22,573**	**3,762,044**	**940.71**

* Savings for Wave 201507_E were not statistically significant.

3.3.4 My Energy Sub-Program

In addition to the Home Energy Reports distributed by mail or email, SPS also has an online energy report program called My Energy. There is some crossover between the Home Energy Report and My Energy programs with many customers having access to both programs. We attempted to run a similar regression model approach as described above for the Home Energy Report program, however, once overlap between the Home Energy Report program and the My Energy program was accounted for, there were only

73 households with sufficient billing data to analyze. As a result of this small sample size, the regression model results were not statistically significant. Therefore the estimated kWh and kW savings for the My Energy program were found to be zero.

In reviewing the participation data for this program we did identify two potentially problematic issues:

1) For recipient households that receive both the Home Energy Reports and My Energy online access it will not be possible to separate savings attributable to each program, introducing the potential for double counting savings in the future.
2) Some households that participate in the My Energy program are control homes in the Home Energy Report program. The impact of the My Energy program on energy consumption may make them inappropriate to use in the Home Energy Report program as a control home.

The evaluation team recommends careful tracking of the overlap of Energy Feedback Home Energy Report participants and controls and My Energy participants and controls, to minimize the possibility of double counting savings and to ensure all control group customers are valid comparison households.

3.4 Residential Cooling

For the Residential Cooling program, the gross impact analysis consisted of an engineering review of a statistically representative sample of projects. A stratified random sample was used to select the projects for review, as shown in Table 31. A total of 10 projects were reviewed, which was a sufficient sample to achieve a 90/6.5 level of relative precision.

Table 31: Residential Cooling Desk Review Sample

Measure Group	Stratum	Count	Average kWh	Total kWh Savings	% of Savings	Final Sample
ECM Furnace Fan	1	9	1,348	12,132	31%	3
ECM Furnace Fan	2	9	1,348	12,132	31%	3
ECM Furnace Fan	3	9	1,335	12,011	30%	3
Premium Evap Cooler	Certainty	1	3,332	3,332	8%	1
Total		**28**		**39,607**	**100%**	**10**

Based on the review, the evaluation team adjusted savings slightly higher for the electronically commutated motors (ECM) measures. The adjustments were made to correct for some occasional discrepancies found in several project applications.[22] The resulting engineering adjustment for ECMs is 1.01 for kWh and 1.03 for kW.

For net impacts, we attempted to conduct a phone survey with customers that had an ECM added to their HVAC systems, but given the very small sample available (27 customers), we were only able to complete two surveys for this group. Consequently, we used the original *ex ante* NTG value of 0.66 for the Residential Cooling program to calculate net savings for PY2017.

The final realized gross and net savings for kWh and kW are shown in Table 32 and Table 33.

[22] See Appendix E for notes on each of the individual project adjustments.

Table 32: Residential Cooling PY2017 kWh Impact Summary

Measure Group	# of Projects	Expected Gross kWh Savings	Engineering Adjustment Factor	Realized Gross kWh Savings	NTG Ratio	Realized Net kWh Savings
EC Motor Furnace Fan	27	36,275	1.0102	36,644	0.66	24,185
Premium Evap Cooler	1	3,332	1.0000	3,332	0.66	2,199
Total	**28**	**39,607**	**1.0093**	**39,976**	**0.66**	**26,384**

Table 33: Residential Cooling PY2017 kW Impact Summary

Measure Group	# of Projects	Expected Gross kW Savings	Engineering Adjustment Factor	Realized Gross kW Savings	NTG Ratio	Realized Net kW Savings
EC Motor Furnace Fan	27	3.39	1.0313	3.49	0.66	2.31
Premium Evap Cooler	1	2.38	1.0000	2.38	0.66	1.57
Total	**28**	**5.77**	**1.0184**	**5.87**	**0.66**	**3.88**

3.5 School Education Kits

The SPS School Education Kits program provides energy efficiency education and kits of easy-to-install energy efficiency and water saving measures such as LEDs, faucet aerators, and low-flow showerheads to students through participating schools. In 2017, 2,685 kits were distributed, with a total of 1,656,045 kWh and 41 kW gross savings claimed. To evaluate the impacts of the School Education Kits program, the evaluation team conducted a deemed savings review of the energy saving measures included in the school kits.

In the deemed savings review, we attempted to replicate the per unit savings values used by SPS based on the assumptions in the SPS Technical Assumptions. For all measures in the program, we found that the deemed savings values were being correctly applied from the Technical Assumptions documentation. Therefore, the engineering adjustment factor for the School Education Kits program was 1.00.

We did find two minor issues that did not affect savings during our review of the tracking data and Technical Assumptions documents:

1) The reported values in the "2017 YE Achievement.xlsx" file are mislabeled for bathroom and kitchen aerators, with the reported savings values switched between the two measures. This has no impact on total savings as the correct values were

used in the calculation, but should be corrected to avoid possible confusion in the future.

2) The SPS School Education Kits Program Technical Assumptions PDF document does not include separate savings values for the 11 Watt and 9 Watt bulbs. These are included in the “2017 NMx Tech Assumptions Summary Round 4 – REGULATORY.xlsx” file, however.

The NTG ratio for the School Education Kits program is stipulated at 1.00, and as a result, the net realized savings are equal to the gross verified savings of 1,656,045 kWh and 41 kW.

3.6 Saver’s Stat

As discussed earlier in the *Evaluation Methods* chapter, Saver’s Stat is a smart thermostat pilot offered to residential customers energy efficiency and demand response benefits of smart thermostat technology. To facilitate load control, participants must have a communicating smart thermostat installed in their home and connected to a central air conditioning unit. The smart thermostat is capable of receiving signals that decrease air conditioning runtime by one of two dispatch methods. The first dispatch method is an approximation of duty cycling that turns the compressor off for 15 minutes of each 30 minute period (i.e., cycling 50 percent of the time), aka a "duty cycling" strategy. The second dispatch method increases the thermostat’s set point (thereby reducing the need for the compressor to run) until the indoor temperature rises to the new set point (4 degrees higher) during event periods, a.k.a. a "temperature offset" strategy.

The results of the Saver’s Stat impact analysis are summarized below, with a more detailed discussion provided in Appendix D.

Demand impacts for Saver’s Stat events are the baseline load less the observed event day load. Figure 3 shows average baseline loads (grey), observed event day loads (blue), and estimated reductions (orange) for active devices. Upon visual inspection, it is clear that the shape of reductions varies substantially by dispatch strategy. While duty cycling appears to deliver relatively consistent reductions for the duration of the event, temperature offsets deliver large reductions at the onset of the event, but much smaller impacts and larger snapback towards the end of the event. These patterns reflect expected behavior of a compressor that is not only being switched on and off, but also adjusting to an increased set point.

Figure 3: Load Impacts by Dispatch Strategy

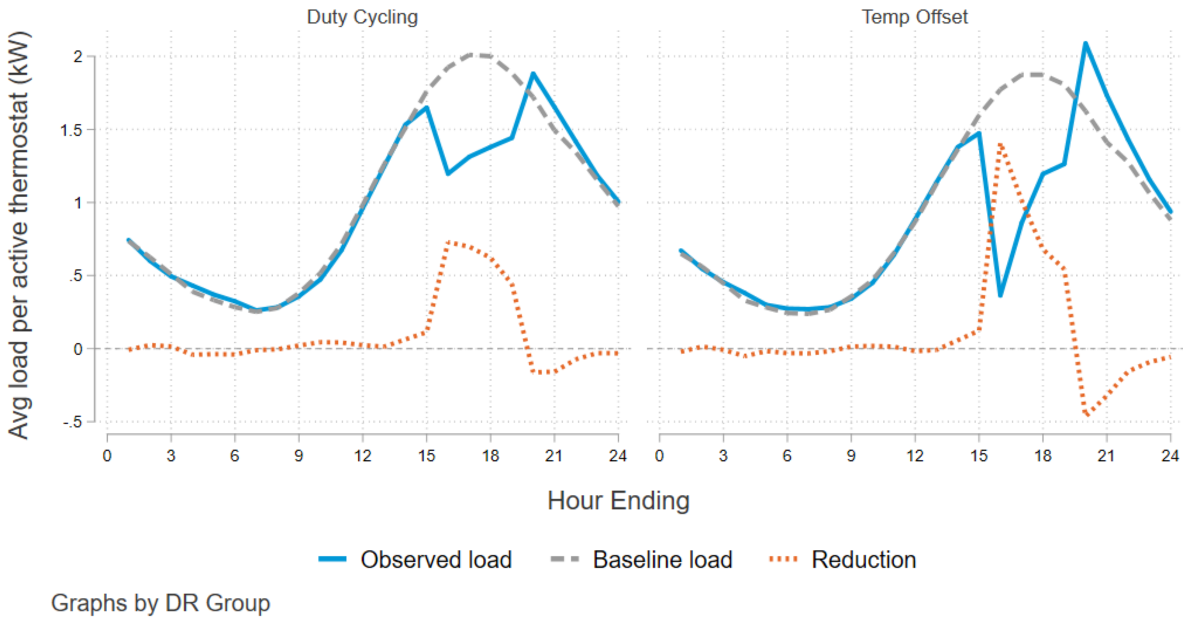


Table 34 shows the hourly and average event reductions per active device for each event and dispatch strategy. This summary reveals that average impacts per active device are indeed higher for temperature offset devices (0.91 kW) than for duty cycling devices (0.63 kW). However, the higher impacts for temperature offset dispatch come at a cost of more substantial snapback: an average of 0.46 kW snapback per active device for temperature offset versus 0.16 kW per active duty cycling device in the hour following the conclusion of the demand response event. In addition, while the impact for duty cycling is about 0.3 kW lower in the last event hour compared to the first event hour, this difference is 0.95 kW for temperature offset devices.

Table 34: Hourly Reductions

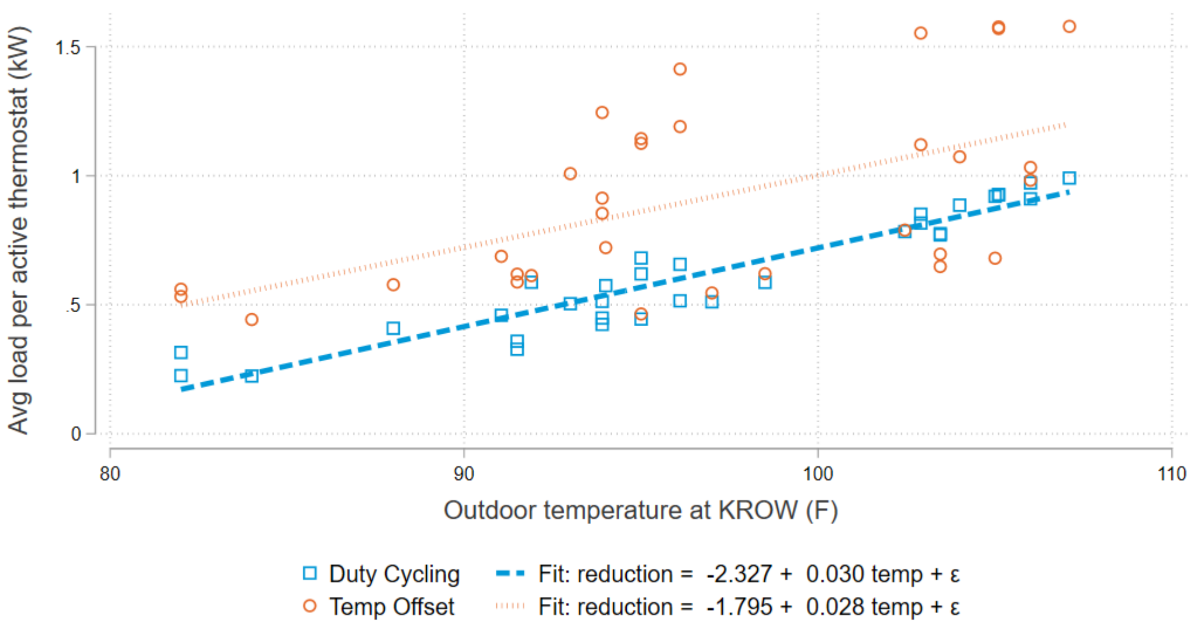
Dispatch Group	Date	Reduction per Active Device (kW), Hour Beginning (MDT) 3:00 p.m.	4:00 p.m.	5:00 p.m.	6:00 p.m.	7:00 p.m. (post event)	Average 3-7 p.m.
Duty Cycling	16-Jun	0.93	0.97	0.92	0.68	-0.16	0.87
Duty Cycling	22-Jun	0.99	0.91	0.78	0.59	-0.14	0.82
Duty Cycling	28-Jun	0.85	0.82	0.78	0.59	-0.23	0.76
Duty Cycling	29-Jun	0.93	0.89	0.77	0.51	-0.21	0.77
Duty Cycling	10-Aug	0.66	0.62	0.57	0.41	-0.18	0.56
Duty Cycling	15-Sep	0.51	0.50	0.46	0.32	-0.08	0.45
Duty Cycling	20-Sep	0.44	0.42	0.33	0.22	-0.15	0.36
Duty Cycling	21-Sep	0.52	0.45	0.36	0.23	-0.15	0.39
Duty Cycling	***Avg event***	***0.73***	***0.70***	***0.62***	***0.45***	***-0.16***	***0.63***
Temp Offset	16-Jun	1.58	1.03	0.68	0.46	-0.41	0.94
Temp Offset	22-Jun	1.58	0.98	0.65	0.61	-0.35	0.96
Temp Offset	28-Jun	1.55	1.12	0.79	0.62	-0.46	1.02
Temp Offset	29-Jun	1.57	1.07	0.70	0.55	-0.42	0.97
Temp Offset	10-Aug	1.41	1.13	0.72	0.58	-0.55	0.96
Temp Offset	15-Sep	1.25	1.01	0.69	0.56	-0.56	0.88
Temp Offset	20-Sep	1.14	0.91	0.59	0.44	-0.49	0.77
Temp Offset	21-Sep	1.19	0.85	0.62	0.53	-0.48	0.80
Temp Offset	***Avg event***	***1.41***	***1.01***	***0.68***	***0.54***	***-0.46***	***0.91***

To produce an *ex ante* impact estimate, the evaluation team analyzed the relationship between temperature and impacts. Figure 4 compares the load reduction estimate for each event hour (e.g., the hourly data points in Table 34) with the outdoor air temperature for that hour. Weather data, which were obtained from the NOAA website,[23] come from weather station KROW in Roswell. There is a clear trend in the figure—the hotter it is outside, the greater the impacts tend to be (note the trend line equations in the legend).

[23] ftp://ftp3.ncdc.noaa.gov/pub/data/noaa/

The slope of this relationship is nearly the same for both dispatch strategies, though the constant is about 0.5 kW larger for temperature offset impacts, reflecting the higher average impacts noted above for this dispatch strategy. However, the correlation between temperature and impact is weaker for the temperature offset dispatch (orange) than for duty cycling (blue)—the orange points are less closely aligned with the orange line than are the blue points with the blue line. This is consistent with the fact that the impacts are much greater in the first one or two hours of a temperature offset event than in subsequent hours. Because of this, using a simple linear temperature-impact model to predict *ex ante* impacts will not be as accurate as an approach that also takes event hour into account.

Figure 4: Hourly Impacts Against Outdoor Temperature (F)



Note: Each data point corresponds to the average impact in each hour of an event, as opposed to the average hourly impact for an event. As such, each four hour event is represented by four different data points.

In addition to showing a relationship with outdoor temperature, hourly impacts also varied by hour of the day. To capture this relationship, we ran a linear regression model featuring the addition of an event day indicator variable interacted with hour of day (ending) and the average event temperature variable. With this model, the coefficient on the interactive term (event day x temp x hour) can be used to interpret how much load is reduced on event days for every degree increase in outside temperature. For example, on an event day in hour 16 (holding constant the load in hour 15 and the temperature in that hour), for each additional degree of average temperature from 3 p.m. to 7 p.m., load impact estimates increase by approximately 0.0075 kW. (Additional regression model details are included in Appendix D.)

To predict the hourly impacts of a future duty cycling event of a given average temperature, one would multiply that temperature (e.g., 93 degrees Fahrenheit, which was the temperature during the August 10 event) by the difference of the corresponding hourly coefficients. For example, the predicted impact during hour ending 16 (3 p.m. to 4 p.m.) would be a reduction of 0.696 kW (0.0074888 * 93 = -0.696). While not a perfect prediction, this figure is quite close to the 0.66 kW impact during the actual August 10 event, demonstrating that taking event hour into account provides a relatively accurate impact estimate.

Using the regression coefficients, the evaluation team created a time-temperature matrix (TTM) that shows expected load reductions (per device) for different outdoor temperatures and at different times of the day.[24] The TTM is shown in Table 35, and Table 36 provides the analogous TTM for temperature offset events.

The estimated reductions in hour 16 for a 93 degree Fahrenheit temperature offset event (1.375 kW) are similarly close to the actual hour 16 event impacts on August 10 (1.41 kW). In contrast to duty cycling, which produces impacts which taper off only slightly in each hour, temperature offset impacts in the first two event hours are double what they are in the last two event hours. As described above, this makes sense given the mechanics of the two dispatch strategies. Were a temperature offset event to begin an hour earlier or later than the 3 p.m. start time of the 2017 events, impacts would likely be similar to the impacts predicted for the first event hour assuming the same average event temperature.

[24] The average column is based on a regression variant that does not incorporate hourly variation.

Table 35: Time-Temperature Matrix – Duty Cycling

Average Event Temp	Event Hour 1	Event Hour 2	Event Hour 3	Event Hour 4	Average
85	0.637	0.597	0.539	0.378	0.534
86	0.644	0.604	0.545	0.382	0.541
87	0.652	0.611	0.552	0.387	0.547
88	0.659	0.618	0.558	0.391	0.553
89	0.667	0.625	0.564	0.396	0.560
90	0.674	0.632	0.571	0.400	0.566
91	0.681	0.639	0.577	0.405	0.572
92	0.689	0.646	0.583	0.409	0.578
93	0.696	0.653	0.590	0.414	0.585
94	0.704	0.660	0.596	0.418	0.591
95	0.711	0.667	0.602	0.423	0.597
96	0.719	0.674	0.609	0.427	0.604
97	0.726	0.681	0.615	0.431	0.610
98	0.734	0.688	0.621	0.436	0.616
99	0.741	0.695	0.628	0.440	0.622
100	0.749	0.703	0.634	0.445	0.629
101	0.756	0.710	0.640	0.449	0.635
102	0.764	0.717	0.647	0.454	0.641
103	0.771	0.724	0.653	0.458	0.648
104	0.779	0.731	0.660	0.463	0.654
105	0.786	0.738	0.666	0.467	0.660
106	0.794	0.745	0.672	0.471	0.666

Table 36: Time-Temperature Matrix – Temperature Offset

Average Event Temp	Event Hour 1	Event Hour 2	Event Hour 3	Event Hour 4	Average
85	1.257	0.881	0.591	0.435	0.786
86	1.272	0.892	0.598	0.440	0.795
87	1.286	0.902	0.605	0.445	0.804
88	1.301	0.912	0.612	0.451	0.813
89	1.316	0.923	0.619	0.456	0.823
90	1.331	0.933	0.626	0.461	0.832
91	1.345	0.944	0.633	0.466	0.841
92	1.360	0.954	0.640	0.471	0.850
93	1.375	0.964	0.647	0.476	0.860
94	1.390	0.975	0.654	0.481	0.869
95	1.405	0.985	0.661	0.486	0.878
96	1.419	0.995	0.668	0.492	0.887
97	1.434	1.006	0.675	0.497	0.897
98	1.449	1.016	0.682	0.502	0.906
99	1.464	1.027	0.689	0.507	0.915
100	1.479	1.037	0.696	0.512	0.924
101	1.493	1.047	0.703	0.517	0.934
102	1.508	1.058	0.710	0.522	0.943
103	1.523	1.068	0.717	0.527	0.952
104	1.538	1.078	0.724	0.532	0.961
105	1.552	1.089	0.731	0.538	0.971
106	1.567	1.099	0.738	0.543	0.980

Table 37 summarizes our findings by dispatch group. Note that 21 percent of duty cycling devices and 16 percent of temperature offset devices were not active during events. Because the analysis was conducted on data for active devices, an adjustment was applied to the impact estimates to arrive at estimated reduction per dispatched device. For example, because only 80 percent of duty cycling devices were active, the reduction per dispatched device was 0.50 kW, or 80 percent of the 0.63 kW reduction per active device. The key difference between the two dispatch groups is the variation in impact by event hour. Duty cycling impacts tapered off only slightly with each subsequent event hour, so impacts in the first event hour are only about 15 percent lower than average event impacts. In contrast, temperature offset impacts are much higher in the first event hour than for subsequent hours, so impacts in the first event hour are about 55 percent higher than average event impacts.

Table 37: Saver's Stat High Level Results

Dispatch Group	Average Temp 3-7 p.m. at KROW (F)	Devices Dispatched	% of Devices Active	Reduction per Active Device (kW)		Reduction per Dispatched Device (kW)	
				Event Average	First Hour of Event	Event Average	First Hour of Event
Duty Cycling	97	259	79%	0.63	0.73	0.50	0.58
Temp Offset	97	275	84%	0.91	1.41	0.76	1.18

To calculate what the Saver's Stat resource is worth on aggregate, the number of active devices within each dispatch group can be multiplied by the values shown Table 37.

Using this approach, we calculated the total demand impacts of 377 kW for the Saver's Stat pilot in 2017.

3.6.1 Saver's Stat Energy Impacts

In addition to demand impacts, we also analyzed the Saver's Stat data to determine if there were any significant energy savings during the 2017 cooling season. The summer energy savings evaluation for the Saver's Stat residential participants relied on a statistical matching approach to develop a baseline estimate for energy usage in the absence of the smart thermostat technology. This analysis evaluated energy usage impacts in summer months, and monthly whole house billing data were used to select matches and to assess energy usage impacts. Matches were selected from among all non-participating SPS residential premises using usage prior to thermostat installation.

Matches were selected for each participant premise using a distance-matching algorithm.[25] Essentially, each participant premise was paired with the non-participating premise with

[25] The algorithm relied on calculating the Euclidean distance, which is defined as the root of the sum of square differences. Here, the difference in usage for each pretreatment month was squared. Then, the square root was taken of the sum of these squared differences. The non-participant with the least Euclidean distance from a participant was chosen as the match. Matches were selected with a replacement, so a matched control premise could be selected more than once.

the closest usage in the pre-treatment period (i.e., prior to thermostat installation). The following considerations were taken into account when preparing data for matching:

- For each participant, pre-treatment was defined as the period ending in the month prior to thermostat installation, and post-treatment was defined as the period beginning the month following thermostat installation.
- Thermostat connection dates were used as a proxy for installation dates after validating accuracy of this data using known installation dates.
- Only participants with 12 months of pre-treatment data and 10 months of post-treatment data were analyzed. They were matched to non-participants with data available for this same period. Calendarization[26] was used to normalize monthly usage across customer premises with different billing cycles.
- To eliminate identifiable exogenous factors, participants and non-participants who moved or changed electricity rates during the analysis period (including pre- and post-treatment periods) were excluded. Only participants on the two primary residential rates (RL and RHS) were analyzed.

After the above filters were applied, 406 participant premises were retained for analysis.

Matching was conducted with and without controlling for zip code[27] and electric rate. Using the latter approaches, matching participants only with non-participants that lived in close proximity or on the same electric rate did not meaningfully improve the matching, and consequently they were not used in the final matching process.

After matching, summer energy usage impacts were assessed using the following regression approaches:

- Difference-in-differences panel regression with the matched control group using calendarized monthly usage and monthly cooling degree days.
- Within-subjects pre-post regression using actual bill period usage and billing period cooling degree days.

Within each of these approaches, multiple model variants were assessed, such as including and excluding variation by weather month, including and excluding interactions between treatment and weather, etc.

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[26] Bill period start and end dates were used to derive average daily usage for each day in the billing period. Then, this average daily usage was averaged for each day in each calendar month.
[27] The first three zip code digits were used to establish geographic proximity without limiting as much as individual zip codes.

Despite exploring several different models, no significant changes in summer energy usage were detected for Saver's Stat participants. Results were the same for all regression approaches and models.

4 Cost Effectiveness Results

The evaluation team calculated cost effectiveness using the Utility Cost Test (UCT) for each individual SPS energy efficiency and demand response program, as well as the cost effectiveness of the entire portfolio of programs.[28] The evaluation team conducted these tests in a manner consistent with the California Energy Efficiency Policy Manual.[29]

Cost effectiveness tests compare relative benefits and costs from different perspectives. The specific cost effectiveness test used in this evaluation, the UCT, compares the benefits and costs to the utility or program administrator implementing the program. The UCT explicitly accounts for the benefits and costs shown in Table 38.

Table 38: Utility Cost Test Benefits and Costs

Benefits	Costs
• Utility avoided energy-related costs • Utility avoided capacity-related costs, including generation, transmission, and distribution	• Program overhead/administrative costs • Utility incentive costs • Utility installation costs

Using net realized savings from this evaluation and cost information provided by SPS, the evaluation team calculated the ratio of benefits to costs for each of SPS's programs and for the portfolio overall. The results of the UCT are shown below in Table 39. All programs except Residential Cooling and Saver's Stat had a UCT of greater than 1.00, and the portfolio overall was found to have a UCT ratio of 2.29.

[28] The Utility Cost Test is sometimes referred to as the Program Administrator Cost Test, or PACT.

[29] http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/Utilities_and_Industries/Energy_-_Electricity_and_Natural_Gas/EEPolicyManualV5forPDF.pdf

Table 39: PY2017 Cost Effectiveness

Program	Utility Cost Test (UCT)
Business Comprehensive	2.09
Home Lighting & Recycling	3.06
Energy Feedback	1.74
Residential Cooling	0.38
School Education Kits	3.46
Home Energy Services	2.21
Saver's Switch	2.94
Saver's Stat	0.74
Overall Portfolio	**2.29**

5 Process Evaluation Results

This chapter summarizes key methods and findings from the PY2017 process evaluation of the SPS Business Comprehensive, Residential Cooling, and School Education Kits programs. These findings, along with findings from the impact evaluation, informed the conclusions and recommendations presented in the following chapter.

5.1 Business Comprehensive Participant Surveys

As part of the process evaluation, the evaluation team conducted telephone surveys with representatives from 42 participating companies that received rebates through the SPS Business Comprehensive program. This included participants in the Lighting, Cooling, Motors, and Custom sub-programs. The surveys were completed in February 2018 and ranged from 15 to 20 minutes in length.

The participant survey was designed to cover the following topics:

- Verifying the installation of measures included in the program tracking database;
- Collecting information on participants' satisfaction with their program experience;
- Survey responses for use in the free ridership calculations;
- Baseline data on energy use and/or equipment holdings;
- Participant drivers/barriers; and
- Additional process evaluation topics.

SPS provided program data on the Business Comprehensive participant projects, which allowed us to select a sample for interviews. The evaluation team randomly selected and recruited program participants based on whether they had valid contact information and received a rebate through the Lighting, Cooling, Motors, or Custom sub-programs.

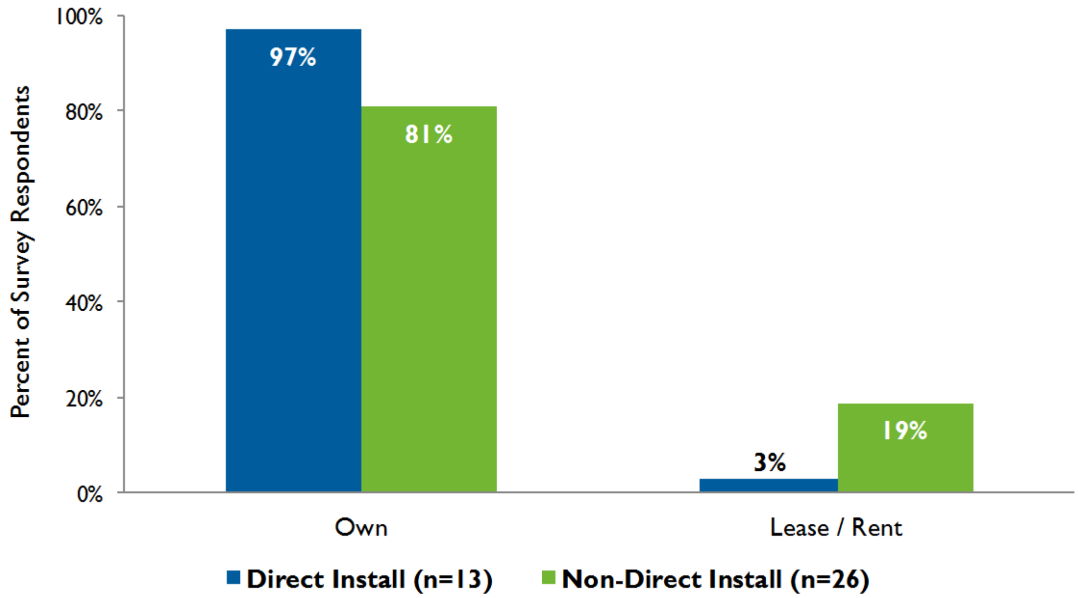
The following subchapters report results on company demographics, sources of program awareness, motivations for participation, and program satisfaction.

Throughout the analysis described here, we present the survey results as weighted percentages based on the proportion of savings represented by survey respondents relative to the total savings of all program participants.

5.1.1 Company Demographics

We asked survey respondents whether their company owns or leases the building where the project was completed. Counterintuitive to what would be expected of direct install participants, Figure 5 shows that 97 percent of participants with direct install projects own their building, which is somewhat unexpected as direct install programs are often targeted toward customers that rent their spaces. Eighty-one percent of non-direct install participants also reported they own the building where the measures were installed, which is consistent with what we would expect of non-direct install participants.

Figure 5: Direct Install and Non-Direct Install Participant Own or Rent



The following two figures summarize the survey respondents' building size and number of employees by whether they had direct install or non-direct install projects. Consistent with program design, Figure 6 and Figure 7 both show that the majority of larger customers get rebates through a non-direct install sub-program, with 61 percent occupying buildings of 10,000 square feet or more. Additionally, 53 percent of non-direct install participants reported having more than 100 full-time employees representing multiple sectors including construction, government and healthcare. Comparatively, mid- to small-sized customers more commonly had direct install projects, with these participants reporting having less than 100 employees and representing multiple sectors including healthcare, hospitality, office/retail, non-profit and financial. In addition, the majority of direct install participant firms also occupied buildings of 10,000 square feet or more; however, a large portion (43%) occupied buildings of less than 5,000 square feet.

Figure 6: Direct Install and Non-Direct Install Participant Number of Employees

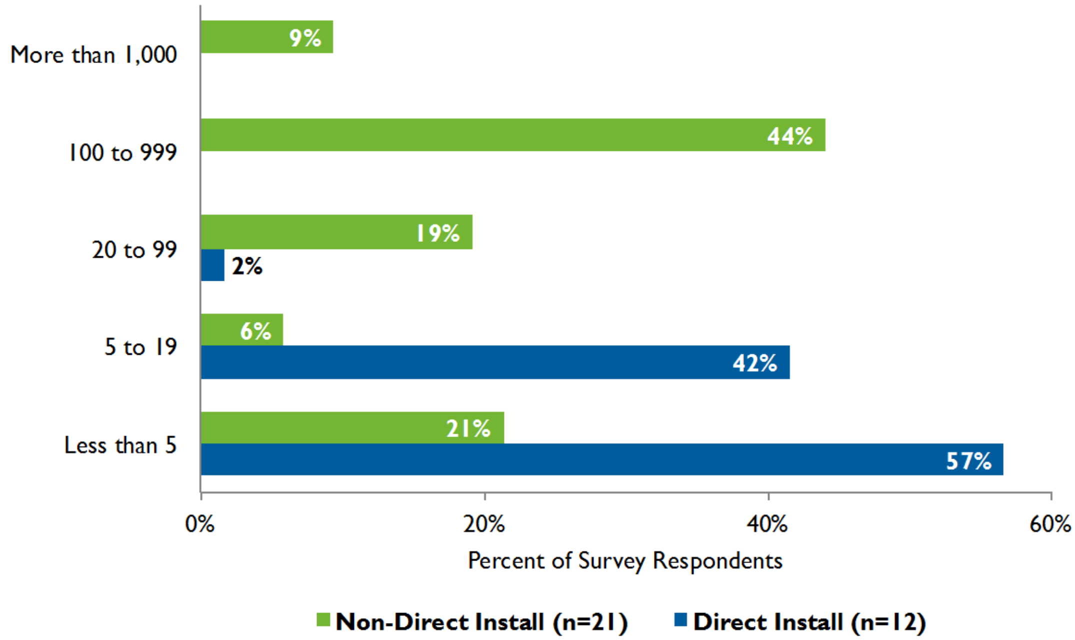
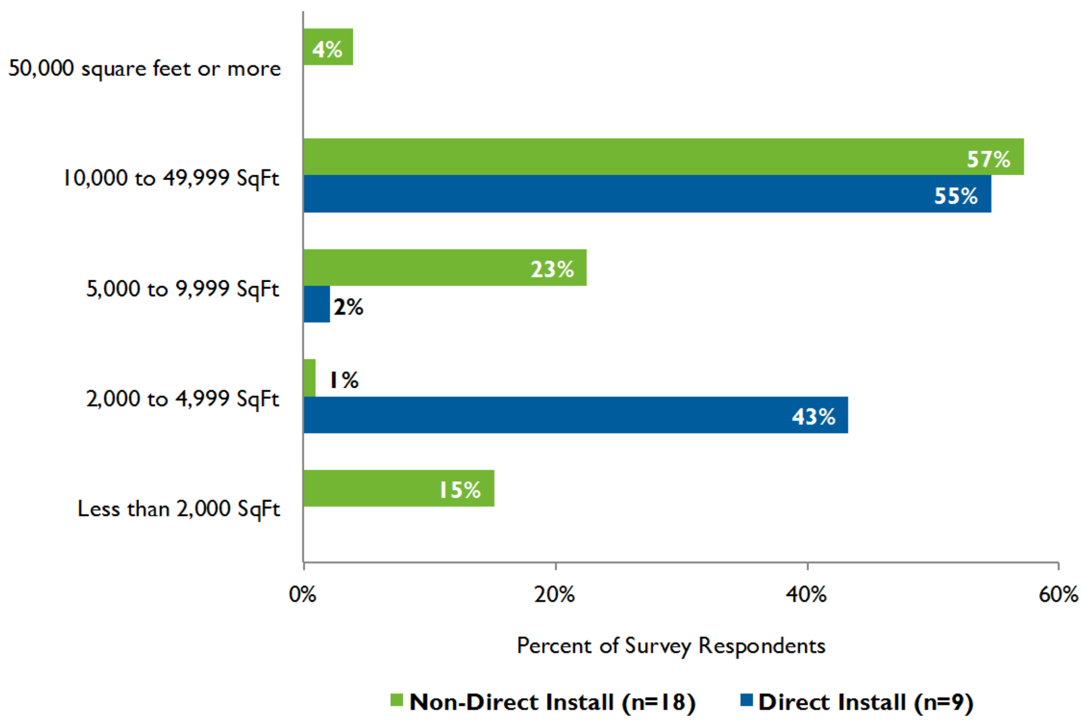
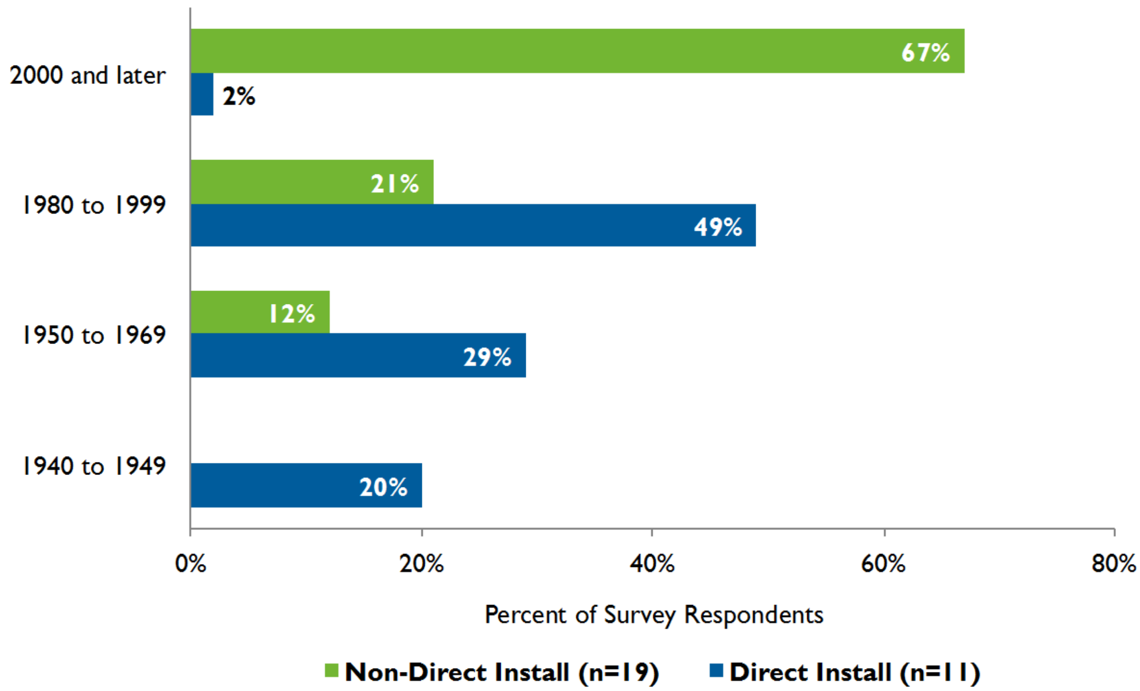


Figure 7: Direct Install and Non-Direct Install Participant Building Size



Additionally, Figure 8 shows that the majority (67%) of non-direct install participants' buildings were built in 2000 or later, compared to 2 percent of direct install participant's buildings. Direct install participants generally occupy older buildings on average, with 49 percent reporting that their buildings were built sometime before 1969 compared to just 12 percent of non-direct install participants' buildings built in the same time frame. This suggests that both programs are doing a good job at targeting older buildings where the potential for significant energy savings is the greatest. No participants reported buildings built between 1970 and 1979.

Figure 8: Direct Install and Non-Direct Install Participant Building Age



5.1.2 Sources of Awareness

Business Comprehensive program participants became aware of the program rebates and assistance through a variety of channels including word of mouth, contractors and/or distributors, online web searches and SPS marketing and outreach. As shown in Figure 9, 41 percent of participants learned about the program offerings through word of mouth. Additionally, 39 percent of participants also learned about the program offerings through contractors and/or distributors. Counterintuitive to what would be expected, the 39 percent of participants who first learned about the program offerings through contactors and/or distributors were those with non-direct install projects, which is somewhat unexpected as direct install participants typically are the ones who learn about program offerings through this channel. Instead, the vast majority of direct install participants initially became aware of the program rebates through SPS marketing and outreach.

For those who indicated that they learned about the program through multiple sources, the evaluation team asked which source was the most useful in their decision to participate. As shown in Figure 10, word of mouth was the most frequently reported useful source of awareness. Additionally, contractors and/or distributors were reported as being a useful source of awareness, with 17 percent of participants mentioning it. This indicates that word of mouth from business associates and co-workers and interactions with contractors and distributors are significant drivers for the program.

Figure 9: Initial Source of Awareness (n=40)

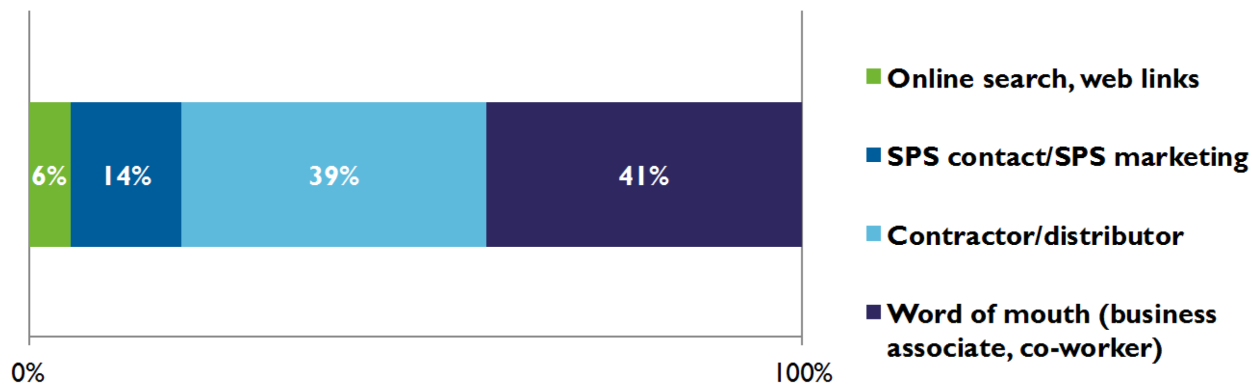
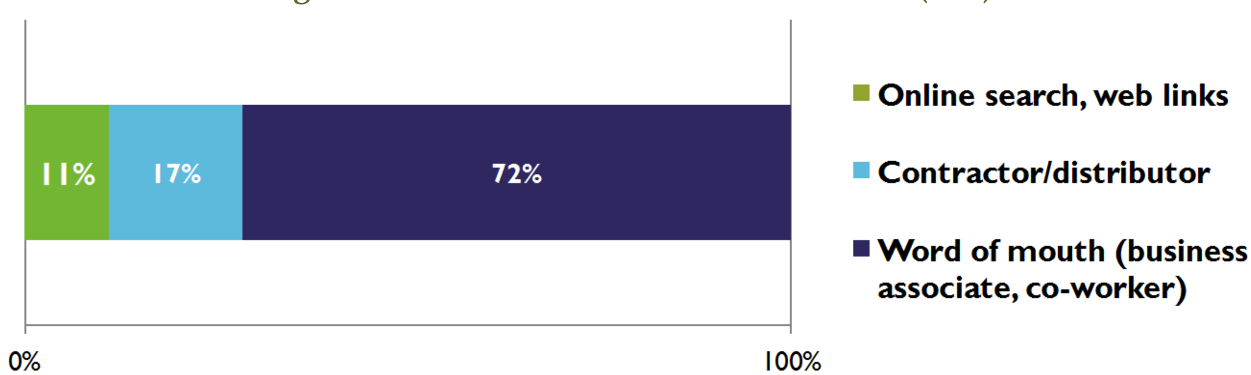


Figure 10: Most Useful Source of Awareness (n=9)

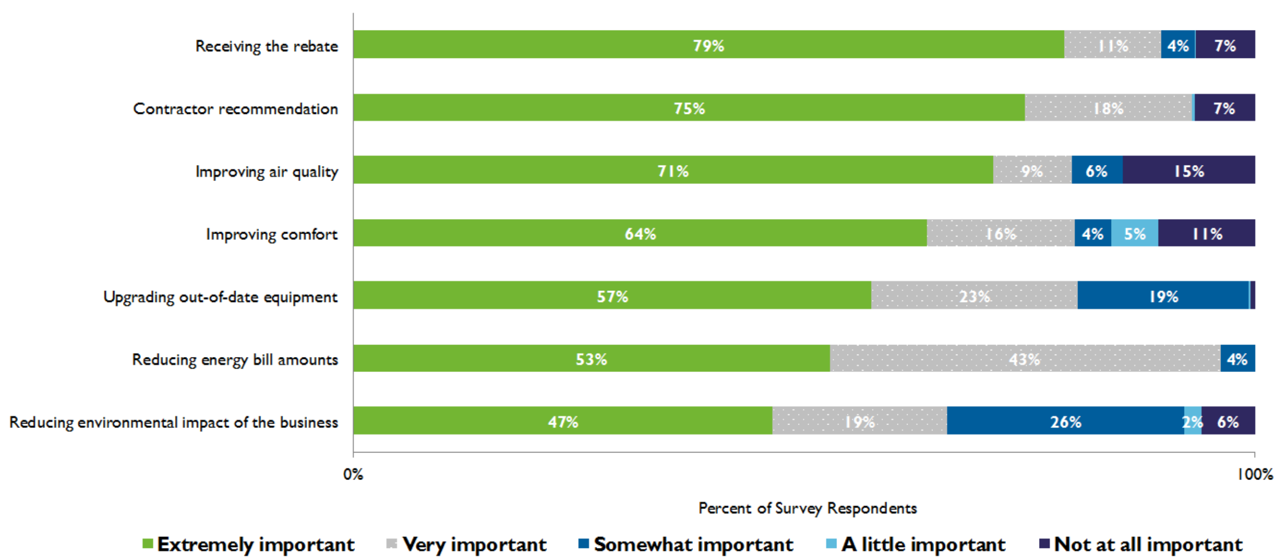


5.1.3 Motivations for Participation

Figure 11 shows the level of importance placed on a variety of factors that might be influencing customers to participate in the program.

The money that participants received back from the rebate was the most influential factor, with 79 percent of participants reporting that it was extremely important in their decision to participate in the program. Other factors that participants reported as important included the contractor recommendation, improving air quality, improving comfort, upgrading out-of-date equipment and reducing energy bill amounts. Interestingly, reducing the environmental impact of the business was the least important (but still important) factor in participants' decision to participate in the Business Comprehensive program, with 34 percent saying it was either "somewhat," "a little," or "not at all important" in their decision to participate.

Figure 11: Motivations for Participation (n=42)



In addition to motivations for participating, respondents were given a list of potential program and non-program factors that may have influenced their decision about how energy efficient their equipment would be and were then asked to rate their importance on a 0 to 10 point scale.[30] As showing in Figure 12 below, the majority of participants rated the contractor who performed the work, the dollar amount of the rebate and the endorsement or recommendation by a contractor as extremely important (a score of 8 to 10) in their decision to determine how energy efficient their project would be. Interestingly, previous participation in an SPS program was the least important factor in

[30] On the 0 to 10 point scale, 0 indicated 'not at all important' and 10 indicated ' extremely important'.

participants' decision to determine how energy efficient their project would be, with 19 percent saying it was extremely important and the majority reporting it was only a little important (a score of 4 or 5) in their decision.

Figure 12: Importance of Program Factors (n=29)

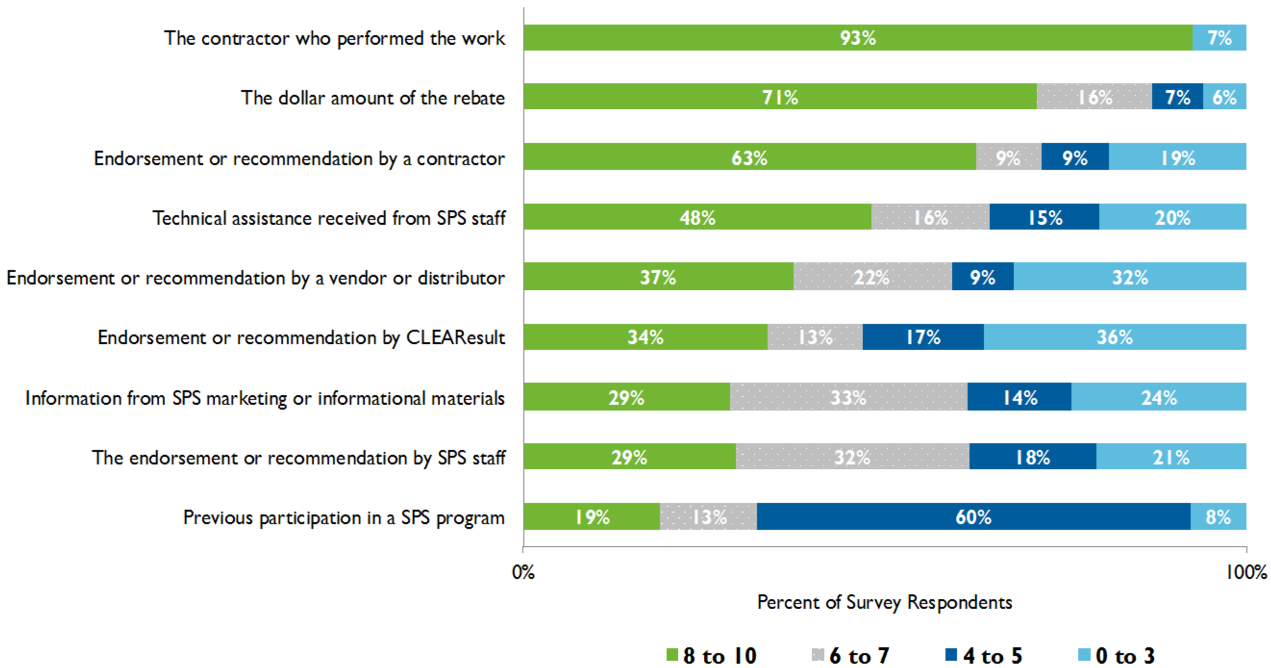
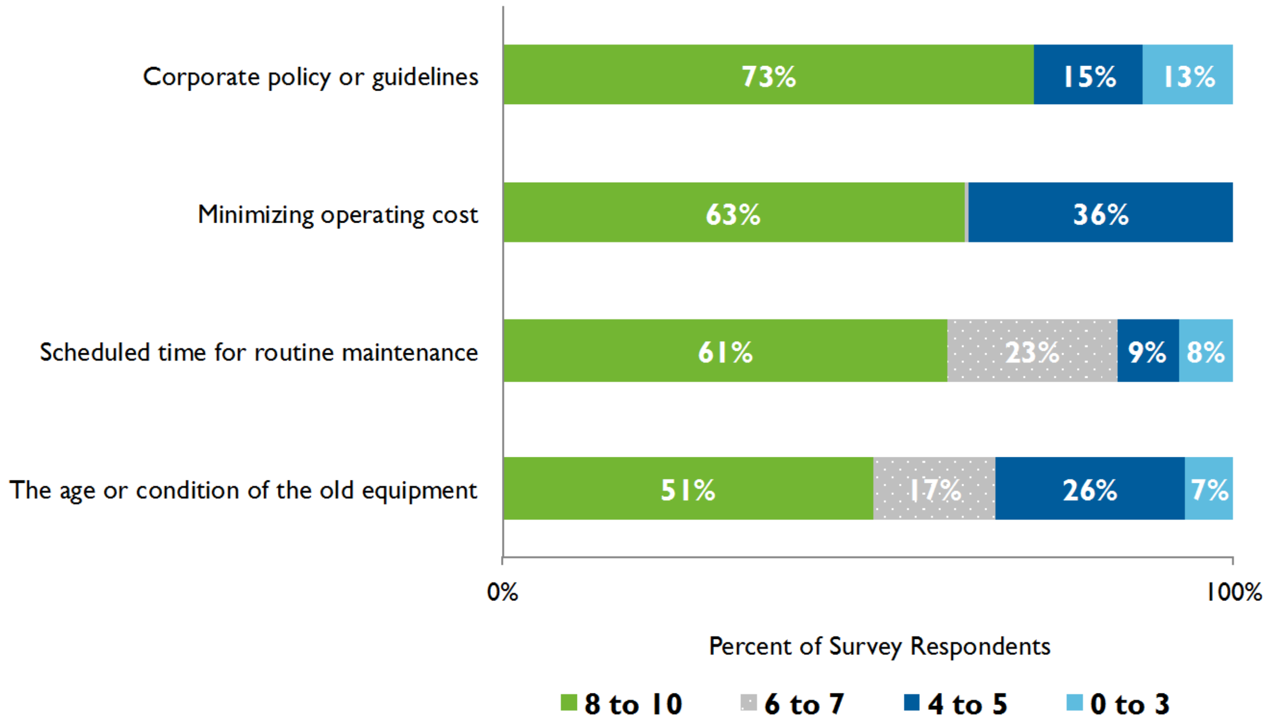


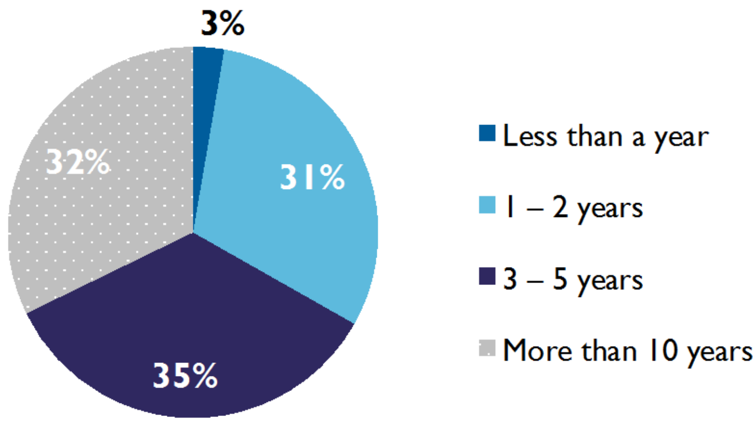
Figure 13 shows that the majority of Business Comprehensive program participants rated all of the non-program factors as very to extremely important (a score of 8 to 10) on the decision to determine how energy efficient their project would be. Corporate policy or guidelines was the most influential non-program factor in the decision regarding efficiency level of the equipment. The age or condition of the old equipment was reported as less influential (but still relatively influential) than other non-program factors, with 49 percent of participants reporting that it was somewhat important (6 to 7), a little important (4 to 5), or not at all important (0 to 3).

Figure 13: Importance of Non-Program Factors (n=29)



To get a sense of the condition of the existing equipment, respondents were asked approximately how much longer would the equipment have lasted if it had not been replaced. Figure 14 shows that the majority of surveyed respondents believed that their equipment would have lasted more than three years. This suggests that the program is doing a good job of targeting customers with functioning equipment, rather than those whose equipment is not working and would need to be replaced anyway (i.e., potential free riders).

Figure 14: Equipment Remaining Life (n=27)



5.1.4 Participant Satisfaction

The participants evaluated their satisfaction with various components of the Business Comprehensive program on the following scale: very satisfied, somewhat satisfied, neither satisfied nor dissatisfied, somewhat dissatisfied, and very dissatisfied. The individual components that participants were asked to rank their satisfaction with included:

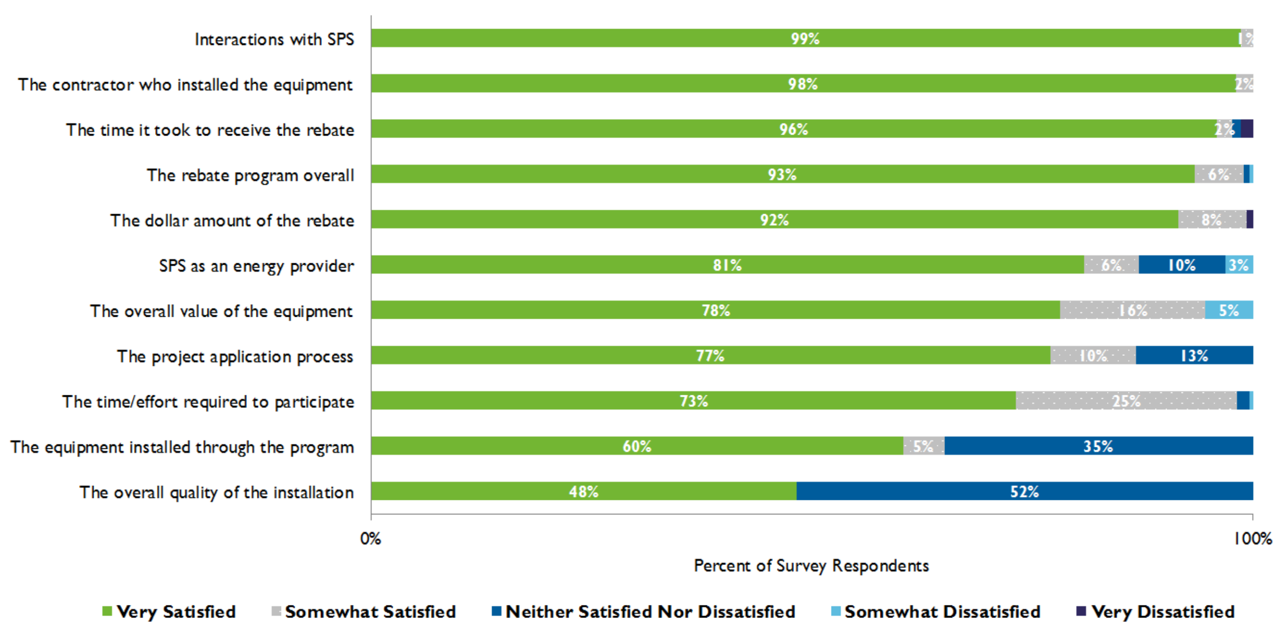
- SPS as an energy provider
- The rebate program overall
- The equipment installed through the program
- The contractor who installed the equipment
- Overall quality of the equipment installation
- The time it took to receive the rebate
- The dollar amount of the rebate
- Interactions with SPS
- The overall value of the equipment for the price they paid
- The time and effort required to participate
- The project application process

Figure 15 summarizes the satisfaction levels of the Business Comprehensive program participants.

Overall, surveyed program participants expressed high levels of satisfaction with the Business Comprehensive program components. As shown in Figure 15, Business Comprehensive participants expressed high levels of satisfaction, with the majority of participants reporting that they were "very satisfied" with all but one program component. Ninety-nine percent reported being "very satisfied" with their interactions with SPS staff, and 98 percent were "very satisfied" with the contractor who installed the equipment. Contrarily, the majority of participants reported being "neither satisfied nor dissatisfied" with the overall quality of the installation. A small percentage of participants reported lower satisfaction ratings with some program aspects, primarily with the overall value of the equipment.

Some of the justifications participants provided for their low satisfaction ratings were that "the rebate wasn't as much as I thought it would be," "the equipment keeps going out," and "it took many months to receive most rebates."

Figure 15: Participant Program Satisfaction (n=42)



5.1.5 Net Promoter Score

In order to calculate a net promoter score, the evaluation team also asked customers about their likelihood to recommend the Business Comprehensive program to others on a scale from 1 to 10. Net promoter scores are measures of brand loyalty. To calculate a net promoter score, responses are classified in the following fashion:

- On a 1 to 10 scale, ratings of 9 or 10 are classified as **Promoters**, as these are customers who are satisfied with the program and are likely to actively recommend the program to other customers.
- Ratings of 7 or 8 are classified as **Passives**, as these are customers who are satisfied with the product, but are not likely to actively promote it.
- Ratings of 1 through 6 are classified as **Detractors**, as these customers likely had some issues with the program and may dissuade other customers from participating.

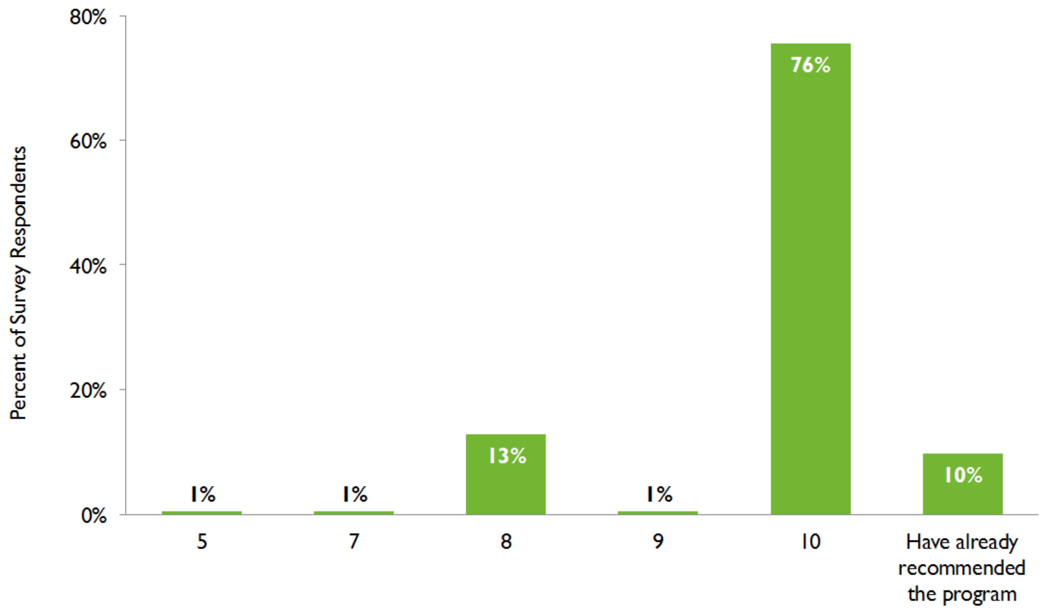
The score is then calculated using the following formula:

Net Promoter Score = % of Promoters - % Detractors

Responses from participating customers yielded a net promoter score of 86 percent. Figure 16 shows the distribution of responses, with 87 percent of respondents counting as promoters and 1 percent as detractors.

Some of the justifications provided by the detractors who reported they would not be willing to recommend the Business Comprehensive program were that "when I called the contractor about installing and replacing light bulbs, no over ever called me back," and "the contractor was not knowledgeable enough about the product."

Figure 16: Distribution of Net Promoter Question Responses



5.2 Residential Cooling

For the Residential Cooling program process evaluation, the evaluation team conducted surveys with participating customers and interviews with contractors that installed electronically commutated motors (ECMs). A sample of 20 participants with information on the type of heating or cooling system installed with their ECM was used for the phone survey. The participant phone survey was designed to gather information on participant satisfaction with the program, motivations for participation, and other process evaluation topics. For the contractor interviews, SPS provided a list of the four contractors with rebated ECM installations in 2017. The contractor interviews were designed to gather information on their typical approach to heating and cooling system upgrades that may include an ECM, how the Residential Cooling program fits in to what they offer their customers, how influential the program is in the customer's decision to install an ECM, and the contractors' satisfaction with the program.

5.2.1 Participant Surveys

The evaluation team conducted two full and two partial telephone surveys with program participants who were identified in the SPS tracking data as active participants who had installed ECMs rebated by the Residential Cooling program. The two partial surveys were due to the respondents not being able to recall that the heating or cooling system installed included the installation of a new ECM. Both program participants who completed the full survey reported they own the home where the ECM was installed and live in homes of between 1,000 to 1,499 square feet and 2,000 to 2,499 square feet.

To better understand what motivates customers to participate in the Residential Cooling program, the evaluation team asked the surveyed respondents the level of importance of a variety of factors that might be influencing customers to participate in the program. Reducing the environmental impact of the home, upgrading out-of-date equipment and the contractor recommendation were the most influential factors, with both participants reporting that these factors were very or extremely important in their decision to upgrade to an ECM. Other factors that one participant reported as being very or extremely important included receiving the rebate and reducing energy bill amounts. Interestingly, both respondents reported that improving comfort was only somewhat important in their decision to participate in the program. Improving air quality was the least important factor on average, with one respondent reporting that it was not at all important and the other mentioning it was extremely important.

In addition to motivations for participating, respondents were given a list of potential factors that may have influenced their decision to upgrade to an ECM and were then asked to rate their influence on a 1 to 5 point scale where 1 was "not at all influential" and 5 was "extremely influential." The contractor recommendation was reported as the most influential of all the factors, with both survey respondents reporting that it was either very or extremely influential in their decision to install the ECM. The availability of the rebate was not as influential (but still influential), with one respondent reporting it was extremely influential (a score of 5) in their decision to install the ECM compared to the other respondent who mentioned it was somewhat influential (a score of 3). Additionally, one surveyed respondent reported that encouragement they saw from SPS was not at all influential; however, the other respondent reported that the encouragement from SPS was very influential (a score of 4).

The participants were asked to evaluate their satisfaction with various components of the Residential Cooling program on the following scale: very satisfied, somewhat satisfied, neither satisfied nor dissatisfied, somewhat dissatisfied, and very dissatisfied. Overall, the two surveyed program participants expressed high levels of satisfaction with the Residential Cooling program components. Both reported being "very satisfied" with all but one of the program components including the rebate program overall, the ECM installed, the contractor who installed the ECM, the amount of time it took to receive the rebate, the dollar amount of the rebate, and the overall value of the ECM for the price that was paid. SPS as an energy provider received the lowest satisfaction rating (but respondents still were relatively satisfied), with one reporting they were "neither satisfied nor dissatisfied" and the other mentioning they were "very satisfied."

5.2.2 Contractor Interviews

The evaluation team interviewed two of four contractors who installed electronically commutated motors (ECMs) that were rebated by SPS in 2017. These contractors represented 72 percent of ECM rebates shown in the program tracking data for the year. For both interviews, we spoke with a contractor involved in sales and project scope discussions with customers and with an office staff person who completes the rebate application.

Both contractors replace existing and install new heating and cooling systems as part of their work for residential customers. They indicated that they promote efficient equipment whenever possible because it makes sense for the customer. They both also make use of multiple utility rebates for the bulk of their projects, usually involving rebates from SPS.

ECM installations are generally part of whole system change-outs in which a customer needs to have an entire cooling or heating system replaced and are not isolated choices to replace an inefficient or failing blower motor. Both contractors suggested that many of their projects involve ECM installations, and they mention the ECM rebate when it is technically feasible alongside other available rebates for the system being installed.

The contractors suggested that the ECM rebates do not affect their business practices; both rated the likelihood that they would promote ECMs even without the rebate as a 10 on a scale from 0 to 10 where 0 is not at all likely and 10 is extremely likely. However, they both believe that the rebates help sway customers toward the more efficient systems available to them. One contractor put the likelihood that customers would install an ECM without the rebate at an 8, while the other judged it at 3 or 4 on the same 0-10 point scale.

One contractor, in particular, commented that he promotes a specific cooling system that already comes with an ECM and with its own rebates. However, the ability to take an additional $100 off the price is very helpful in nudging customers to the more efficient system (and not just the more efficient blower motor). The other contractor estimated that their sales of efficient equipment would slip by 30 percent without the rebate.

Both contractors were very satisfied with the program, suggesting only that a little more promotion and outreach by SPS could help. Both contractors gave the program a rating of 5 on a scale of 1 to 5 where 1 is not satisfied and 5 is extremely satisfied. The office staff indicated that the applications are easy to complete and work well.

Both contractors learned of the ECM rebate two or three years ago from the same SPS staff person.

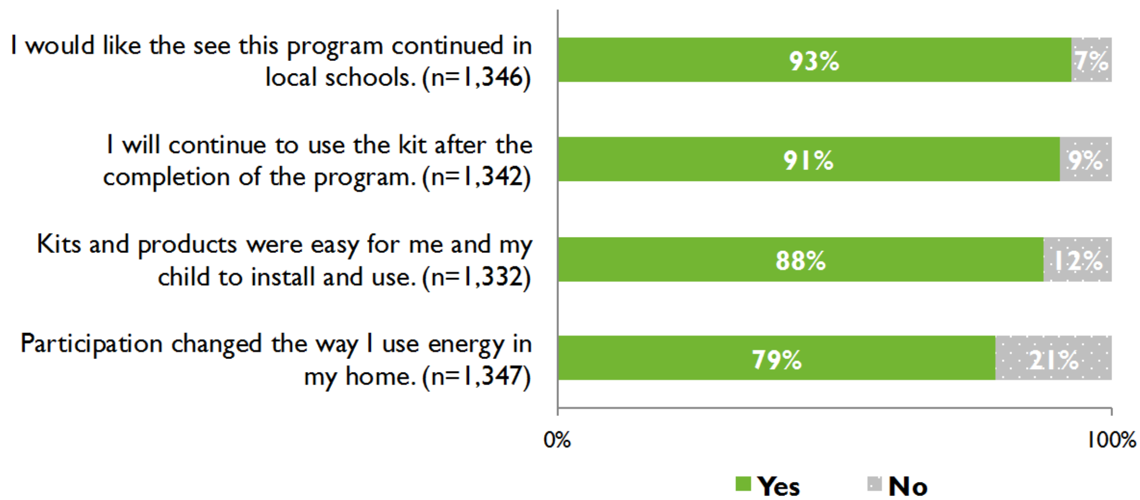
5.3 School Education Kits Questionnaires

Through the School Education Kits program, SPS provides energy efficiency education and distributes kits containing LEDs, faucet aerators, and low flow showerheads to elementary school students. SPS provided the evaluation team with data from the student, parent and teacher surveys that are distributed along with the kits as part of the School

Education Kits program. The evaluation team conducted analysis on these data to assess satisfaction and feedback associated with this program.

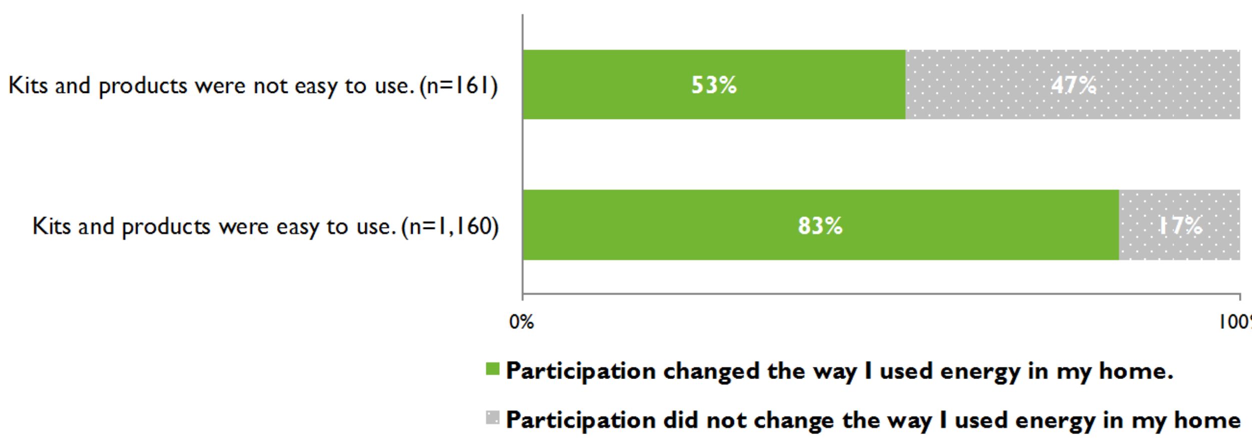
Parents of students who took part in the program were asked about their experience. Overall, responses were positive. As shown in Figure 17, close to 90 percent of parents indicated that they continued using the kits after the program was over, that the products were easy to use, and that they would like to see the program continued in local schools. Eighty percent of parents reported that the program changed how they use energy in their home.

Figure 17: Parent Opinions Regarding School Education Kits Program



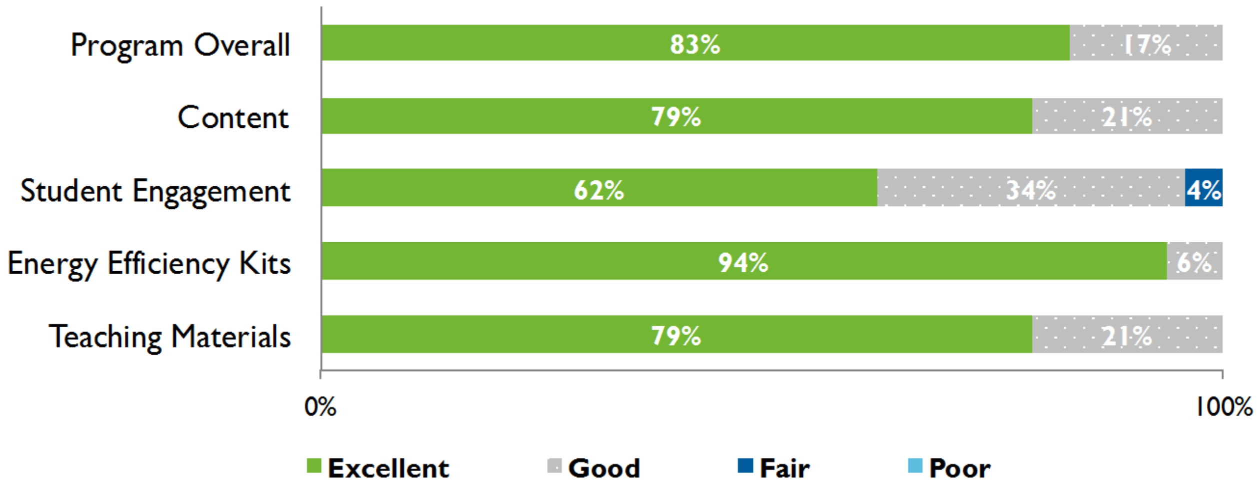
Parents were more likely to report that their participation changed the way they use energy in the home if they thought the products were easy to use, as shown in Figure 18.

Figure 18: Change in Home Energy Usage Compared to Ease of Use of Kits



Teachers were also asked to give their opinions about the program; overall, 83 percent of teachers rated the program as excellent, as shown in Figure 19. The lowest ratings received were regarding student engagement, although 96 percent of teachers still reported that it was either good or excellent. The majority of teachers (94%) believed the gift card that they received as a thank you for participating was a good incentive.

Figure 19: Teacher Opinions Regarding School Education Kits Program (n=47)



Only 28 percent of the teachers who responded had thoughts on how to improve the School Education Kits program. Some suggestions included:

- Addition of shower head and faucet adapters;
- More visuals for monolingual students;
- Addition of STEM activities relating to what the students receive; and
- Modify the water flow check, as the activity is time consuming.

Overall, it appears the School Education Kits program is well received by both parents and teachers, as a large majority reported positive opinions of the program, with only minor suggestions for improvements.

6 Conclusions and Recommendations

Based on the results from the data collection and analysis described in the previous chapters, the evaluation team has developed a number of conclusions and associated recommendations to improve SPS's programs. These are organized below by evaluation component (impact evaluation, cost effectiveness, and process evaluation) and program.

6.1 Impact Evaluation

Impact evaluation activities for the 2017 programs included engineering desk reviews for a sample of Business Comprehensive program projects. This included projects for the Computers, Cooling, Custom, Lighting, Motors, and Retrocommissioning sub-programs. In addition, the evaluation team conducted desk reviews for a sample of Residential Cooling projects. Net impacts for the Home Lighting & Recycling program were estimated with an elasticity model, using program tracking data of bulb sales. Net impacts for the Energy Feedback program were estimated using a billing regression analysis that included participants and a control group. A deemed savings review was conducted for measures in the School Education Kits program. Finally, impacts for the Smart Thermostat Pilot (Saver's Stat) were estimated using a billing regression model.

6.1.1 Business Comprehensive Program

For the Business Comprehensive desk reviews, an overall engineering adjustment factor of 0.9846 was found for kWh savings and 0.9933 was found for kW savings. For individual projects with engineering adjustment factors that varied significantly from 1, there were three overarching reasons for those discrepancies:

1. The lighting measures in the New Mexico Technical Reference Manual (TRM) and the SPS Technical Assumptions conflict with each other. Most notably, lighting operating hours are not consistent between these two documents.
    - **Recommendation 1:** Update the SPS Technical Assumptions for lighting to be consistent with the TRM, as is appropriate. In cases where the Technical Assumptions are in direct conflict with the TRM, indicate the reasoning and justification for deviating from the TRM.
2. Project-specific *ex ante* calculation steps and values for some prescriptive projects are unclear. There is limited documentation of the specific steps taken for some individual projects between application submission and final reported savings. Using inputs from project documents and algorithms from the Technical Assumptions resulted in savings different than those reported for multiple projects. Without project-specific inputs and calculation steps documented, the sources of discrepancies between reported savings and verified savings cannot be identified. As discussed in the *Impact Evaluation Results* chapter, these discrepancies were most pronounced for cooling and computer efficiency measures.

- **Recommendation 2:** Clearly document calculation steps and adjustments made for each project, ensuring that submitted project documentation can be followed to reproduce the reported savings estimates.

3. The reported savings for multiple projects did not account for changes made to the analyses by the implementer based on post-installation inspections and other QA/QC activities. Documented changes included post-retrofit lighting hours, baseline lighting fixture wattages, and lighting fixture quantities. These changes resulted in both increases and decreases in savings estimates, depending on the individual project.
    - **Recommendation 3:** Ensure that all changes made to the analyses based on post-installation inspections and other QA/QC activities are carried through to the final reported values.

Additional findings and recommendations from the Business Comprehensive desk reviews are discussed below:

- The variable frequency drive (VFD) measure savings algorithms would be improved by including additional detail, however the evaluation team did not make any adjustments to verified project savings based on these findings.
    - The VFD savings documentation assumes that VFDs are installed on motors that do not exceed federal minimum motor efficiency standards. This could result in the over-claiming of savings if VFDs are installed on motors that are more efficient than the federal standards.
    - The VFD savings documentation assumes that motors with VFDs are operated using variable-speed control strategies. However, VFDs are occasionally installed on motors for system balancing purposes but run at constant speed.
    - **Recommendation 4:** Collect project-specific data on motor efficiencies and use these efficiencies in VFD savings calculations.
    - **Recommendation 5:** Include language and verification procedures to ensure that incentivized VFDs operate motors with variable-speed control.
- The pump off controller (POC) measure algorithms in the SPS Technical Assumptions incorrectly estimate peak demand reduction. The algorithms divide the kWh savings by the baseline operating hours to estimate 'customer kW' savings, to which a coincidence factor is applied to determine peak coincident demand savings. However, POCs do not change the kW demand of pumps while they are operating; rather, they turn pumps off more often than in the baseline scenario. If the pump with baseline controls would have been on during the peak demand period and is turned off by the POC during the peak demand period, then the peak

coincident demand savings are equal to the kW demand of the pump while operating. Therefore, the correct way to estimate peak coincident demand savings for POCs would be to apply a coincidence factor to the pump operating kW (e.g. Baseline Demand x POC Coincidence Factor).

  - **Recommendation 6:** Update the algorithm for calculating POC peak coincident demand reduction per above. SPS has stated that the POC coincidence factor will be updated to conform to the deemed method in their 2020 filing.

- The savings claimed for upstream computer efficiency measures are based on a straight average of cooling system type efficiencies. This introduces a high level of variability, as the highest assumed efficiency (0.407 kW/ton for chilled water with waterside economizer systems) is over three times more efficient than the lowest assumed efficiency (1.263 kW/ton for direct expansion systems). The evaluation team did not make any adjustments to computer efficiency project savings based on this finding; however, we do provide recommendations below for refining savings calculations.
  - **Recommendation 7:** Refine the upstream computer efficiency savings estimates by weighting cooling systems by expected penetration.
  - **Recommendation 8:** To the extent possible, collect project-specific information regarding cooling system type to further refine measure savings.
- One Business Comprehensive project received incentives for the installation of an evaporative cooler. Based on project documentation, the pre-retrofit equipment was an existing evaporative cooler. However, the savings algorithms in the SPS Technical Assumptions assume a baseline of direct expansion (DX) equipment. While it is possible that in this situation, the customer could have been deciding between installing a new DX system or a new evaporative cooler, additional guidance should be provided regarding appropriate baselines and measure qualification.
  - **Recommendation 9:** Refine the guidance and requirements regarding the situations in which the evaporative cooler measure is applicable.
- The SPS Technical Assumptions algorithms for economizer savings use an assumed value for the efficiency of the air conditioning unit. This could result in the over-claiming of savings if economizers are installed on units that are more efficient than this assumed value.
  - **Recommendation 10:** Refine the economizer algorithms to use the actual efficiency of the unit on which the economizer is installed.
- One group of projects used custom analyses to determine estimated savings, correlating energy use with facility production. These analyses used between two to four months of post-retrofit data. These estimates could be refined by using

additional post-retrofit data, as is set forth in IPMVP Option C (one or more full years of data).

  - **Recommendation 11:** When performing custom analyses using regression/billing analysis/etc., gather additional post-retrofit data whenever possible.

- One custom project used a custom analysis to determine savings, correlating energy use with facility production. The *ex ante* analysis included the month during which the equipment retrofit took place. This month should be considered an outlier and as such was removed from the analysis by the evaluation team.
  - **Recommendation 12:** Exclude outliers (such as months during which retrofit work takes place) from custom analyses.

6.1.2 Home Lighting & Recycling Program

The deemed savings review for the Home Lighting & Recycling program did not find any discrepancies between the per unit savings values in the tracking data and the values in the SPS Technical Assumptions. The elasticity model used to estimate net savings for the program produced a net-to-gross (NTG) ratio of 0.71, which yielded net kWh savings of 9,300,382 and net kW savings of 1,460.

During review of the Home Lighting & Recycling program tracking data, the evaluation team noted that effective useful life is not included as a field in the data.

- **Recommendation 13:** To facilitate evaluation of the Home Lighting & Recycling program in the future, the evaluation team recommends that effective useful life be included in the tracking data.

6.1.3 Energy Feedback Program

Using a fixed effects billing regression analysis that included both participant and control groups, the evaluation team estimated net kWh savings of 3,762,044 and net kW savings of 940.71 for the Energy Feedback program. These savings resulted from the Wave 1 (March 2012) and Wave 3 (May 2017) Home Energy Report participant groups. For Wave 2 (July 2015) and for the online My Energy participants, no statistically significant savings were found.

For the online My Energy component of this program, the evaluation team identified two potentially problematic issues with participation:

1. For recipient households that receive both the Home Energy Reports and My Energy online access, it will not be possible to separate savings attributable to each program, introducing the potential for double counting savings in the future.

2. Some households that participate in the My Energy program are control homes in the Home Energy Report program. The impact of the My Energy program on energy consumption may make them inappropriate to use in the Home Energy Report program as a control home.

Recommendation 14: Carefully track the overlap of Energy Feedback print report participants and controls and My Energy online participants and controls, to minimize the possibility of double counting savings and to ensure all control group customers are valid comparison households.

6.1.4 Residential Cooling Program

Desk reviews of a sample of the Residential Cooling projects yielded a slight upward adjustment in savings with an engineering adjustment factor of 1.01 for kWh savings and 1.02 for kW savings. The original *ex ante* NTG value of 0.66 for the program was applied to realized gross savings which yielded total net savings for the program of 26,384 kWh and 4 kW.

During the desk reviews of electronically commutate motors (ECM) projects, the evaluation team found that the ECM furnace fan measure is based on the pre- and post-retrofit fans being operated at a constant speed. Customers may potentially install ECM furnace fans with variable-speed operation, which would result in higher savings. However, the current measure does not allow for these extra savings to be claimed.

- **Recommendation 15:** Add a variable-speed option to the ECM furnace fan measure to claim these additional savings when present.

6.1.5 School Education Kits Program

The deemed savings review conducted for the School Education Kits program found that the per-unit values were being correctly applied from the Technical Assumptions documentation. Therefore, the engineering adjustment factor for the School Education Kits program was 1.00. The NTG ratio for the School Education Kits program is stipulated at 1.00, and as a result, the net realized savings are equal to the gross verified savings of 1,656,045 kWh and 41 kW.

In reviewing the tracking data and Technical Assumptions documentation for the School Education Kits program, the evaluation team did find two minor issues that did not affect savings:

1. The reported values in the "2017 YE Achievement.xlsx" file are mislabeled for bathroom and kitchen aerators, with the reported savings values switched between the two measures. This has no impact on total savings as the correct values were

used in the calculation, but should be corrected to avoid possible confusion in the future.

- **Recommendation 16:** Make sure all savings values are correctly labeled in tracking data and summary spreadsheets.

2. The SPS School Education Kits Program Technical Assumptions PDF document does not include separate savings values for the 11 Watt and 9 Watt bulbs. These are included in the "2017 NMx Tech Assumptions Summary Round 4 – REGULATORY.xlsx" file, however.

   - **Recommendation 17:** Update the Technical Assumptions document for the School Education Kits measures to include savings for both the 11 Watt and 9 Watt bulbs.

6.1.6 Smart Thermostat Pilot (Saver's Stat)

The impact evaluation for the Saver's Stat pilot included a regression analysis to estimate the demand reduction associated with smart thermostats installed through the pilot. Based on this analysis, the demand reduction for the Saver's Stat pilot was found to be 377 kW. A billing regression analysis to estimate energy savings associated with the Saver's Stat pilot did not yield any statistically significant kWh savings.

6.2 Cost Effectiveness

Cost effectiveness was calculated using the Utility Cost Test (UCT) for each individual program, as well as for the entire portfolio of SPS programs. The evaluation team found the following during our analysis:

- SPS does not use the Total Resource Cost (TRC) test, and instead relies solely on the UCT to determine program and portfolio cost effectiveness.
- A 20 percent benefit adder is included in the UCT calculation for low-income projects to account for utility system economic benefits.
- The UCT revealed that all programs except Residential Cooling and the Saver's Stat pilot were cost effective (i.e., had a UCT ratio of greater than 1.00) and the SPS portfolio overall had a UCT ratio of 2.29.

Recommendation 18: If there is a desire or need to calculate cost effectiveness using the TRC test by either SPS or the New Mexico Public Regulation Commission (NMPRC), SPS should track measure costs for all programs so that the TRC test can be used in future program years.

6.3 Process Evaluation

The process evaluation component of the 2017 SPS evaluation included surveys with Business Comprehensive participants in the Lighting, Cooling, Custom, and Motors sub-programs, as well as interviews with participants and contractors for the Residential Cooling program. The evaluation team also analyzed School Education Kits survey data provided by SPS. The subchapters below summarize the evaluation team's conclusions and recommendations resulting from this research.

6.3.1 Business Comprehensive Program

Business Comprehensive participants were found to be highly satisfied with their program experience and the contractor who installed their equipment, among other program factors. The contractor who performed the work was also reported to be the most important factor in the customer's decision to upgrade to the efficiency level that they did. The net promoter score for the Business Comprehensive program was found to be 86 percent, with 10 percent of respondents indicating that they have already recommended the program to others. This is significant given that the most useful source of awareness of the program was reported to be word of mouth, with contractors reported to be the second most useful source.

- **Recommendation 19:** Continue to promote the program through contractors and track participant satisfaction and net promoter scores, as contractors and word of mouth are both key sources of information for program participants.

6.3.2 Residential Cooling Program

For the Residential Cooling program, only two surveys were completed with program participants that had ECMs installed as part of an HVAC upgrade through the Home Energy Services program. However, both of these participants were highly satisfied with their experience with the Residential Cooling program. The most influential factor in the decision to upgrade to an ECM was the contractor recommendation, which reinforces the importance of the contractor's role in this program.

The Residential Cooling contractor interviews were conducted with two of the four participating contractors in 2017. Both contractors indicated that they promote energy efficient equipment whenever possible. In the case of ECMs specifically, they mention the ECM rebate to customers when the upgrade is technically feasible alongside other available rebates for the HVAC system being installed. The two contractors gave varying responses as to how likely customers would be to install an ECM without the rebate, but both did indicate that the rebate helps sway customers to the more efficient option.

- **Recommendation 20:** Continue to promote the program rebates through contractors, as they are the primary source of program awareness and play an important role in the customer's decision to pursue efficiency upgrades.

6.3.3 School Education Kits Program

Parent survey responses to the School Education Kits questionnaires indicate that the kits are well received by students' families. The majority of parents indicated that participation in the program changed the way they used energy in their home, particularly if they felt that the products included in the kit were easy to use.

- **Recommendation 21:** Continue to provide easy-to-install measures in the School Education Kits and track responses to program surveys to assess satisfaction.

Teachers were also highly satisfied with the program and offered a few ways they felt the program could be improved, including the addition of adapters for showerheads and faucet aerators and the addition of science, technology, engineering, and math (STEM) activities that are related to what students receive in the kits.

- **Recommendation 22:** If looking for ways to modify the program, consider making changes based on teacher and parent suggestions from the surveys.

Evaluation of the 2017 Southwestern Public Service Company's Energy Efficiency and Demand Response Programs

Final Report - Appendices

April 27, 2018

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Appendix A – Business Comprehensive Participant Survey Instrument

Hello, my name is (*YOUR NAME*) from Research & Polling, Inc. I am calling on behalf of SPS. May I please speak with ________________?

A. (Once correct respondent is reached) Hello, my name is (*YOUR NAME*) from Research & Polling, Inc. I am calling on behalf of SPS.

I'm calling because our records show that you recently completed an energy efficiency project where you installed [MEASURE_1] at your business located at [SITE_ADDRESS] and received a rebate through the SPS [REBATE PROGRAM] program. I'd like to ask a short set of questions about your experience with the [REBATE PROGRAM] program. Your time will help us improve this program for other customers like you. Are you the best person to talk to about the/these energy efficiency upgrade(s) and energy use at your firm?

1. Yes
2. No (Ask, Who would be the best person to talk to about the [MEASURE(S)] installed and energy use at your business? (REPEAT INTRO WHEN CORRECT PERSON COMES ON LINE; ARRANGE CALLBACK IF NECESSARY)
3. Never installed *(VOLUNTEERED SKIP TO Q.5)*

(IF NEEDED) SPS would like to better understand how businesses like yours think about and manage their energy use. The [REBATE_PROGRAM] program is designed to help firms with energy saving efforts. Your input is very important to help SPS improve its energy rebate programs.

SECTION A [MEASURE _1]

1. (A 1) Our records show in 2017 your business got a rebate through SPS for installing [MEASURE_1]. Are you familiar with this project?

1. Yes
2. No *(SKIP TO Q.2)*
3. Never installed *(VOLUNTEERED) (SKIP TO Q.5)*
4. Don't know *(SKIP TO Q.2)*

1a. Our records show it was installed at [SITE_ADDRESS] in [SITE_CITY]. Is that correct?

1. Yes *(SKIP TO Q. 3)*
2. No *(GO TO Q. 1b)*
3. Never installed *(VOLUNTEERED) (SKIP TO Q.5)*
4. Don't know *(SKIP TO Q.2)*

1b. Where was [MEASURE_1] installed? *(RECORD LOCATION)*

____*(SKIP TO Q. 3)*

99. Never installed *(SKIP TO Q. 5)*

2. (A 1a) Is there someone else in your company who would know about buying the [MEASURE_1]?

1. Yes (Ask to be transferred to better contact and go back to intro)
2. Yes (Unable to be transferred, record contact's and number to call back)
3. No **(THANK AND TERMINATE)**
4. Don't know **(THANK AND TERMINATE)**

3. (A 2) Thinking about the [MEASURE_1] for which you received a rebate, is the [MEASURE_1] still installed in your facility?

1. Yes *(SKIP TO Q. 6)*
2. No *(CONTINUE TO Q. 4a)*
3. Prefer not to answer *(SKIP TO Q. 6)*
4. Don't know *(SKIP TO Q. 6)*

4a. (A 3) Was the [MEASURE_1] removed?

01. Yes, it was removed *(SKIP TO Q.5)*
02 No *(CONTINUE TO Q.4b)*
03. Prefer not to answer *(DO NOT READ) (SKIP TO Q.7)*
99. Don't know *(DO NOT READ) (SKIP TO Q.7)*

Other *(SPECIFY)* ______________________________

4b. (A 3) Was the [MEASURE_1] never installed?

01. Yes, never installed
02. Prefer not to answer *(DO NOT READ) (SKIP TO Q.7)*
99. Don't know *(DO NOT READ) (SKIP TO Q.7)*

Other *(SPECIFY)* ______________________________

5. (A3a) Why was the [MEASURE_1] removed/never installed? *(OPEN VERBATIM)*

____

____

____

(SKIP TO SECTION A [MEASURE_2]

6. (A 4) Is the [MEASURE_1] still functioning as intended?

1. Yes
2. No
3. Prefer not to answer *(DO NOT READ)*
4. Don't know *(DO NOT READ)*

7. (A 5) Did your firm use a contractor to install the [MEASURE_1] or did internal staff do the work?

01. Contractor *(SKIP TO SECTION A [MEASURE_2])*

02. Internal Staff

03. Prefer not to answer *(SKIP TO SECTION A [MEASURE_2])*

99. Don't know *(SKIP TO SECTION A [MEASURE_2])*

Other *(SPECIFY)*____
(SKIP TO SECTION A [MEASURE_2])

8. (A 6) Why did your firm choose to use internal staff instead of a contractor?

____

____

____

98. Prefer not to answer

99. Don't know

<u>SECTION A [MEASURE_2]</u>

1. (A 1) Our records also show in 2017 your business got a rebate through SPS for installing a (MEASURE_2]. Do you remember this?

1. Yes
2. No *(SKIP TO INTRO BEFORE Q. 10)*
3. Never installed *(VOLUNTEERED) (SKIP TO Q.5)*
4. Don't know *(SKIP TO INTRO BEFORE Q. 10)*

1a. Our records show it was installed at [SITE_ADDRESS] in [SITE_CITY]. Is that correct?

1. Yes *(SKIP TO Q. 3)*
2. No *(GO TO Q. 1b)*
3. Never installed *(VOLUNTEERED) (SKIP TO Q.5)*
4. Don't know *(SKIP TO INTRO BEFORE Q. 10)*

1b. Where was [MEASURE_2] installed? *(RECORD LOCATION)*

____*(SKIP TO Q. 3)*

99. Never installed *(SKIP TO Q. 5)*

3. (A 2) Thinking about the [MEASURE_2] for which you received a rebate, is the [MEASURE_2] still installed in your facility?

1. Yes *(SKIP TO Q. 6)*
2. No *(CONTINUE TO Q. 4a)*
3. Prefer not to answer *(SKIP TO Q. 6)*
4. Don't know *(SKIP TO Q. 6)*

4a. (A 3) Was the [MEASURE_2] removed?

01. Yes, it was removed *(SKIP TO Q.5)*

02 No *(CONTINUE TO Q.4b)*

03. Prefer not to answer *(DO NOT READ) (SKIP TO Q.7)*

99. Don't know *(DO NOT READ) (SKIP TO Q.7)*

Other *(SPECIFY)* ____

4b. (A 3) Was the [MEASURE_2] never installed?

01. Yes, never installed

02. Prefer not to answer *(DO NOT READ) (SKIP TO Q.7)*

99. Don't know *(DO NOT READ) (SKIP TO Q.7)*

Other *(SPECIFY)* ____

5. (A3a) Why was the [MEASURE_2] removed/never installed? *(OPEN VERBATIM)*

____

____

____

(SKIP TO INTRO TO Q. 10)

6. (A 4) Is the [MEASURE_2] still functioning as intended?

1. Yes
2. No
3. Prefer not to answer *(DO NOT READ)*
4. Don't know *(DO NOT READ)*

7. (A 5) Did your firm use a contractor to install the [MEASURE_2] or did internal staff do the work?

01. Contractor *(SKIP TO Q. 9)*

02. Internal Staff

03. Prefer not to answer *(SKIP TO Q. 9)*

99. Don't know *(SKIP TO Q. 9)*

Other *(SPECIFY)*____*(SKIP TO Q. 9)*

8. (A 6) Why did your firm choose to use internal staff instead of a contractor?

____

____

____

98. Prefer not to answer

99. Don't know

9. (A 7) Was your [MEASURE_1] AND [MEASURE_2], installed/purchased together as a single project or were these done separately?

1. Together as one project
2 Separately
3. Prefer not to answer *(DO NOT READ)*
4. Don’t know *(DO NOT READ)*

<u>SECTION B</u>

Now I have some questions about how your company became aware of the SPS rebate program.

10. (B 1) How did your company FIRST learn about the program?
(DO NOT READ CATEGORIES) (TAKE <u>ONE</u> RESPONSE)

01. Word of mouth (business associate, co-worker)

02. Utility program staff

03. Utility website

04. Utility bill insert

05. Utility representative

06. Utility advertising

07. Email from utility

08. Contractor/distributor

09. Building audit or assessment

10. Television Advertisement – Mass Media

11. Other mass media (sign, billboard, newspaper/magazine ad)

12. Event (conference, seminar workshop)

13. Online search, web links

14. Participated or received rebate before

98. No way in particular

99. Don't know

Other *(SPECIFY)* ____

11. (B 2) What other sources did your company use to gather information about the program….Were there any others? *(DO NOT READ CATEGORIES) (TAKE UP TO THREE RESPONSES)*

01. Word of mouth (business associate, co-worker)
02. Utility program staff
03. Utility website
04. Utility bill insert
05. Utility representative
06. Utility advertising
07. Email from utility
08. Contractor/distributor
09. Building audit or assessment
10. Television Advertisement – Mass Media
11. Other mass media (sign, billboard, newspaper/magazine ad)
12. Event (conference, seminar, workshop)
13. Online search, web links
14. Participated or received rebate before

98. None *(SKIP TO POLLER NOTE BEFORE Q. 13a)*

99. Don't know *(SKIP TO POLLER NOTE BEFORE Q. 13a)*

Other *(SPECIFY)* ____

12. (B 3) Of all the sources you mentioned, which did you find most useful in helping you decide to participate in the program?

____

____

____

97. None in particular

98. Prefer not to answer

99. Don't know

<u>SECTION C</u>

POLLER NOTE:

If Respondent's answer to Q. 9 was:
***Together as one project, prefer not to answer, or don't know* then READ:**

"For the remainder of this survey we will refer to your equipment upgrades collectively as a single project.

If Respondent's answer Q. 9 was:
***Separately*, READ:**

"For the remainder of this survey we will refer only to the project where you installed [MEASURE_1]

POLLER NOTE: WAS MEASURE INSTALLED?

1. **Yes (GO TO Q. 13a)**
2. **No (GO TO Q. 13b)**

13a. (C 1) Did the equipment that your firm installed replace existing equipment?

1. Yes (i.e. all equipment was replacing old equipment) *(SKIP TO Q. 14a)*
2. Some equipment was a replacement and some was a new addition *(SKIP TO Q. 14a)*
3. No (i.e. all equipment was an addition to existing equipment*) (SKIP TO INTRO TO Q. 17)*
4. Prefer not to answer *(SKIP TO INTRO TO Q. 17)*
5. Don't know *(SKIP TO INTRO TO Q. 17)*

13b. (C 1) Is the equipment that your firm purchased intended to replace existing equipment?

1. Yes (i.e. all equipment is replacing old equipment) *(SKIP TO Q. 14b)*
2. Some equipment is a replacement and some was a new addition *(SKIP TO Q. 14b)*
3. No (i.e. all equipment is an addition to existing equipment) *(SKIP TO INTRO TO Q. 17)*
4. Prefer not to answer *(SKIP TO INTRO TO Q. 17)*
5. Don't know *(SKIP TO INTRO TO Q. 17)*

14a. (C 2) Was the replaced equipment…*(READ CATEGORIES)*

1. Fully functional and not in need of repair? *(SKIP TO Q. 15a)*
2. Functional, but needed minor repairs? *(SKIP TO Q. 15a)*
3. Functional, but needed major repairs? *(SKIP TO Q. 15a)*
4. Not functional? *(SKIP TO INTRO TO Q. 17)*
5. Prefer not to answer *(DO NOT READ) (SKIP TO INTRO TO Q. 17)*
6. Don't know *(DO NOT READ) (SKIP TO INTRO TO Q. 17)*

14b. (C 2) Is the equipment you intend to replace*…(READ CATEGORIES)*

1. Fully functional and not in need of repair? *(SKIP TO Q. 15b)*
2. Functional, but needed minor repairs? *(SKIP TO Q. 15b)*
3. Functional, but needed major repairs? *(SKIP TO Q. 15b)*
4. Not functional? *(SKIP TO INTRO TO Q. 17)*
5. Prefer not to answer *(DO NOT READ) (SKIP TO INTRO TO Q. 17)*
6. Don’t know *(DO NOT READ) (SKIP TO INTRO TO Q. 17)*

15a. (C 3) About how old, in years, was the equipment prior to replacement? (Probe if necessary: Best guess is fine.)

____ _____ _____ (Record Years)

499. Prefer not to answer

500. Don’t know

ALL ANSWERS TO 15a GO TO Q. 16

15b. (C 3) About how old, in years, is the equipment you are replacing? (Probe if necessary: Best guess is fine.)

_____ _____ _____ (Record Years)

499. Prefer not to answer

500. Don’t know

ALL ANSWERS TO 15b. GO TO Q.16

16. (C 4) How much longer (in years) do you think your old equipment would have lasted if you had not replaced it? (Probe if necessary: Best guess is fine.)

1. Less than a year
2. 1 – 2 years
3. 3 – 5 years
4. 6 – 10 years
5. More than 10 years
6. Prefer not to answer
7. Don’t know

(C 5a-g) Next I will read a list of reasons your firm may have considered when you decided to conduct your project. For each one, please tell me if it was *not at all important, a little important, somewhat important, very important or extremely important*.

How important was… on your decision to conduct your project?

(RANDOMIZE)	*Extremely Important*	*Very Important*	*Somewhat Important*	*A little Important*	*Not important At All*	*Don't Know/ Won't Say*
17. (C5a) Reducing environmental impact of the business	5	4	3	2	1	6
18. (C5b) Upgrading out-of-date equipment	5	4	3	2	1	6
19. (C5c) Improving comfort at the business	5	4	3	2	1	6

POL

20. (C5d) Improving air quality	5	4	3	2	1	6
21. (C5e) Receiving the rebate	5	4	3	2	1	6

(Q21 NOT ASKED IF DIRECT INSTALL)

22. (C5f) Reducing energy bill amounts	5	4	3	2	1	6

POLLER NOTE: Did respondent answer Contractor in Q.7?

1. **Yes (CONTINUE TO Q. 23)**
2. **No (SKIP TO INTRO Q. 24)**

23. (C5g) The contractor recommendation	5	4	3	2	1	6

SECTION D (INTRO TO Q.24)

Next, I'm going to ask a few questions about your decision to participate in the program, and choose equipment that was energy efficient

(D 1A-N). I'm going to ask you to rate the importance of each of the following factors on your decision to determine how energy efficient your project would be. Please rate the importance of each of these factors in determining your project's energy efficiency level using a scale from 0 to 10, where 0 means *not at all important* and 10 means *extremely important.* Please let me know if the factor is not applicable.

First I would like to read you some factors related to the rebate program itself.

POLLER NOTE: Did respondent answer Contractor in Q.7?

1. **Yes (CONTINUE TO Q. 24)**
2. **No (CIRCLE [12 N/A] ON Q. 24 AND SKIP TO Q. 25)**

How important was (read below)…in determining how energy efficient your project would be?

(RANDOMIZE)
N/A

								Not at all Important		*DK/ WS*	
Program Factors											
24. (D1A) The contractor who performed the work........		07	06	05	04	03	02	01	00	11	12
25. (D1B) The dollar amount of the rebate........		07	06	05	04	03	02	01	00	11	12
26. (D1C) Technical assistance received from SPS staff........		07	06	05	04	03	02	01	00	11	12
27. (D1D) Endorsement or recommendation by your SPS account manager or other SPS staff........		07	06	05	04	03	02	01	00	11	12
28. (D1E) Information from SPS marketing or informational materials........		07	06	05	04	03	02	01	00	11	12
29. (D1F) Previous participation in a SPS program........		07	06	05	04	03	02	01	00	11	12
30. (D1G) Endorsement or recommendation by a contracto		07	06	05	04	03	02	01	00	11	12

31. (D1H) Endorsement or recommendation by a vendor or distributor..........10 .... 09..... 08..... 07..... 06 ..... 05 .... 04..... 03..... 02 ... 01 ... 00 ... 11 12

32. (D1I) Endorsement or recommendation by CLEAR Result, the program implementer..........10 .... 09..... 08..... 07..... 06 ..... 05 .... 04..... 03..... 02 ... 01 ... 00 ... 11 12

Now, I would like to read you some factors that are not related to the rebate program. Using the same scale from 0 to 10, where 0 means *not at all important* and 10 means *extremely important,* please rate the following non program factors importance in determining your project's energy efficiency.

How important was (read below)…..in determining your project's energy efficiency?

(RANDOMIZE)	*Extremely Important*										*Not at all Important*	*DK/ WS*	*N/A*
Non-program Factors													
33. (D1J) The age or condition of the old equipment	10	09	08	07	06	05	04	03	02	01	00	11	12
34. (D1K) Corporate policy or guidelines	10	09	08	07	06	05	04	03	02	01	00	11	12
35. (D1L) Minimizing operating cost	10	09	08	07	06	05	04	03	02	01	00	11	12
36. (D1M) Scheduled time for routine maintenance	10	09	08	07	06	05	04	03	02	01	00	11	12

37. (D2) Of the items I just asked you about, think of the program factors as relating to assistance provided by the utility, such as the rebate, marketing from SPS, recommendation by a contractor and technical assistance from SPS. I also asked you about some non-program factors, which included the age and condition of the old equipment, company policy, operating costs and routine maintenance.

If you had to divide 100% of the influence on your decision to determine how energy efficient your new equipment would be between the SPS program and non-program factors, what percent would you give to the importance of the program factors? [IF NEEDED: Again, these are things like the rebate, marketing from SPS, recommendation by a contractor and technical assistance from SPS]

____ ____ _____ % = Program Factors

499. Prefer not to answer *(SKIP TO Q.39)*

500. Don't know *(SKIP TO Q. 39)*

38. D3. And what percent would you give to the importance of the non-program factors? (IF NEEDED: These include things like the age and condition of the old equipment, company policy, operating costs and routine maintenance.)

_____ _____ _____ %= Non Program Factors

499. Prefer not to answer *(SKIP TO Q.39)*

500. Don't know *(SKIP TO Q.39)*

POLLER NOTE: ENSURE ANSWERS TO Q. 37 AND Q. 38 EQUAL 100%

39. (D 5) Did you first learn about the [REBATE_PROGRAM] program BEFORE or AFTER you decided how energy efficient your equipment would be?

1. Before
2. After
3 Prefer not to answer
4. Don't know

40. (D6) Using a scale from 0 to 10, where 0 means *not at all likely* and 10 means *extremely likely*, please rate the likelihood that you would have installed the same equipment with the exact same level of energy efficiency if the [REBATE_PROGRAM] program was not available.

Extremely Likely			*Not at all Likely*	*DK/ WS*
	10 ....09 08	07.......06 ....05 .... 04.........03	02 .... 01............00	
	GO TO Q. 41	**SKIP TO Q. 43**	**GO TO Q. 42**	

POLLER NOTE: IF ANSWER TO Q. 40 IS 8 OR HIGHER AND ANY RESPONSE TO Q. 24-Q.32 IS 8 OR HIGHER, THEN GO TO Q. 41. IF ANSWER TO Q. 40 IS 2 OR LESS AND ANY RESPONSE TO Q.24-Q.32 IS 2 OR LESS THEN GO TO Q. 42.

41. (D7) You just rated your likelihood to install the same equipment without any assistance from the program as a(n) [RATE RESPONSE FROM Q. 40] out of 10. Earlier, when I asked you to rate the importance of each program factor on your decision, the highest rating you gave was a [HIGHEST RATING FROM Q.24-Q.32] out of 10 for the importance of [RE-READ WORDING FOR HIGHEST RESPONSES Q.24-Q.32, PAGE 10].

Can you briefly explain why you were likely to install the equipment without the program but also rated the program factors as highly influential in your decision?
(RECORD VERBATIM)

____

____

____

____

(SKIP TO Q. 43)

42. (D8) You just rated your likelihood to install the same equipment without any assistance from the program as a(n) [RATE RESPONSE FROM Q. 40] out of 10. Earlier, when I asked you to rate the importance of each program factor on your decision, the highest rating you gave was a [LOWEST RATING FROM Q.24-Q.32, Page 10] out of 10.

Can you briefly explain why you said you were not likely to install the equipment without help from the program, yet did not rate the program as highly influential in your decision? *(RECORD VERBATIM)*

____

____

____

____

43. (D 9) If the [REBATE_PROGRAM] program was not available, would you have delayed starting the project to a later date?

1. Yes
2. No *(SKIP TO INTRO TO Q. 46)*
3. Would not have done the project at all *(SKIP TO INTRO TO Q. 46)*
4. Prefer not to answer *(SKIP TO INTRO TO Q. 46)*
5. Don't know *(SKIP TO INTRO TO Q. 46)*

44. (D10) Approximately how much later would you have done the project if the [REBATE_PROGRAM] program was not available? Would it have been…
(READ CATEGORIES)

1. Within one year
2. Between 12 months and less than 2 years *(SKIP TO INTRO TO Q. 46)*
3. Between 2 years and 3 years *(SKIP TO INTRO TO Q. 46)*
4. Greater than 3 years *(SKIP TO INTRO TO Q. 46)*
5 Or would you not have installed the equipment at all *(SKIP TO INTRO TO Q. 46)*
6. Prefer not to answer *(SKIP TO INTRO TO Q. 46)*
7. Don't know *(SKIP TO INTRO TO Q. 46)*

45. (D11) Using a scale from 0 to 10, where 0 means *not at all likely* and 10 means *extremely likely*, please rate the likelihood that you would have conducted this project within 12 months of when you actually completed this project if the [REBATE_PROGRAM] program was not available.

Extremely *Not at all DK/*
Likely *Likely WS*

10 ....09 ....08 .... 07.......06 ....05 .... 04.........03 ....02 .... 01..... 00 11

SECTION E

Now I have some questions about your satisfaction with various aspects of SPS and the [REBATE_PROGRAM] program.

(E 1A-K). For each of the following, please tell me if you were *very dissatisfied, somewhat dissatisfied, neither satisfied nor dissatisfied, somewhat satisfied or very satisfied*.

46. (E1A) SPS as an energy provider

1. Very Dissatisfied
2. Somewhat Dissatisfied
3. Neither Satisfied Nor Dissatisfied
4. Somewhat Satisfied *(SKIP TO Q. 48)*
5. Very Satisfied *(SKIP TO Q. 48)*
6. Not applicable *(SKIP TO Q. 48)*
7. Prefer not to answer *(SKIP TO Q. 48)*
8. Don't know *(SKIP TO Q. 48)*

47. Can you tell me why you gave that rating? *(RECORD VERBATIM)*

____

____

____

48. (E1B) The rebate program overall

1. Very Dissatisfied
2. Somewhat Dissatisfied
3. Neither Satisfied Nor Dissatisfied
4. Somewhat Satisfied *(SKIP TO Q.50)*
5. Very Satisfied *(SKIP TO Q.50)*
6. Not applicable *(SKIP TO Q.50)*
7. Prefer not to answer *(SKIP TO Q.50)*
8. Don't know *(SKIP TO Q.50)*

49. Can you tell me why you gave that rating? *(RECORD VERBATIM)*

____

____

50. (E1C) The equipment installed through the program

1. Very Dissatisfied
2. Somewhat Dissatisfied
3. Neither Satisfied Nor Dissatisfied
4. Somewhat Satisfied *(SKIP TO Q.52)*
5. Very Satisfied *(SKIP TO Q.52)*
6. Not applicable *(SKIP TO Q.52)*
7. Prefer not to answer *(SKIP TO Q.52)*
8. Don't know *(SKIP TO Q. 52)*

51. Can you tell me why you gave that rating? *(RECORD VERBATIM)*

____

____

____

52. (E1D) The contractor who installed the equipment

1. Very Dissatisfied
2. Somewhat Dissatisfied
3. Neither Satisfied Nor Dissatisfied
4. Somewhat Satisfied *(SKIP TO Q.54)*
5. Very Satisfied *(SKIP TO Q.54)*
6. Not applicable *(SKIP TO Q.54)*
7. Prefer not to answer *(SKIP TO Q.54)*
8. Don't know *(SKIP TO Q.54)*

53. Can you tell me why you gave that rating? *(RECORD VERBATIM)*

____

____

____

54. (E1E) The overall quality of the equipment installation

1. Very Dissatisfied
2. Somewhat Dissatisfied
3. Neither Satisfied Nor Dissatisfied
4. Somewhat Satisfied *(SKIP TO Q.56)*
5. Very Satisfied *(SKIP TO Q.56)*
6. Not applicable *(SKIP TO Q.56)*
7. Prefer not to answer *(SKIP TO Q.56)*
8. Don't know *(SKIP TO Q.56)*

55. Can you tell me why you gave that rating? *(RECORD VERBATIM)*

____

____

____

(Q56-59 NOT ASKED IF DIRECT INSTALL)

56. (E1F) The amount of time it took to receive your rebate for your equipment

1. Very Dissatisfied
2. Somewhat Dissatisfied
3. Neither Satisfied Nor Dissatisfied
4. Somewhat Satisfied *(SKIP TO Q.58)*
5. Very Satisfied *(SKIP TO Q.58)*
6. Not applicable *(SKIP TO Q.58)*
7. Prefer not to answer *(SKIP TO Q.58)*
8. Don't know *(SKIP TO Q.58)*

57. Can you tell me why you gave that rating? *(RECORD VERBATIM)*

____

____

____

58. (E1G). The dollar amount of the rebate for the equipment

1. Very Dissatisfied
2. Somewhat Dissatisfied
3. Neither Satisfied Nor Dissatisfied
4. Somewhat Satisfied *(SKIP TO Q.60)*
5. Very Satisfied *(SKIP TO Q.60)*
6. Not applicable *(SKIP TO Q.60)*
7. Prefer not to answer *(SKIP TO Q.60)*
8. Don't know *(SKIP TO Q.60)*

59. Can you tell me why you gave that rating? *(RECORD VERBATIM)*

____

____

____

60. (E1H) Interactions with SPS

1. Very Dissatisfied
2. Somewhat Dissatisfied
3. Neither Satisfied Nor Dissatisfied
4. Somewhat Satisfied *(SKIP TO Q.62)*
5. Very Satisfied *(SKIP TO Q.62)*
6. Not applicable *(SKIP TO Q.62)*
7. Prefer not to answer *(SKIP TO Q.62)*
8. Don't know *(SKIP TO Q.62)*

61. Can you tell me why you gave that rating? *(RECORD VERBATIM)*

____

____

____

62. (E1I) The overall value of the equipment your company received for the price you paid

1. Very Dissatisfied
2. Somewhat Dissatisfied
3. Neither Satisfied Nor Dissatisfied
4. Somewhat Satisfied *(SKIP TO Q.64)*

5. Very Satisfied *(SKIP TO Q.64)*
6. Not applicable *(SKIP TO Q.64)*
7. Prefer not to answer *(SKIP TO Q.64)*
8. Don't know (SKIP TO Q.64)

63. Can you tell me why you gave that rating? *(RECORD VERBATIM)*

____

____

____

64. (E1J) The amount of time and effort required to participate in the program

1. Very Dissatisfied
2. Somewhat Dissatisfied
3. Neither Satisfied Nor Dissatisfied
4. Somewhat Satisfied *(SKIP TO Q.66)*
5. Very Satisfied *(SKIP TO Q.66)*
6. Not applicable *(SKIP TO Q.66)*
7. Prefer not to answer *(SKIP TO Q.66)*
8. Don't know *(SKIP TO Q.66)*

65. Can you tell me why you gave that rating? *(RECORD VERBATIM)*

____

____

____

(Q66 and Q67 NOT ASKED IF DIRECT INSTALL)

66. (E1K) The project application process

1. Very Dissatisfied
2. Somewhat Dissatisfied
3. Neither Satisfied Nor Dissatisfied *(SKIP TO Q.68)*
4. Somewhat Satisfied *(SKIP TO Q.68)*
5. Very Satisfied *(SKIP TO Q.68)*
6. Not applicable *(SKIP TO Q.68)*
7. Prefer not to answer *(SKIP TO Q.68)*
8. Don't know *(SKIP TO Q.68)*

67. Can you tell me why you gave that rating? *(RECORD VERBATIM)*

____

____

____

68. (E2) Do you have any recommendations for improving the [REBATE_PROGRAM] program?

01. Yes *(RECORD VERBATIM)*

____

____

____

97. No
98 Prefer not to answer
99. Don't know

69. (E 3) On a scale from 0 to 10, where 0 is "not at all likely" and 10 is "very likely," how likely is it that you would recommend the [REBATE_PROGRAM] to a colleague or professional contact?

Extremely Likely									*Not at all Likely*	*DK/ WS*
	08	07	06	05	04	03	02	01	00	11

97. Have already recommended the program *(SKIP TO Q. 71)*
98. Prefer not to answer *(SKIP TO Q. 71)*
99. Don't know *(SKIP TO Q. 71)*

70. (E 3a). Can you tell me why you gave that rating? (RECORD VERBATIM)

____

____

____

98 Prefer not to answer
99. Don't know

SECTION: CHARACTERISTICS AND DEMOGRAPIHCS

71. (Gen 1) Finally, I have a few questions about your firm for classification purposes only. Do you own or lease your building where the project was completed?

01. Own
02. Lease / Rent
03. Prefer not to answer *(SKIP TO Q. 73)*
99. Don't know *(SKIP TO Q. 73)*

Other *(SPECIFY)* ____

72. (Gen1a) Does your firm pay your SPS bill, or does someone else (e.g., a landlord)?

1. Pay own
2. Someone else pays
3. Prefer not to answer
4. Don't know

73. (Gen2) Approximately what is the total square footage of the building where the project was completed? (READ CATEGORIES IF NEEDED)

1. Less than 1,000 square feet
2. Between 1,000 and 1,999 square feet
3. Between 2,000 and 4,999 square feet
4. Between 5,000 and 9,999 square feet
5. Between 10,000 and 49,999 square feet
6. Between 50,000 and 99,999 square feet
7. 100,000 square feet or more
8. Prefer not to answer *(DO NOT READ)*
9. Don't know *(DO NOT READ)*

74. (Gen3) Approximately what year was your firm's building built? (READ CATEGORIES IF NEEDED)

1. 1939 or earlier
2. 1940 to 1949
3. 1950 to 1959
4. 1960 to 1969
5. 1970 to 1979
6. 1980 to 1989

7. 1990 to 1999
8. 2000 to 2009
9. 2010 and later
10. Prefer not to answer *(DO NOT READ)*
11. Don't know *(DO NOT READ)*

75. (Gen4) Approximately, How many full-time equivalent (FTE) employees does your company currently have in the state of New Mexico?

1. Less than 5
2. 5-9
3. 10-19
4. 20 - 49
5. 50 - 99
6. 100 - 249
7. 250 - 499
8. 500 - 999
9. 1,000 - 2,500
10. More than 2,500
11. Prefer not to answer
12. Don't know

76. (Gen5) And this is my last question. How long has your company been in business? (Poller : Please be specific, by writing in months and years.)

____

98. Prefer not to answer
99. Don't know

THIS CONCLUDES OUR SURVEY. THANK YOU FOR YOUR TIME. HAVE A GOOD DAY.

NOTE TO INTERVIEWER, WAS RESPONDENT:

1. Male
2. Female

Unique ID #:______ ______ ______

Respondent's Phone Number:__________________________________

Interviewer's Name:____

Interviewer's Code:____

Appendix B – Residential Cooling Participant Survey Instrument

Hello, my name is (*YOUR NAME*) from Research & Polling, Inc. I am calling on behalf of Southwestern Public Service Company (SPS). May I please speak with _______________?

A. (Once correct respondent is reached) Hello, my name is (*YOUR NAME*) from Research & Polling, Inc. I am calling on behalf of SPS.

I'm calling because our records show that you recently completed an energy efficiency project at your home located at [SITE_ADDRESS] and received from SPS. I'd like to ask a short set of questions about your experience with this rebate program. Your time will help us improve this program for other customers like you. Are you the best person to talk to about these energy efficiency upgrades and energy use in your home?

1. Yes
2. No (Ask, Who would be the best person to talk to about the energy efficiency upgrades and energy use in your home? (REPEAT INTRO WHEN CORRECT PERSON COMES ON LINE; ARRANGE CALLBACK IF NECESSARY)
3. Never installed *(VOLUNTEERED SKIP TO Q.4)*

(IF NEEDED) SPS would like to better understand how residential customers like you think about and manage their energy use. The SPS rebate program is designed to help customers with saving energy and money. Your input is very important to help SPS improve its energy rebate programs.

B. (S1) Our records show that you received a rebate from SPS for installing a [HEATING/COOLING SYSTEM] at your home at [SITE_ADDRESS]. And this was done in approximately [MONTH, YEAR]. Is this correct?

1. Yes
2. No *(THANK AND TERMINATE)*
3. Don't know *(THANK AND TERMINATE)*

C. (S2) Do you recall that your new [HEATING/COOLING SYSTEM] included the installation of a variable speed motor?

1. Yes *(SKIP TO Q. 1)*
2. No
3. Don't know

D. (S3) Do you recall whether the HVAC contractor discussed the efficiency options available for the new motor for your [HEATING/COOLING SYSTEM]?

1. Yes
2. No *(THANK AND TERMINATE)*
3. Don't know *(THANK AND TERMINATE)*

E. **(S4) What do you remember the contractor mentioning about the efficiency options for the new motor?** *(RECORD VERBATIM AND THEN THANK AND TERMINATE)*

____

____

____

THANK AND TERMINATE

SECTION A

As I go through these questions, please remember that while you may have completed other projects at the same time as your efficient equipment, for today we are only focused on the variable speed motor installed as part of your [HEATING/COOLING SYSTEM] upgrade.

4. **(A 1) Just to confirm, our records show that you received a rebate from SPS when you installed a variable speed motor at your home at [SITE_ADDRESS]. And this was done in approximately [MONTH, YEAR]. Is this correct?**
   1. Yes
   2. No *(THANK AND TERMINATE)*
   3. Don't know *(THANK AND TERMINATE)*

5. **(A 2) Is the variable speed motor still installed?**
   1. Yes *(SKIP TO Q. 5)*
   2. No *(CONTINUE TO Q. 3)*
   3. Prefer not to answer *(SKIP TO Q. 5)*
   4. Don't know *(SKIP TO Q. 5)*

3. **(A 3) Was the variable speed motor removed or never installed?**

   01. Removed

   02 Never Installed

   03. Prefer not to answer *(SKIP TO INTRO TO Q.6)*

   99. Don't know *(SKIP TO INTRO TO Q.6)*

   Other *(SPECIFY)* ______________________________________ *(SKIP TO INTRO TO Q.6)*

4. **(A3a) Why was the variable speed motor removed/never installed?** *(OPEN VERBATIM)*

   ____

   ____

   ____

   (SKIP TO INTRO TO Q.6)

5. **(A 4) Is the variable speed motor still functioning properly?**
    1. Yes
    2. No
    3. Prefer not to answer *(DO NOT READ)*
    4. Don't know *(DO NOT READ)*

Section C: Motivations for Participation

(C 1) Next I will read a list of reasons you may have considered when you decided to install a variable speed motor. For each one, please tell me if it was *not at all important, a little important, somewhat important, very important or extremely important*.

How important was…on your decision to upgrade to a variable speed motor?

(RANDOMIZE)	*Extremely Important*	*Very Important*	*Somewhat Important*	*A little Important*	*Not imp At All*	*Don;t Know*	*Prefer not to answer*	*N/A*
6. (C1a) Reducing environmental impact of your home	**5**	**4**	**3**	**2**	**1**	**6**	**7**	**8**
7. (C1b) Upgrading out-of-date equipment	**5**	**4**	**3**	**2**	**1**	**6**	**7**	**8**
8. (C1c) Improving comfort of your home	**5**	**4**	**3**	**2**	**1**	**6**	**7**	**8**
9. (C1d) Improving air quality	**5**	**4**	**3**	**2**	**1**	**6**	**7**	**8**
10. (C1e) Receiving financial incentive	**5**	**4**	**3**	**2**	**1**	**6**	**7**	**8**
11. (C1f) Reducing energy bill amounts	**5**	**4**	**3**	**2**	**1**	**6**	**7**	**8**
12. (C1g) The contractor recommendation	**5**	**4**	**3**	**2**	**1**	**6**	**7**	**8**

13. **(C 2) Were there any other reasons that you installed the variable speed motor that were more important than the ones we have mentioned?**

    Yes. (Ask what those reasons were and record response)

    ____

    ____

    ____

97. No, none in particular

98. Prefer not to answer

99. Don't know

14. **(C 3) What impacts or effects have you experienced as a result of the variable speed motor that was installed?** PROBE… **Are there any others?**
(DO NOT READ CATEGORIES) (TAKE UP TO 5 RESPONSES)

01. Improved the comfort of your home

02. Reduced energy bills

03. Improved safety

97. No impacts or effects

98. Prefer not to Answer

99. Don't know

Other *(SPECIFY)* ____

SECTION D CUSTOMER DECISION MAKING PROCESS, FREE-RIDERSHIP

Next, I'm going to ask a few questions about your decision to participate in the SPS rebate program, and to install a variable speed motor.

15. **(D 2) Before participating in the SPS rebate program, do you recall receiving any other rebates from SPS for making energy efficiency upgrades at your home?**

1. Yes
2. No
3. Prefer not to answer
4. Don't know

16. **(D 3). Thinking of the variable speed motor installed as part of your [HEATING/COOLING SYSTEM] upgrade, how influential was any encouragement you saw from SPS to consider a more efficient motor in your decision to upgrade to a variable speed motor? Would you say it was….** *(READ CATEGORIES)*

1. Not at all influential
2. Slightly influential
3. Somewhat influential
4. Very influential
5. Extremely influential
6. Prefer not to answer *(DO NOT READ)*
7. Don't know *(DO NOT READ)*

17. **(D 4) How influential was the availability of the rebate from SPS on your decision to install the variable speed motor? Would you say it was…** *(READ CATEGORIES):*

1. Not at all influential
2. Slightly influential
3. Somewhat influential
4. Very influential
5. Extremely influential
6. Prefer not to answer *(DO NOT READ)*
7. Don't know *(DO NOT READ)*

18. (D 5) And how influential was the contractor recommendation on your decision to install the variable speed motor? Would you say it was…*(READ CATEGORIES)*

1. Not at all influential
2. Slightly influential
3. Somewhat influential
4. Very influential
5. Extremely influential
6. Prefer not to answer *(DO NOT READ)*
7. Don't know *(DO NOT READ)*

19. (D 6) Now, please think about all of the items we have talked about – information from SPS, rebates from SPS, and information from the contractor you used, together as a package. How influential was this package of customer support on your decision to install the new variable speed motor? Would you say it was…*(READ CATEGORIES)*

1. Not at all influential
2. Slightly influential
3. Somewhat influential
4. Very influential
5. Extremely influential
6. Prefer not to answer *(DO NOT READ)*
7. Don't know *(DO NOT READ)*

20. (D 7) Still thinking about this same package of customer support and rebate, if this package had not existed, do you think you would have….*(READ CATEGORIES)*

1. Installed the same exact motor
2. Installed a similarly energy-efficient motor
3. Installed a less energy efficient motor
4. Not installed a new motor yet
5. Prefer not to answer *(DO NOT READ)*

6. Don't know *(DO NOT READ)*

21. **(D 8) Now I would like you to think about the timing of the project. If this SPS consumer support and rebate package did not exist, do you think you would have installed this variable speed motor….***(READ CATEGORIES*)

    1. About the same time as you did
    2. In a year or two
    3. Three or four years from now
    4. Longer than four years from now
    5. Prefer not to answer *(DO NOT READ)*
    6. Don't know *(DO NOT READ)*

22. **(D 9) In your own words, how would you describe the influence the package of customer support from SPS had on your decision to install the new variable speed motor?** (RECORD VERBATIM)

SECTION E Program Implementation and Delivery

Now I have some questions about the program processes.

23. **(E 1) About how long did it take to receive your rebate after the project was completed?** (DO NOT READ CATEGORIES)

    1. 1 week or less
    2. More than a week, but less than 1 month
    3. 1 or 2 months
    4. More than 2 months
    5. HAVE NOT RECEIVED REBATE YET
    6. Prefer not to answer
    7. Don't know

24. **(E 2) Did you contact the contractor, or did a contractor contact you and suggest the [HEATING/COOLING SYSTEM] upgrade that included a variable speed motor**? (INTERVIEWER NOTE: This could be any contractor with whom the customer discussed the project they did; not just the one who did the work)

    01. We contacted a contractor about this project
    02. A contractor contacted us (SKIP TO Q.26)
    03. Prefer not to answer (SKIP TO Q.26)

04. Do not recall/don't know (SKIP TO Q.26)

Other *(SPECIFY)* ____

25. (E 3) How did you find the contractor or contractors you called?
(DO NOT READ CATEGORIES)

01. Referral, word of mouth, friends or family
02. Online resource (Angie's List, Yelp, etc.)
03. Utility Website
04. Prefer not to answer
05. Do not recall/don't know

Other *(SPECIFY)* ____

26. (E 4) Did the contractor you selected talk with you about different options for your [HEATING/COOLING SYSTEM] motor, or was the conversation always just about the variable speed motor?

1. Different options
2. Variable speed motor only
3. Don't know

SECTION F Program Satisfaction

Now I have some questions about your satisfaction with various aspects of the program.

(F 2a-h). For each of the following, please tell me if you were *very dissatisfied, somewhat dissatisfied, neither satisfied nor dissatisfied, somewhat satisfied or very satisfied*.

27. (F1a) SPS as an energy provider

1. Very Dissatisfied
2. Somewhat Dissatisfied
3. Neither Satisfied Nor Dissatisfied
4. Somewhat Satisfied *(SKIP TO Q. 29)*
5. Very Satisfied *(SKIP TO Q. 29)*
6. Not applicable *(SKIP TO Q. 29)*
7. Prefer not to answer *(SKIP TO Q. 29)*
8. Don't know *(SKIP TO Q. 29)*

28. Can you tell me why you gave that rating? *(RECORD VERBATIM)*

____

29. (F1b) The rebate program overall

1. Very Dissatisfied
2. Somewhat Dissatisfied
3. Neither Satisfied Nor Dissatisfied
4. Somewhat Satisfied *(SKIP TO Q.31)*
5. Very Satisfied *(SKIP TO Q.31)*
6. Not applicable *(SKIP TO Q.31)*
7. Prefer not to answer *(SKIP TO Q.31)*
8. Don't know *(SKIP TO Q.31)*

30. Can you tell me why you gave that rating? *(RECORD VERBATIM)*

31. (F1c) The variable speed motor installed through the program

1. Very Dissatisfied
2. Somewhat Dissatisfied
3. Neither Satisfied Nor Dissatisfied
4. Somewhat Satisfied *(SKIP TO Q.33)*
5. Very Satisfied *(SKIP TO Q.33)*
6. Not applicable *(SKIP TO Q.33)*
7. Prefer not to answer *(SKIP TO Q.33)*
8. Don't know *(SKIP TO Q.33)*

32. Can you tell me why you gave that rating? *(RECORD VERBATIM)*

33. (F1d) The contractor who installed the variable speed motor

1. Very Dissatisfied

2. Somewhat Dissatisfied
3. Neither Satisfied Nor Dissatisfied
4. Somewhat Satisfied *(SKIP TO Q.35)*
5. Very Satisfied *(SKIP TO Q.35)*
6. Not applicable *(SKIP TO Q.35)*
7. Prefer not to answer *(SKIP TO Q.35)*
8. Don't know *(SKIP TO Q.35)*

34. Can you tell me why you gave that rating? *(RECORD VERBATIM)*

____

____

____

35. (F1e) The amount of time it took to receive your rebate for your variable speed motor

1. Very Dissatisfied
2. Somewhat Dissatisfied
3. Neither Satisfied Nor Dissatisfied
4. Somewhat Satisfied *(SKIP TO Q.37)*
5. Very Satisfied *(SKIP TO Q.37)*
6. Not applicable *(SKIP TO Q.37)*
7. Prefer not to answer *(SKIP TO Q.37)*
8. Don't know *(SKIP TO Q.37)*

36. Can you tell me why you gave that rating? *(RECORD VERBATIM)*

____

____

____

37. (F1f). The dollar amount of the rebate for the variable speed motor

1. Very Dissatisfied
2. Somewhat Dissatisfied
3. Neither Satisfied Nor Dissatisfied
4. Somewhat Satisfied *(SKIP TO Q.39)*
5. Very Satisfied *(SKIP TO Q.39)*

6. Not applicable *(SKIP TO Q.39)*
7. Prefer not to answer *(SKIP TO Q.39)*
8. Don't know *(SKIP TO Q.39)*

38. Can you tell me why you gave that rating? *(RECORD VERBATIM)*

____

____

____

39. (F1g) Interactions with SPS regarding this project

1. Very Dissatisfied
2. Somewhat Dissatisfied
3. Neither Satisfied Nor Dissatisfied
4. Somewhat Satisfied *(SKIP TO Q.41)*
5. Very Satisfied *(SKIP TO Q.41)*
6. Not applicable *(SKIP TO Q.41)*
7. Prefer not to answer *(SKIP TO Q.41*
8. Don't know *(SKIP TO Q.41)*

40. Can you tell me why you gave that rating? *(RECORD VERBATIM)*

____

____

____

41. (F1h) The overall value of the variable speed motor you received for the price you paid

1. Very Dissatisfied
2. Somewhat Dissatisfied
3. Neither Satisfied Nor Dissatisfied
4. Somewhat Satisfied *(SKIP TO Q.43)*
5. Very Satisfied *(SKIP TO Q.43)*
6. Not applicable *(SKIP TO Q.43)*
7. Prefer not to answer *(SKIP TO Q.43)*
8. Don't know (SKIP TO Q.43)

42. Can you tell me why you gave that rating? *(RECORD VERBATIM)*

____

____

____

43. (F2) Do you have any recommendations for improving the SPS program?

01. Yes *(RECORD VERBATIM)*

____

____

____

97. No
98 Prefer not to answer
99. Don't know

<u>**SECTION GEN: CHARACTERISTICS AND DEMOGRAPIHCS**</u>

44. (Gen 1) Finally, I have a few questions about your household for classification purposes only. Do you own or lease your building where the variable speed motor was installed?

01. Own (SKIP TO Q. 46)
02. Lease / Rent
03. Prefer not to answer
99. Don't know

Other *(SPECIFY)* ____

45. (Gen1a) Do you pay your SPS bill, or does someone else (e.g., a landlord)?

1. Pay own
2. Someone else pays
3. Prefer not to answer
4. Don't know

46. (Gen2) Is your home a single-family home or part of a multifamily building with more than one unit?

1. Single-family home (SKIP TO Q. 48)
2. More than one residence in building
88. Prefer not to answer (SKIP TO Q. 48)
99. Don't know (SKIP TO Q.48)

47. **(Gen2a) How many units are in the structure?** (Record number)

______ _____ ______

499. Prefer not to answer

500. Don't know

48. **(Gen3) Approximately what is the total square footage of your home?** (READ CATEGORIES IF NEEDED)

1. Less than 500 square feet
2. 500 to 749 square feet
3. 750 to 999 square feet
4. 1,000 to 1,499 square feet
5. 1,500 to 1,999 square feet
6. 2,000 to 2,499 square feet
7. 2,500 to 2,999 square feet
8. 3,000 to 3,999 square feet
9. 4,000 or more square feet
10. Prefer not to answer *(DO NOT READ)*
11. Don't know *(DO NOT READ)*

49. **(Gen4) Approximately what year was your home built?** (READ CATEGORIES IF NEEDED)

1. 1939 or earlier
2. 1940 to 1949
3. 1950 to 1959
4. 1960 to 1969
5. 1970 to 1979
6. 1980 to 1989
7. 1990 to 1999
8. 2000 to 2009
9. 2010 and later
10. Prefer not to answer *(DO NOT READ)*
11. Don't know *(DO NOT READ)*

50. **(Gen5) How many people live in your household?** (Record number)

______ _____

499. Prefer not to answer

500. Don't know

51. (Gen6) How long have you lived in this home?

1. Less than 6 years
2. 6 to 10 years
3. 11 to 15 years
4. 16 to 20 years
5. 21 to 25 years
6. 26 to 30 years
7. More than 30 years
8. Prefer not to answer
9. Don't know

THIS CONCLUDES OUR SURVEY. THANK YOU FOR YOUR TIME. HAVE A GOOD DAY.

NOTE TO INTERVIEWER, WAS RESPONDENT:

1. Male
2. Female

Unique ID #:_____ _____ _____

OPPORTUNITY ID#____________________________________

Respondent's Phone Number:________________________________

Interviewer's Name:____

Interviewer's Code:____

Appendix C – Residential Cooling Contractor Interview Guide

Background Information to Retrieve during Interview Prep

Contact Person	**Project Information**
Name	Utility
Title / Role	Program
Company	Number of Projects Completed
Contact Info	Calendar Year

Introduction

Talking points for recruitment

- Evergreen Economics is conducting an evaluation of utility energy efficiency programs for the New Mexico Public Regulation Commission and Xcel Energy
- We are contacting HVAC contractors who conducted HVAC system installations that included an EC motor and were rebated by Xcel Energy's rebate program in 2017 for brief telephone interviews; our records show that your company conducted some of these projects in 2017.
- You were listed as the contact for your company. Are you the best person to discuss these HVAC installations and EC motors that were rebated by Xcel Energy and your organization's experiences with the rebate program? Or is there someone else involved in these installations who would better be able to answer questions?
- We would need about 15-20 minutes for the interview.
- Your responses will be anonymous, but will be very helpful in helping the state's utilities ensure their energy efficiency programs best serve their customers and the contractors that make these projects possible.
- When would be a good time to talk?

Talking points for starting the interview

- Identify self.

- Thank you for taking the time to talk your experience with the Xcel Energy rebate program.
- This should take about 15-20 minutes.
- Your responses will be anonymous, so please feel free to speak candidly.
- What we hear from you and other HVAC contractors will be helpful to the state's utilities to ensure their programs are achieving their goals.
- Do you have any questions before we begin?
- Would you feel comfortable if I record this call only for note taking purposes? We will not share the recording with anyone outside our company and will not attribute anything you say back to you.

Interview Guide

Section A: Company Overview

A1. To start, please tell me a bit about your company.

Probe, as needed:

- What kinds of services do you provide?
- What region do you serve?
- How long have you been in business?
- What is your role?

A2. What share of your work is HVAC installations in existing homes?

Probe, as needed:

- Has this changed over time?
- In what way?

Section B: Awareness

B1. How did you become aware of the EC Motor rebate?

Section C: Motivations/Barriers

C1. In what ways is the availability of the EC Motor rebate helpful to you in your business?

Probe, as needed:

- dollar amount of rebate
- ability to mention the connection with the Xcel Energy program
- Xcel Energy messaging to customers on benefits of heating/cooling upgrades

C2. Have there been any challenges in submitting applications for EC Motor rebates?

Probe:

- If so, what?
- What suggestions do you have to address those issues?

Section D: Program Role in Customer Interaction and Equipment Choices

D1. Next, I would be interested in hearing a little more about how your typical residential HVAC installations work beginning with that initial customer contact. How do you tend to find your residential HVAC customers?

[Listen for sales techniques: brochures, cold calls, ads, door to door, etc.]

Probe on:

- What are your customers usually trying to accomplish?
- Do they already know what type of system that they want?
- Are they aware of the Xcel Energy rebates?

D2. What are the main things you discuss with customers when they are considering a new HVAC system?

Listen for / probe on:

- one equipment spec or discuss various options?
- discuss efficiency ratings or not that technical?
- bottom line costs only or feature Xcel Energy rebate specifically?

Now I have some questions about the replacement of blower motors that may be done as part of the installation of a new HVAC system.

D3. Do you typically discuss replacement of the blower motor with your customers when doing an HVAC installation?

- If yes, what do you typically suggest for the replacement of the motor?

Probe on:

- Single speed or EC motor?
    - Why is that?

D4. Do customers typically know about the options available for their blower motor?

D5. How often do you mention the rebate for an EC motor to a customer installing a new HVAC system?

D6. [If the answer to D5 is more often than "never"] Are customers aware of the rebate available to them for installing an EC motor prior to you mentioning it?

D7. What role, if any, does the Xcel Energy rebate play in spurring the customer to install an EC motor?

D8. How likely do you think your customers would be to install an EC motor without the rebate? Please tell me on a scale from 0 to 10 where 0 is not at all likely and 10 is extremely likely.

D9. What else, if anything, could Xcel Energy do to help prep or prompt customers to install EC motors as part of a larger HVAC upgrade?

D10. Are there ever instances when you don't mention rebates during sales discussions with customers?

Probe on:

- In what situations?
- Why?

D11. Do you sell any eligible equipment without applying rebates? If so, why?

D12. Has participating in the Xcel Energy rebate program changed your approach to projects that are not rebated by the program?

D13. How likely would you be to promote EC motors if the Xcel Energy rebate program didn't exist? Please tell me on a scale from 0 to 10 where 0 is not at all likely and 10 is extremely likely.

D14. Do you think your sales of EC motors would be different if Xcel Energy didn't offer the rebate program?

- How so? (i.e. Would sales be higher or lower?)

- Can you estimate how much higher/lower you think sales would be, in terms of a percentage?

D15. Let's talk about the rebate application process itself. Do you fill out the application for the EC motor on behalf of the customer?

- Do you just complete the application for the customer or do you use the alternative rebate section so the payment goes to you to offset project costs?
- How does the rebate process work for you? Are there any changes you would like to see?

Section E: Satisfaction

E1. Finally, I'd like to ask about your and your customers' satisfaction with the Xcel Energy rebate program. Please rate your overall satisfaction with the program on a 1 to 5 scale where 1 is not satisfied and 5 is extremely satisfied.

[IF E1<5] What could Xcel Energy do to increase your satisfaction with the rebate program?

E2. Have you had any feedback from your customers about their experiences with the rebate program that you think Xcel Energy should know?

Section F: Closing

F1. Is there anything we didn't cover that you'd like to mention or discuss about your experiences with the Xcel Energy rebate program?

Thank you. Those are all the questions I have.

Appendix D – Saver's Stat Detailed Evaluation Methods and Findings

Saver's Stat is a smart thermostat demand response pilot offered to residential Southwestern Public Service (SPS) customers. To facilitate load control, participants must have a communicating smart thermostat installed in their home and connected to a central air conditioning unit. This device is capable of receiving internet based signals that aim to diminish air conditioning runtime by one of two methods. The first dispatch method is an approximation of duty cycling by keeping the compressor off for every 15 of each 30 minutes, e.g. cycling 50% of the time. The second dispatch method is enabled by raising the thermostat's set point, thereby reducing the need for the compressor to run—until the indoor temperature rises to the new set point. For Saver's Stat, temperature offset based dispatches raised thermostat set points by 4 degrees F during events. Such dispatch signals are typically sent on the hottest weekday afternoons of the summer, with the goal being to reduce peak demand. Residential participants receive a $2.50 bill credit for each demand response event they participate in. Thus, should SPS dispatch the target goal of 10 events per control season, participants can receive a maximum of $25 annually for their participation.

There were eight Saver's Stat events during the summer 2017 demand response (DR) season, which began June 1st and ended September 30th. Table 1 provides some information on these eight 2017 events. Note that the event start and end times are labeled Mountain Daylight Time (MDT), which would be the local prevailing time in SPS service territory during the summer DR season. All events began at 3 PM MDT and ended at 7 PM MDT.

Table 1: 2017 Saver's Stat Event Summary

Date	Day of Week	Start Time (MDT)	End Time (MDT)	Daily High at KROW (F)	Avg Temp 3-7pm at KROW (F)	Daily Avg Humidity at KROW (F)
16-Jun	Friday	3:00 PM	7:00 PM	106	103	31%
22-Jun	Thursday	3:00 PM	7:00 PM	107	102	51%
28-Jun	Wednesday	3:00 PM	7:00 PM	103	102	46%
29-Jun	Thursday	3:00 PM	7:00 PM	105	102	40%
10-Aug	Thursday	3:00 PM	7:00 PM	96	93	58%
15-Sep	Friday	3:00 PM	7:00 PM	94	90	46%
20-Sep	Wednesday	3:00 PM	7:00 PM	95	91	40%
21-Sep	Thursday	3:00 PM	7:00 PM	97	91	43%

To evaluate impacts for these eight events the Evergreen team used runtime interval data collected by the smart thermostats. Runtime intervals were converted to loads by applying connected load measurements from the 2016 evaluation to the runtime data. The interval loads were further combined with NOAA weather station data for Roswell Airport (KROW), central to the SPS territory. While the thermostats also collect local, more granular outdoor weather data the Roswell weather was used for the ex-post impact analysis to allow for consistency with the ex-ante peak impact estimate.

Table 2 summarizes our findings by dispatch group. Note that 21% of duty cycling devices and 16% of temperature offset devices were not active during events.[1] Because the analysis was conducted on data for active devices, an adjustment was applied to the impact estimates to arrive at estimated reduction per dispatched device. For example, because only 80% of duty cycling devices were active, the reduction per dispatched device was 0.50 kW, or 80% of the 0.63 kW reduction per active device. The key difference between the two dispatch groups is the variation in impact by event hour. Duty cycling impacts tapered off only slightly with each subsequent event hour so impacts in the first event hour are only about 15% lower than average event impacts. In contrast, temperature offset impacts are much higher in the first event hour than for subsequent hours, so impacts in the first event hour are about 55% higher than average event impacts.

Table 2: High Level Results

Dispatch Group	Avg Temp 3-7 PM at KROW (F)	Devices Dispatched	% of devices active	Reduction per active device (kW)		Reduction per dispatched device (kW)	
				Event avg	First hour of event	Event avg	First hour of event
Duty Cycling	97	259	79%	0.63	0.73	0.50	0.58
Temp Offset	97	275	84%	0.91	1.41	0.76	1.18

Changes in energy usage for summer months was also evaluated for Saver's Stat participants. However, no significant or detectable changes in summer energy usage were detected for Saver's Stat participants.

1 Saver's Stat Event Impacts

[1] Active devices refers to those connected or online during an event—including devices participating or opted-out—and excludes those that were offline.

The impact evaluation for the residential customers relied on a within-subjects approach to develop a baseline estimate for event days. This approach was necessary because no interval data was available to form a comparison group. Instead, load patterns on event-like days were used to select a weather based regression model, which was in turn used to calculate a baseline estimate for event days.

1.1 Evaluation Methodology

To estimate demand reductions on event days, the approach was based on runtime data obtained from participant thermostats. The raw data was recorded by the device manufacturer for active devices (those connected or online during a given interval)[2] in five minute intervals and showed the number of compressor runtime seconds in each interval. Runtime intervals were converted to kW by applying average compressor data collected during the 2016 Saver's Stat evaluation[3]. This detailed 5-minute interval data was converted to average runtime per hour was used for the load impact analysis.

To estimate impacts, loads from non-event days were used to develop event-day baseline estimates specific to each event day. Ex post impacts are simply the difference between observed hourly loads and the estimated baseline. Baseline accuracy was assessed using the following steps.

1. Identify event-like days and narrow dataset to these days;
2. Remove these days one at a time to create training datasets;
3. Use regression analysis to estimate reference loads;
4. Compare estimated reference loads to actual loads on validation days;
5. Compute metrics of bias, accuracy and precision; and
6. Assess estimation method based on performance across key metrics[4].

Equation 1 shows the model selected for its performance in predicting loads on event-like days. This model was selected among 17 candidate models, which in addition to the terms below included various combinations of terms addressing maximum temperature, heat accumulation (average early morning temperature), average and hourly humidity, and monthly variation.

Equation 1: Ex-Post Baseline Regression Model

---

[2] Active devices refers to those connected or online—including devices participating or opted-out—and excludes those that were offline.
[3] 2.938 kW for duty cycling devices and 2.757 kW for temperature offset devices. See Table 7-2 Smart Thermostat Event Summary; 2016 Energy Efficiency and Load Management Annual Report.
[4] The following algorithm was used to identify the best performing baseline model: select the model with the best fit (lowest root mean square error) among the three models with the least bias (lowest absolute percent bias)

$$\widehat{kW_t} = \beta_0 + \beta_1 * kW_{14} + \beta_2 * temp_{16-19} + \beta_3 * temp_t + \varepsilon$$

Table 3: Definition of Terms for Equation 1

Term	Definition
t	Hour t
kW_{14}	Load in pre-event hour ending 14 (1 PM to 2 PM)
$temp_{16-19}$	Average temperature during the event (hours ending 16 through 19)
$temp_t$	Temperature in hour t
ε	Error term

Table 4 shows the event like days used for the model selection process. These days were chosen to mirror the range of temperature and humidity of the event days.

Table 4: Event-like Days Used for Model Selection

Date	Day of Week	Daily High at KROW (F)	Avg Temp 3-7pm at KROW (F)	Daily Avg Humidity at KROW (F)
12-Jun	Monday	102	98	27%
30-Jun	Friday	97	95	53%
11-Jul	Tuesday	99	96	49%
19-Jul	Wednesday	94	88	59%
16-Aug	Wednesday	95	92	51%
18-Aug	Friday	96	89	60%
19-Sep	Tuesday	97	92	43%
22-Sep	Friday	96	90	58%

1.2 Active Devices and Participation

Table 5 shows how the quantity of devices enrolled in the pilot decreased over the course of the summer, largely due to unenrollments. In addition, it shows that only 81% of dispatched devices were active during events[5] and 69% of dispatched devices were logged

[5] An active device shows non-zero data in at least some device data fields in a given interval. The average percent of devices active reflects average activity across all event intervals and dispatched devices.

as participating during events[6]. By extension, participation among *active* devices was about 85%. While participation rates did not vary consistently by dispatch strategy or over time, activity rates did vary by dispatch strategy—they were consistently about five percentage points higher for the temperature offset devices. The event and dispatch specific activity rates in Table 5 were used to convert impacts per active device to impacts per dispatched device.

Table 5: Saver's Stat Devices Counts During Events

Date	Dispatched Devices			Active (% of Dispatched)			Participating (% of Dispatched)		
	Duty Cycling	Temp Offset	All	Duty Cycling	Temp Offset	All	Duty Cycling	Temp Offset	All
16-Jun	264	277	541	79%	85%	82%	71%	72%	71%
22-Jun	263	277	540	80%	86%	83%	69%	70%	69%
28-Jun	263	277	540	79%	85%	82%	70%	71%	70%
29-Jun	263	277	540	78%	82%	80%	66%	67%	66%
10-Aug	262	275	537	78%	84%	81%	70%	70%	70%
15-Sep	253	272	525	81%	83%	82%	73%	67%	70%
20-Sep	253	272	525	79%	82%	81%	70%	67%	68%
21-Sep	253	272	525	80%	82%	81%	69%	64%	66%
Avg event	***259***	***275***	***534***	***79%***	***84%***	***81%***	***70%***	***68%***	***69%***

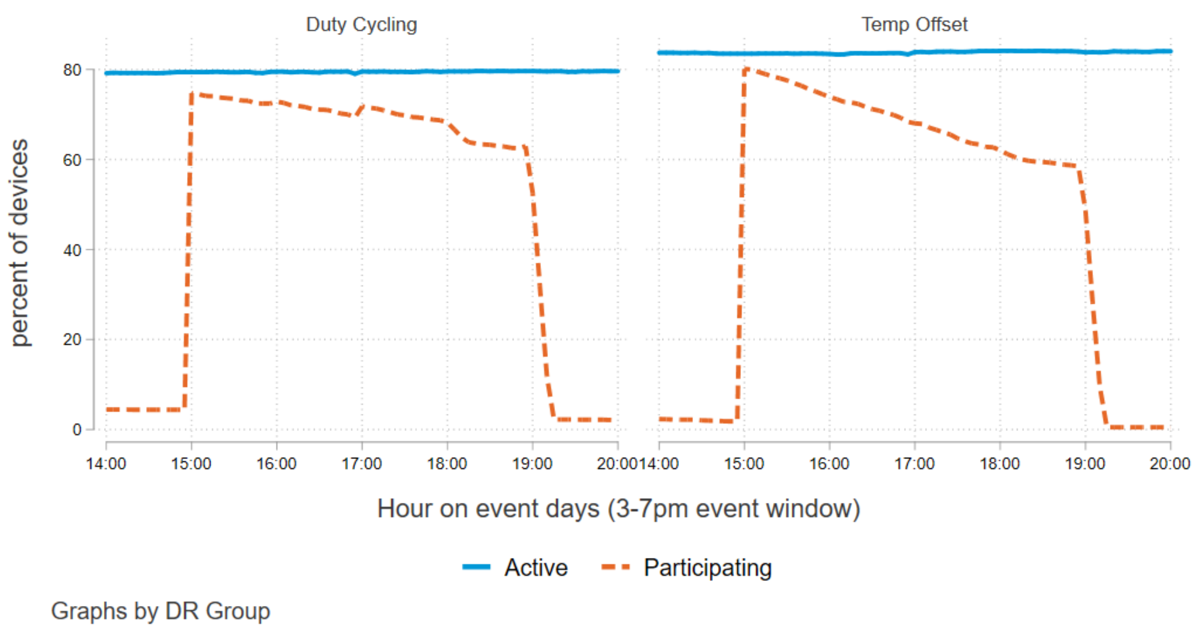
While Table 5 shows average participation and active status during events, Figure 1 portrays how participation and active status changed during the average duty cycling event and the average temperature offset event (these patterns were not noticeably different between individual events. First, as noted above, about 80% of devices were active (blue line) for the duration of the events leaving about 20% offline. Further exploration of device status showed that about 20% of devices (and largely the same devices) were offline for the entire period analyzed (June through September 2017).

Second, participation rate patterns (orange line) are somewhat different for the two dispatch strategies. During duty cycling events participation (among dispatched devices) started just below 80% and ended just above 60%. During temperature offset events participation began slightly higher (in part due to more devices being online) and ended

[6] Participation in each 5-minute interval is logged in the device data. The average percent of devices participating reflects average participation across all event intervals and dispatched devices.

slightly lower. For both dispatch approaches participation declined at a more or less steady rate for the duration of the event.

Figure 1: Participation by Dispatch Strategy



1.3 Event Load Impacts

Event impacts for Saver's Stat events are the baseline load less the observed event day load. Figure 2 shows average baseline loads (grey), observed event day loads (blue), and estimated reductions (orange) for active devices. Upon visual inspection it is clear that the shape of reductions varies substantially by dispatch strategy. While duty cycling appears to deliver relatively consistent reductions for the duration of the event, temperature offsets deliver large reductions at the onset of the event, but much smaller impacts and larger snapback towards the end of the event. These patterns reflect expected behavior of a compressor faced with being switched on and off on the one hand and on the other hand faced with an increased set point that is eventually reached.

Figure 2: Load Impacts by Dispatch Strategy

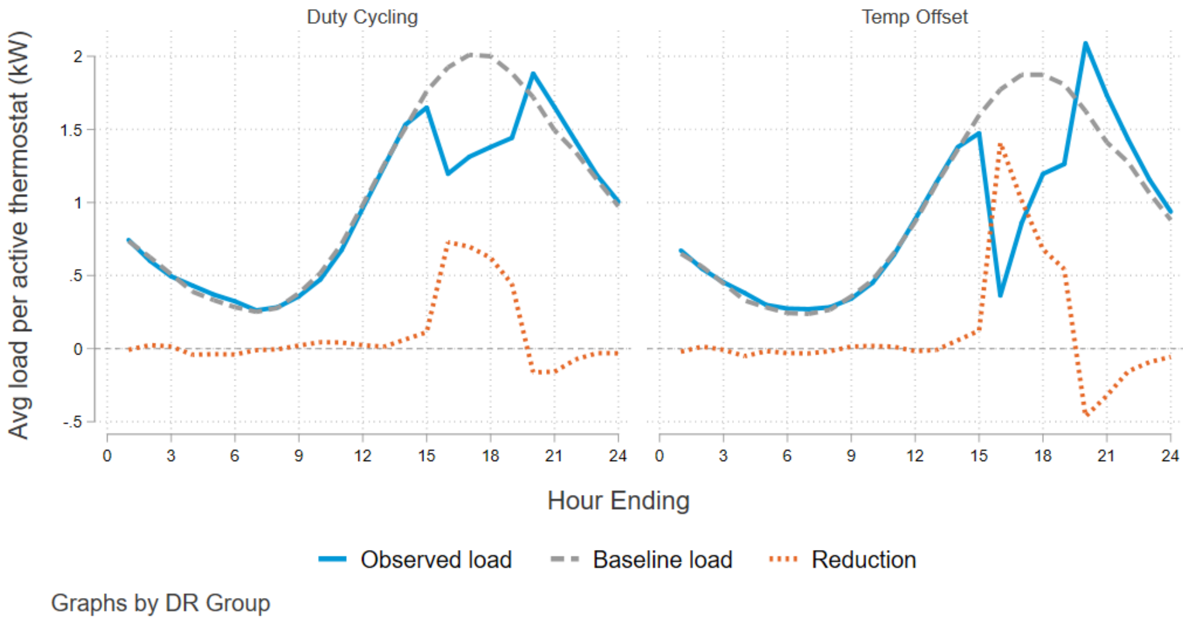


Table 6 shows the hourly and average event reductions per active device for each event and dispatch strategy. This summary reveals that average impacts are indeed higher for temperature offset devices (0.91 kW) than for duty cycling devices (0.63 kW). However, the higher impacts for temperature offset dispatch come at a cost of more substantial snapback: an average of 0.46 kW snap back per active device for temperature offset versus 0.16 kW per active duty cycling device in the hour following the conclusion of the DR event. In addition, while the impact for duty cycling is about 0.3 kW lower in the last event hour compared to the first event hour, this difference is 0.95 kW for temperature offset devices.

As noted previously, impacts per dispatched device would be roughly 20% smaller in magnitude and can be derived for a given even and dispatch by multiplying the corresponding active device rate from Table 5.

Table 6: Hourly Reductions

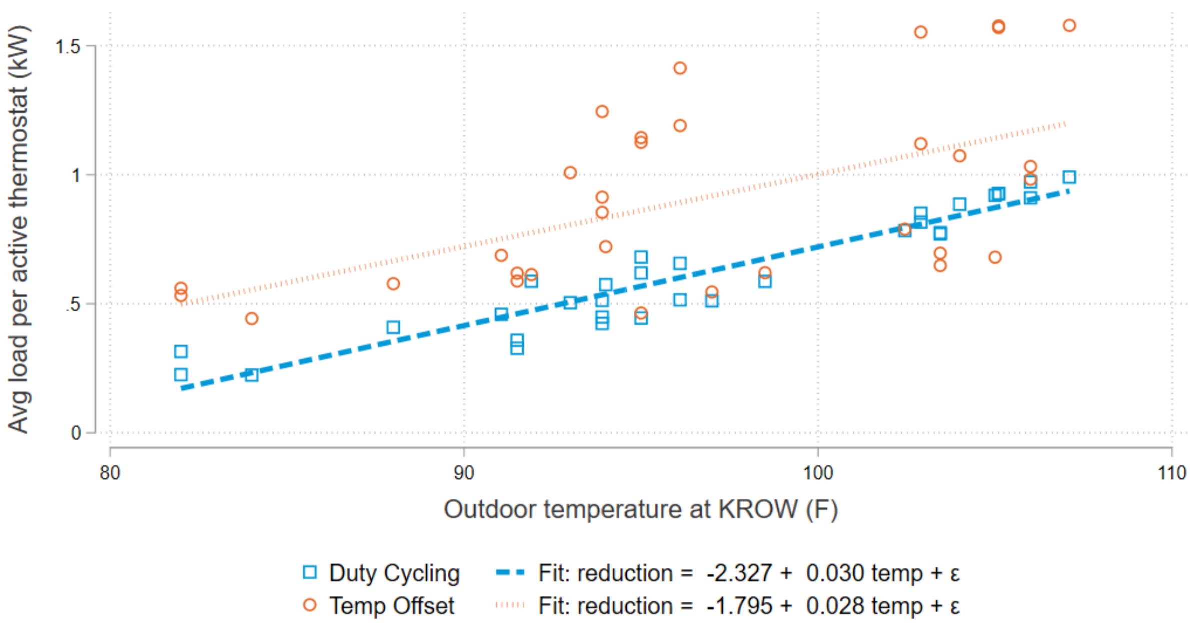
Dispatch Group	Date	Reduction per active device (kW), Hour Beginning (MDT)					
		3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM (post event)	Average 3-7 PM
Duty Cycling	16-Jun	0.93	0.97	0.92	0.68	-0.16	0.87
Duty Cycling	22-Jun	0.99	0.91	0.78	0.59	-0.14	0.82
Duty Cycling	28-Jun	0.85	0.82	0.78	0.59	-0.23	0.76
Duty Cycling	29-Jun	0.93	0.89	0.77	0.51	-0.21	0.77
Duty Cycling	10-Aug	0.66	0.62	0.57	0.41	-0.18	0.56
Duty Cycling	15-Sep	0.51	0.50	0.46	0.32	-0.08	0.45
Duty Cycling	20-Sep	0.44	0.42	0.33	0.22	-0.15	0.36
Duty Cycling	21-Sep	0.52	0.45	0.36	0.23	-0.15	0.39
Duty Cycling	***Avg event***	***0.73***	***0.70***	***0.62***	***0.45***	***-0.16***	***0.63***
Temp Offset	16-Jun	1.58	1.03	0.68	0.46	-0.41	0.94
Temp Offset	22-Jun	1.58	0.98	0.65	0.61	-0.35	0.96
Temp Offset	28-Jun	1.55	1.12	0.79	0.62	-0.46	1.02
Temp Offset	29-Jun	1.57	1.07	0.70	0.55	-0.42	0.97
Temp Offset	10-Aug	1.41	1.13	0.72	0.58	-0.55	0.96
Temp Offset	15-Sep	1.25	1.01	0.69	0.56	-0.56	0.88
Temp Offset	20-Sep	1.14	0.91	0.59	0.44	-0.49	0.77
Temp Offset	21-Sep	1.19	0.85	0.62	0.53	-0.48	0.80
Temp Offset	***Avg event***	***1.41***	***1.01***	***0.68***	***0.54***	***-0.46***	***0.91***

To produce an ex ante impact estimate, the Evergreen team analyzed the relationship between temperature and impacts to derive a relationship. Figure 3 compares the load reduction estimate for each event hour (e.g. the hourly data points in Table 6) with the outdoor air temperature for that hour. (Weather data, which was provided by the Evergreen team from the NOAA website[7], comes from weather station KROW in Roswell.) There is a clear trend in the figure – the hotter it is outside, the greater the impacts tend to be (note the trend line equations in the legend). The slope of this relationship is nearly the same for both dispatch strategies, though the constant is about 0.5 kW larger for

[7] ftp://ftp3.ncdc.noaa.gov/pub/data/noaa/

temperature offset impacts, reflecting the higher average impacts noted above for this dispatch strategy. However, the correlation between temperature and impact is weaker for the temperature offset dispatch (orange) than for duty cycling (blue)—the orange points are less closely aligned with the orange line than are the blue points with the blue line. This makes sense given that the impacts are much greater in the first one or two hours of a temperature offset event than in subsequent hours. Because of this, using a simple linear temperature-impact model to predict ex ante impacts will not be as accurate as an approach which also takes into account event hour.

Figure 3: Hourly Impacts against Outdoor Temperature (F)



Note: Each data point corresponds to the average impact in each hour of an event, as opposed to the average hourly impact for an event. As such, each four hour event is represented by four different data points.

1.3.1 Time-Temperature Matrix

In addition to showing a relationship with outdoor temperature, hourly impacts also varied by hour of the day. Figure 4 shows regression output for an adaptation of the baseline model (here for duty cycling), featuring the addition of an event day indicator variable interacted with hour of day (ending) and the average event temperature variable. Note that all non-holiday summer weekdays were included in this regression to fully capture the underlying temperature-load relationship needed to predict the baseline load. Hourly event day load impact coefficient estimates are preceded by a 1.

The practical interpretation of the 'eventday#hour#event_temp_noaa' regression coefficient interaction is that, on an event day in hour 16 (holding constant the load in hour 14 and the temperature in that hour) for each additional degree of average temperature from 3 PM to 7 PM load impact estimates increase by approximately 0.0075 kW.

Figure 4: Regression Output – Duty Cycling

Prais-Winsten AR(1) regression -- twostep estimates

Linear regression

Number of obs	=	340
F(10, 329)	=	183.11
Prob > F	=	0.0000
R-squared	=	0.9146
Root MSE	=	.11765

kwh	Coef.	Semirobust Std. Err.	t	P>|t|	[95% Conf.	Interval]
preevent	.5609996	.0332129	16.89	0.000	.4956633	.626336
temp_noaa	.0073019	.0038219	1.91	0.057	-.0002165	.0148203
eventday#hour# c.event_temp_noaa						
1 16	-.0074888	.0005882	-12.73	0.000	-.0086458	-.0063317
1 17	-.0070251	.0005906	-11.90	0.000	-.008187	-.0058633
1 18	-.0063414	.0006988	-9.07	0.000	-.007716	-.0049667
1 19	-.0044475	.0006257	-7.11	0.000	-.0056784	-.0032166
hour#c.event_temp_noaa						
16	.015813	.0046214	3.42	0.001	.0067219	.0249042
17	.016633	.0045898	3.62	0.000	.0076039	.025662
18	.0167529	.00454	3.69	0.000	.0078219	.0256839
19	.0161293	.0043349	3.72	0.000	.0076017	.0246569
_cons	-1.205635	.1332433	-9.05	0.000	-1.467751	-.9435187
rho	.3045762					

Durbin-Watson statistic (original) 1.070601
Durbin-Watson statistic (transformed) 1.312853

To predict the hourly impacts of a future duty cycling event of a given average temperature, one would multiply that temperature (say 93 F, like the temperature during the August 10 event) by the difference of the corresponding hourly coefficients. For example, the predicted impact during hour ending 16 (3 PM to 4 PM) would be a reduction of 0.696 kW (0.0074888 * 93 = -0.696). While not a perfect prediction, this figure is quite close to the 0.66 kW impact during the actual August 10 event, demonstrating that taking into account event hour provides a relatively accurate impact estimate.

Using the regression coefficients shown in Figure 4, the Evergreen team created a time-temperature matrix (TTM) that shows expected load reductions (per device) for different outdoor temperatures and at different times of the day[8]. The TTM is shown in Table 7. Figure 5 and Table 8 provide analogous regression output and TTM for temperature offset events. The estimated reductions in hour 16 for a 93 F event (1.375 kW) are similarly close to the actual hour 16 event impacts on August 10 (1.41 kW). In contrast to duty cycling, which produces impacts which taper off only slightly in each hour, temperature offset impacts in the first two event hours are double what they are in the last two event hours. As described above, this makes sense given the mechanics of the two dispatch strategies. Were an event to begin an hour earlier or later than the 3 PM start time of the 2017 events, impacts would likely be similar to the impacts predicted for the first event hour assuming the same average event temperature.

To get an idea of what the Saver's Stat resource is worth on aggregate, the number of active devices can be multiplied by the values shown in the TTM (Table 7 for duty cycling or Table 8 for temperature offset).

[8] The average column is based on a regression variant that does not incorporate hourly variation

Table 7: Time-Temperature Matrix – Duty Cycling

Avg Event Temp	Event Hour 1	Event Hour 2	Event Hour 3	Event Hour 4	Average
85	0.637	0.597	0.539	0.378	0.534
86	0.644	0.604	0.545	0.382	0.541
87	0.652	0.611	0.552	0.387	0.547
88	0.659	0.618	0.558	0.391	0.553
89	0.667	0.625	0.564	0.396	0.560
90	0.674	0.632	0.571	0.400	0.566
91	0.681	0.639	0.577	0.405	0.572
92	0.689	0.646	0.583	0.409	0.578
93	0.696	0.653	0.590	0.414	0.585
94	0.704	0.660	0.596	0.418	0.591
95	0.711	0.667	0.602	0.423	0.597
96	0.719	0.674	0.609	0.427	0.604
97	0.726	0.681	0.615	0.431	0.610
98	0.734	0.688	0.621	0.436	0.616
99	0.741	0.695	0.628	0.440	0.622
100	0.749	0.703	0.634	0.445	0.629
101	0.756	0.710	0.640	0.449	0.635
102	0.764	0.717	0.647	0.454	0.641
103	0.771	0.724	0.653	0.458	0.648
104	0.779	0.731	0.660	0.463	0.654
105	0.786	0.738	0.666	0.467	0.660
106	0.794	0.745	0.672	0.471	0.666

Figure 5: Regression Output – Temperature Offset

```
Prais-Winsten AR(1) regression -- twostep estimates

Linear regression                           Number of obs      =        340
                                            F(10, 329)         =     437.54
                                            Prob > F           =     0.0000
                                            R-squared          =     0.9466
                                            Root MSE           =     .10227
```

kwh	Coef.	Semirobust Std. Err.	t	P>|t|	[95% Conf.	Interval]
preevent	.5717089	.0315431	18.12	0.000	.5096573	.6337606
temp_noaa	.0086468	.0037074	2.33	0.020	.0013536	.0159401
eventday#hour#c.event_temp_noaa						
1 16	-.0147855	.000366	-40.39	0.000	-.0155056	-.0140654
1 17	-.0103688	.0003769	-27.51	0.000	-.0111102	-.0096274
1 18	-.0069576	.0002921	-23.82	0.000	-.0075321	-.0063831
1 19	-.0051202	.0003882	-13.19	0.000	-.0058839	-.0043564
hour#c.event_temp_noaa						
16	.0155807	.0043963	3.54	0.000	.0069322	.0242291
17	.016486	.0043552	3.79	0.000	.0079184	.0250535
18	.0166413	.0043187	3.85	0.000	.0081455	.025137
19	.0162403	.0041081	3.95	0.000	.0081588	.0243218
_cons	-1.369258	.1218246	-11.24	0.000	-1.608911	-1.129604
rho	.2489572					

```
Durbin-Watson statistic (original)    1.127095
Durbin-Watson statistic (transformed) 1.303996
```

EVERGREEN ECONOMICS

Table 8: Time-Temperature Matrix – Temperature Offset

Avg Event Temp	Event Hour 1	Event Hour 2	Event Hour 3	Event Hour 4	Average
85	1.257	0.881	0.591	0.435	0.786
86	1.272	0.892	0.598	0.440	0.795
87	1.286	0.902	0.605	0.445	0.804
88	1.301	0.912	0.612	0.451	0.813
89	1.316	0.923	0.619	0.456	0.823
90	1.331	0.933	0.626	0.461	0.832
91	1.345	0.944	0.633	0.466	0.841
92	1.360	0.954	0.640	0.471	0.850
93	1.375	0.964	0.647	0.476	0.860
94	1.390	0.975	0.654	0.481	0.869
95	1.405	0.985	0.661	0.486	0.878
96	1.419	0.995	0.668	0.492	0.887
97	1.434	1.006	0.675	0.497	0.897
98	1.449	1.016	0.682	0.502	0.906
99	1.464	1.027	0.689	0.507	0.915
100	1.479	1.037	0.696	0.512	0.924
101	1.493	1.047	0.703	0.517	0.934
102	1.508	1.058	0.710	0.522	0.943
103	1.523	1.068	0.717	0.527	0.952
104	1.538	1.078	0.724	0.532	0.961
105	1.552	1.089	0.731	0.538	0.971
106	1.567	1.099	0.738	0.543	0.980

2 Saver's Stat Energy Usage Impacts

The summer energy savings evaluation for the Saver's Stat residential participants relied on a statistical matching approach to develop a baseline estimate for energy usage in the absence of the smart thermostat technology. This analysis evaluated energy usage impacts in summer months. Monthly whole house billing data was used to select matches and to assess energy usage impacts. Matches were selected from among all non-participating SPS residential premises using usage prior to thermostat installation.

2.1 Evaluation Methodology

Matches were selected for each participant premise using Euclidean distance matching[9]. Essentially each participant premise was paired with the non-participating premise with the closest usage in the pre-treatment period, e.g. prior to thermostat installation. The following considerations were taken into account when preparing data for matching:

- For each participant, pretreatment was defined as the period ending in the month prior to thermostat installation, and postreatment was defined as the period beginning the month following thermostat installation.
- Thermostat connection dates were used as a proxy for installation dates after validating accuracy of this data using known installation dates.
- Only participants with 12 months of pretreatment data and 10 months of post treatment data were analyzed. They were matched to non-participants with data available for this same period. Calendarization[10] was used to normalize monthly usage across customer premises with different billing cycles.
- To eliminate identifiable exogenous factors, participants and non-participants who moved or changed electricity rates during the analysis period (including pre and post-treatment periods) were excluded. Only participants on the two primary residential rates (RL and RHS) were analyzed.

After the above filters were applied 406 participant premises were retained for analysis.

[9] Euclidean distance is defined as the root of the sum of square differences. Here, the difference in usage for each pretreatment month was squared. Then, the square root was taken of the sum of these squared differences. The non-participant with the least Euclidean distance from a participant was chosen as the match. Matches were selected with replacement so a matched control premise could be selected more than once.

[10] Bill period start and end dates are used to derive average daily usage for each day in the billing period. Then, this average daily usage is averaged for each day in each calendar month.

Matching was conducted with and without controlling for zip code[11] and electric rate. Using the latter approaches, matching participants only with non-participants that lived in close proximity or on the same electric rate, did not meaningfully change bias or fit of the match so these calipers were ultimately not used for the final match.

After matching, summer energy usage impacts were assessed using the following regression approaches:

- Difference-in-differences panel regression with the matched control group using calendarized monthly usage and monthly cooling degree days
- Within-subjects pre-post regression using actual bill period usage and billing period cooling degree days

Within each of these approaches multiple model variants were assessed, such as including and excluding variation by weather month, including and excluding interactions between treatment and weather, etc.

2.2 Summer Energy Usage Impacts

No significant or detectable changes in summer energy usage were detected for Saver's Stat participants. Results were the same for all regression approaches and models.

[11] The first three zip code digits were used to establish geographic proximity without limiting as much as individual zip codes

Appendix E – Business Comprehensive and Residential Cooling Desk Review Detailed Results

Project ID	OID2528223	OID2696634	OID2698328	OID2896167	OID2918712
Utility	SPS	SPS	SPS	SPS	SPS
Program	Business Comprehensive	Business Comprehensive	Business Comprehensive	Business Comprehensive	Business Comprehensive
Measure Type	Cooling - NM	Custom Efficiency - NM	Custom Efficiency - NM	Cooling - NM	Cooling - NM
Project Description		LED Strip Lights	LED High Bay		DX Unit
Building Type	Office - Small	Retail - Single-Story Large	Manufacturing - Light Industrial	Health/Medical - Hospital	Restaurant - Sit-Down
Other Building Type					
Site Visit Being Conducted	No	No		No	No
Gross Reported kWh	4,955	85,785	73,729	7,779	2,167
Gross Reported kW	4.39	11.73	28.80	7.55	1.59
Gross Verified kWh	4,955	84,704	68,282	7,221	2,167
Gross Verified kW	4.09	11.73	22.82	1.69	1.59
kWh Realization Rate	100%	99%	93%	93%	100%
kW Realization Rate	93%	100%	79%	22%	100%
Calculation Methodology	Prescriptive (TRM, Workpaper)	Utility Calculator	Utility Calculator	Prescriptive (TRM, Workpaper)	Prescriptive (TRM, Workpaper)
Other Calculation Methodology		Also compared with TRM	Lighting Calculator		
Savings Source	New Mexico TRM - 2016	New Mexico TRM - 2016		New Mexico TRM - 2016	New Mexico TRM - 2016
Other Savings Source					
Calculation Assessment	TRM matched technical assumptions	See below.	There is a difference between the TRM savings calculation and the utility calculator that is used to estimate reported program savings.	TRM matched Technical Assumptions. Used SEER for energy savings and EER for demand savings as per TRM.	TRM and Technical Assumptions matched
TRM/Workpaper Assessment	1) Consider updating TRM calculations/assumptions to include a manufacturer's part-load curve in the baseline and EEM inputs to the savings algorithms. 2) The DEER prototype models were used to estimate EFLHs for this measure in the TRM. Could update the EFLHs based on DOE Prototype models in EnergyPlus, which has a more sophisticated engine and incorporated manufacturers' performance curves for HVAC equipment. 3) Consider developing a calculator or deemed savings tables so that the source of reported savings is transparent and repeatable and to minimize human error.	The difference in savings is pretty small, with the TRM method being slightly more conservative than the lighting calculator. We also recommend incorporating ballast factor into calculating the baseline energy consumption to increase accuracy of the savings. TRM Method: kWh savings = (kWbase - kWpost) x annual operating hours x HVAC energy factor where HVAC Energy Factor is defined in a table by building type. Lighting Calculator Method: kWh savings =(kWbase - kWpost) x annual operating hours + (kWbase - kWpost) x (summer peak hours/3) x 33% Where 33% is the factor equivalent to a COP=3 (summer peak hours/3) is probably a way to estimate the HVAC system operating hours in the summer months.	The difference in savings is pretty small, with the TRM method being slightly more conservative than the lighting calculator. We recommend incorporating ballast factor to calculate baseline energy consumption to increase accuracy of savings. TRM Method: kWh savings = (kWbase - kWpost) x annual operating hours x HVAC energy factor where HVAC Energy Factor is defined in a table by building type Lighting Calculator Method: kWh savings =(kWbase - kWpost) x annual operating hours + (kWbase - kWpost) x (summer peak hours/3) x 33% Where 33% is the factor equivalent to a COP=3 (summer peak hours/3) is probably a way to estimate the HVAC system operating hours in the summer months.	1) Consider updating TRM calculations/assumptions to include a manufacturer's part-load curve in the baseline and EEM inputs to the savings algorithms. 2) The DEER prototype models were used to estimate EFLHs for this measure in the TRM. Could update the EFLHs based on DOE Prototype models in EnergyPlus, which has a more sophisticated engine and incorporated manufacturers' performance curves for HVAC equipment. 3) Consider developing a calculator or deemed savings tables so that the source of reported savings is transparent and repeatable and to minimize human error.	1) Consider updating TRM calculations/assumptions to include a manufacturer's part-load curve in the baseline and EEM inputs to the savings algorithms. 2) The DEER prototype models were used to estimate EFLHs for this measure in the TRM. Could update the EFLHs based on DOE Prototype models in EnergyPlus, which has a more sophisticated engine and incorporated manufacturers' performance curves for HVAC equipment. 3) Consider developing a calculator or deemed savings tables so that the source of reported savings is transparent and repeatable and to minimize human error.
Reasons for RR(s) <> 1	Unclear what EER ratings or what formula were used to determine peak savings initially. Gross verified peak demand savings were slightly lower. Energy savings matched.	Verified savings were based on TRM methodology with customer inputs (e.g. operating hours came from the lighting calculator and CF was assumed to be 1.0, based on customer inputs in the calculator).	Verified savings were based on TRM methodology with customer inputs (e.g. operating hours came from the lighting calculator where inputs were provided by the customer). Demand savings were calculated using the TRM HVAC EF, as it seemed more appropriate for an industrial/warehouse type facility. CF was assumed to be 1.0, based on lighting calculator inputs from customer.	It's unclear, as the calculations are not provided in the files.	n/a
Include any other important observations here					

Project ID	OID2961801	OID3066648	OID3067083	OID3127022	OID1984459
Utility	SPS	SPS	SPS	SPS	SPS
Program	Business Comprehensive	Business Comprehensive	Business Comprehensive	Business Comprehensive	Business Comprehensive
Measure Type	Cooling - NM	Cooling - NM	Cooling - NM	Cooling - NM	Custom Efficiency - NM
Project Description	DX Unit	Evaporative Cooling		Centrifugal Chillers	Replace existing jet pumps to beam pumps (well/mining application)
Building Type	Retail - Single-Story Large	Other:	Other:	Education - University	Other:
Other Building Type		Commercial	Commercial		Exterior industrial equipment - no building type
Site Visit Being Conducted	No	No	No	No	No
Gross Reported kWh	1,044	37,343	44,972	110,731	668,078
Gross Reported kW	0.77	30.74	15.35	13.46	77.29
Gross Verified kWh	1,044	39,581	20,512	142,330	668,078
Gross Verified kW	0.36	32.23	6.53	40.00	77.29
kWh Realization Rate	100%	106%	46%	129%	100%
kW Realization Rate	47%	105%	43%	297%	100%
Calculation Methodology	Prescriptive (TRM, Workpaper)	Prescriptive (TRM, Workpaper)	Prescriptive (TRM, Workpaper)	Prescriptive (TRM, Workpaper)	Custom Spreadsheet
Other Calculation Methodology					
Savings Source	New Mexico TRM - 2016	Utility Workpaper	Other:	Utility Workpaper	Custom Analysis
Other Savings Source			Used TRM for RTUs and Technical Docs for Economizers		
Calculation Assessment	Used TRM, Technical Assumptions are the same	Utility workpaper was used	The technical workpaper could use more rigor for the DCV measure, and more analysis is needed to show what the relationship is between % outdoor air and DX unit energy usage. In the calculation it basically is assuming a 1% decrease in %OA is equivalent to a 1% decrease in unit energy consumption. The HE AC unit measure could consider inchoating DOE prototype models to estimate EFLHs, bin calculation with performance curves, or DOE models with performance curves to more accurately estimate savings.	Used Technical Assumptions	Reliable approach but lacking significant post-retrofit data
TRM/Workpaper Assessment	1) Consider updating TRM calculations/assumptions to include a manufacturer's part-load curve in the baseline and EEM inputs to the savings algorithms. 2) The DEER prototype models were used to estimate EFLHs for this measure in the TRM. Could update the EFLHs based on DOE Prototype models in EnergyPlus, which has a more sophisticated engine and incorporated manufacturers' performance curves for HVAC equipment. 3) Consider developing a calculator or deemed savings tables so that the source of reported savings is transparent and repeatable and to minimize human error.	1) Recommend the utility program using a calculator with clear inputs/outputs for the user inputs, as this would make it easier to determine what assumptions the program team used to estimate the reported savings. 2) The savings from the technical workpapers seem reasonable, but are not entirely straightforward. Recommend updating the algorithm/savings calculation methodology based on energy modeling to improve savings accuracy. For example, some assumptions (e.g. motor efficiency) and evap cooler energy using components (e.g. sump pump power, secondary heat recovery fan) were not included in the savings algorithms, but should be. 3) The program should consider including a requirement to prevent incentivizing an evaporative coolers that replaces existing evap coolers, as the Technical Workpaper savings calculations do not account for an evaporative cooler baseline. In this project, the invoice indicates that the incentivized evap cooler replaced an existing evap cooler. However, there was no existing baseline equipment information provided, so the verified savings assume that a DX unit would have been the baseline.	1) The calculation for HE AC units and DCV/Economizer does not provide any guidance for interactions with other measures. For example, on this project high efficiency units were installed (rated at < 1 kW/ton), yet the technical paper references a DX unit efficiency value of 1.44 kW/ton, which will result in over counting/double counting savings from the installation of the high efficiency DX units. 2) The demand savings for the DCV/ Economizer seem unwarranted, unless a coincidence factor is included that is justified. It seems unlikely that the unit will be in economizer mode during peak demand times and there is a lot of uncertainty around whether or not the DCV mode will be also used during peak demand periods. The 3) Consider creating a calculator for the program with all the assumptions, so that it is transparent what assumptions were made to estimate reported savings.	1) Recommend updating the savings calculations/algorithms with better sourcing, and with bin calculations or energy modeling so that part-load efficiency curves can be accounted for in both the baseline and EEM. 2) Consider creating a program calculator for the program with all the assumptions so that is transparent what assumptions were made to estimate reported savings.	None
Reasons for RR(s) <> 1	Yearly difference is rounding. Unclear as to source of reported peak savings	It's unclear, as actual savings calculations were not provided. I included a motor efficiency assumption, when converting HP to kW, which probably attributed to the increase in energy savings compared to the reported savings. Also, the sump pump kW was included in the calculations.	It looks like rounding errors and a doubling of the Economizer savings account for differences; however, calculations were not provided in the reported savings files. Also, the gross verified results accounted for interactions between the two measures installed on the project (the high efficiency DX cooling units and the economizer/DCV measures). These interactive effects were not accounted for in the reported results. Also, the gross verified savings assume that there is are no demand savings for the economizer/DCV measure, as it is unlikely these savings will occur during peak demand time periods.	The technical paper is very unclear for this measure in the utility workpaper. We unfortunately couldn't decipher some of the nuances (e.g. likes the K-adjust factor), which might explain why the numbers are different. In general, for such a potentially large savings measure, the utility workpaper documentation and cited sources should be more rigorous and calculated savings/assumptions transparent.	Barring additional month's data, most reasonable savings value is that which was calculated for ex ante.
Include any other important observations here					

Project ID	OID2284292	OID2394818	OID2558802	OID 2686350	OID2706526
Utility	SPS	SPS	SPS	SPS	SPS
Program	Business Comprehensive	Business Comprehensive	Business Comprehensive	Business Comprehensive	Business Comprehensive
Measure Type	Custom Efficiency - NM	Motors Efficiency - NM	Motors Efficiency - NM	Lighting	Lighting
Project Description	Ammonia refrigeration controls	VFD installed on irrigation pump	VFDs on Non-HVAC fans at gas processing plant	Installation of new LED troffer	Installation of exterior LED lighting
Building Type	Other:	Other:	Manufacturing - Light Industrial	Grocery	Other:
Other Building Type	Food manufacturing	Farm	Gas processing plant		Car Wash
Site Visit Being Conducted	No	No	No		
Gross Reported kWh	2,054,442	38,825	179,291	165,228	32,103
Gross Reported kW	333.36	6.19	28.00	28.46	0.00
Gross Verified kWh	2,054,442	38,825	179,291	116,932	25,338
Gross Verified kW	333.36	6.19	28.00	19.83	0.00
kWh Realization Rate	100%	100%	100%	71%	79%
kW Realization Rate	100%	100%	100%	70%	100%
Calculation Methodology	Custom Spreadsheet	Prescriptive (TRM, Workpaper)	Prescriptive (TRM, Workpaper)	Prescriptive (TRM)	Prescriptive (TRM)
Other Calculation Methodology					
Savings Source	Custom Analysis	Utility Workpaper	Utility Workpaper	New Mexico TRM - 2016	New Mexico TRM - 2016
Other Savings Source					
Calculation Assessment	See Evaluator Analysis sheet under "Conclusions"	Proper algorithms from technical assumptions applied	Greater detail/documentation of specific VFD application should be provided. Motor data/verification should be provided as well to confirm proper efficiencies and paremeters being used.	Evaluator deferred to TRM for lighting hours	Evaluator deferred to TRM for exterior lighting hours
TRM/Workpaper Assessment	n/a	Algorithms do not account for actual motor efficiency - savings are overstated if efficient motor measure is used in addition to VFD measure	Algorithms do not account for actual motor efficiency, creating potential for overstated savings.		
Reasons for RR(s) <> 1	n/a	RR = 1	RR = 1	Difference in operating hours	Diffrence in operating hours, exterior CF is 0 from TRM
Include any other important observations here					

Project ID	OID2712610	OID2747242	OID2747257	OID2768190	OID2855037
Utility	SPS	SPS	SPS	SPS	SPS
Program	Business Comprehensive	Business Comprehensive	Business Comprehensive	Business Comprehensive	Business Comprehensive
Measure Type	Custom Efficiency - NM	Custom Efficiency - NM	Custom Efficiency - NM	Lighting - NM	Custom Efficiency - NM
Project Description	Replace metal halide with LED in "Mini Halls"	Replace existing jet pumps to beam pumps (well/mining application)	Replace existing jet pumps to beam pumps (well/mining application)	New Construction lighting	Fluorescent to LED
Building Type	Manufacturing - Bio/Tech	Other:	Other:	Education - Primary School	Restaurant - Fast-Food
Other Building Type		Exterior industrial equipment - no building type	Exterior industrial equipment - no building type		
Site Visit Being Conducted	No	No	No	No	No
Gross Reported kWh	619,157	639,547	735,987	95,366	4,616
Gross Reported kW	70.68	80.41	84.24	37.26	0.93
Gross Verified kWh	619,956	639,547	735,987	121,312	5,453
Gross Verified kW	70.77	80.41	84.24	30.91	0.93
kWh Realization Rate	100%	100%	100%	127%	118%
kW Realization Rate	100%	100%	100%	83%	100%
Calculation Methodology	Utility Calculator	Custom Spreadsheet	Custom Spreadsheet	Prescriptive (TRM)	Utility Calculator
Other Calculation Methodology					
Savings Source	Other:	Custom Analysis	Custom Analysis	New Mexico TRM - 2016	New Mexico TRM - 2016
Other Savings Source	LightingWorksheet in Xcel spreadsheet calculator				
Calculation Assessment	Calculation accurate with exception of operating hours in post case	Reliable approach but lacking significant post-retrofit data	Reliable approach but lacking significant post-retrofit data	Used NM TRM 2016 Lighting New Construction LPD algorithm	Detailed, comprehensiv
TRM/Workpaper Assessment	None	None	None		None
Reasons for RR(s) <> 1	Rounding	Barring additional month's data, most reasonable savings value is that which was calculated for ex ante.	Barring additional month's data, most reasonable savings value is that which was calculated for ex ante.	kWh savings higher from both interior and exterior lighting calcs - Exterior due to difference in LPD used in project file vs. NM TRM; unknown difference for interior lighting kW savings lower likely due to different HVAC Demand Factor or Coincident Factor used for interior lighting, or if they claimed kW savings from the exterior lighting (we found 0)	Exterior operating hours were updated, but the tracking sheet did not appear to include the updated hours and therefore updated savings value. No change to kW.
Include any other important observations here	Updated to account for ocucpancy sensor savings claimed in project OID2946154. This project is for the light fixtures only.				

Project ID	OID2914885	OID2917971	OID2929853	OID2940443	OID2940486
Utility	SPS	SPS	SPS	SPS	SPS
Program	Business Comprehensive	Business Comprehensive	Business Comprehensive	Business Comprehensive	Business Comprehensive
Measure Type	Computer Efficiency - NMx	Computer Efficiency - NMx	Lighting	Computer Efficiency - NMx	Computer Efficiency - NMx
Project Description	Installation of new high-efficiency servers and desktop PCs	Installation of new high-efficiency servers and desktop PCs	Installation of new LED exterior lighting	Installation of new high-efficiency servers and desktop PCs	Installation of new high-efficiency serv
Building Type			Other:		
Other Building Type			Fire Department		
Site Visit Being Conducted					
Gross Reported kWh	6,600	32,034	34,456	5,073	1,412
Gross Reported kW	0.80	3.99	0.00	0.64	0.18
Gross Verified kWh	5,430	20,147	29,310	4,878	4,867
Gross Verified kW	0.62	2.36	0.00	0.60	0.56
kWh Realization Rate	82%	63%	85%	96%	345%
kW Realization Rate	78%	59%	100%	94%	314%
Calculation Methodology	Utility Calculator	Utility Calculator	Prescriptive (TRM)	Utility Calculator	Utility Calculator
Other Calculation Methodology					
Savings Source	Utility Workpaper	Utility Workpaper	New Mexico TRM - 2016	Utility Workpaper	Utility Workpaper
Other Savings Source					
Calculation Assessment	Calculations are manageable with more data from project files	Calculations are manageable with more data from project files	Evaluator deferred to TRM for exterior lighting hours	Calculations are manageable with more data from project files	Project Sheet shows 41 units, tracker shows only 18. unable to see which were installed
TRM/Workpaper Assessment	It is unknown if servers installed are High Performance or Bus Computing so it is impossible to calculate Load factor with certainty. Weighted average cooling interaction calculation should only use the peak kwh/ton cooling. HVAC system is unknown	It is unknown if servers installed are High Performance or Bus Computing so it is impossible to calculate Load factor with certainty. Weighted average cooling interaction calculation should only use the peak kwh/ton cooling. HVAC system is unknown		It is unknown if servers installed are High Performance or Bus Computing so it is impossible to calculate Load factor with certainty. Weighted average cooling interaction calculation should only use the peak kwh/ton cooling. HVAC system is unknown	It is unknown if servers installed are High Performance or Bus Computing so it is impossible to calculate Load factor with certainty. Weighted average cooling interaction calculation should only use the peak kwh/ton cooling. HVAC system is unknown
Reasons for RR(s) <> 1	several factors were unknown and assumed: (server type: high performance v bus computing); HVAC type (cooling interaction was averaged across all types in workpaper)	several factors were unknown and assumed: (server type: high performance v bus computing); HVAC type (cooling interaction was averaged across all types in workpaper)	Difference in operating hours, exterior CF = 0, demand = 0	several factors were unknown and assumed: (server type: high performance v bus computing); HVAC type (cooling interaction was averaged across all types in workpaper)	several factors were unknown and assumed: (server type: high performance v bus computing); HVAC type (cooling interaction was averaged across all types in workpaper). Quantity of servers/desktops does not match between tracker and project file. Also in tracker, the opportunity for savings is over 8,400 kWh while customer kWh is just 1,412 (something seems off)
Include any other important observations here					

Project ID	OID2941099	OID2942677	OID2946154	OID2946492	OID2948773
Utility	SPS	SPS	SPS	SPS	SPS
Program	Business Comprehensive	Business Comprehensive	Business Comprehensive	Business Comprehensive	Residential Cooling
Measure Type	Lighting	Lighting	Lighting - NM	Computer Efficiency - NMx	EC Motor Furnace Fan
Project Description	Installation of new LED exterior lighting	Installation of new LED exterior lighting	2017 Retrofit -Ceiling mount occupancy sensor - 50 Watts to 300 Watts Controlled Load. Connected load 228 144W LED High Bay Fixtures	Installation of new high-efficiency servers and desktop PCs	EC Motor Furnace Fan
Building Type	Other:	Other:	Manufacturing - Light Industrial		Residential - Single Family
Other Building Type	Car dealership parking lot	City of Loving - Street Lighting			
Site Visit Being Conducted					No
Gross Reported kWh	68,880	96,260	105,610	7,891	1,348
Gross Reported kW	0.00	0.00	12.28	1.00	0.13
Gross Verified kWh	56,573	30,381	88,698	7,775	1,348
Gross Verified kW	0.00	0.00	5.19	0.98	0.13
kWh Realization Rate	82%	32%	84%	99%	100%
kW Realization Rate	100%	100%	42%	97%	99%
Calculation Methodology	Prescriptive (TRM)	Prescriptive (TRM)	Prescriptive (TRM)	Utility Calculator	Prescriptive (TRM, Workpaper)
Other Calculation Methodology					
Savings Source	New Mexico TRM - 2016	New Mexico TRM - 2016	New Mexico TRM - 2016	Utility Workpaper	Utility Workpaper
Other Savings Source					
Calculation Assessment		Evaluator deferred to TRM hours for exterior lighting	Lighting Retrofit formula in 2016 TRM Note - Deemed Savings Technical Assumptions document "NMx Lighting Efficiency.pdf" lists algorithms on page 4. Demand Savings algortihm does not include CF. Application states facility is 24 hours for llighting. Used technical assumptions excel workbook for baseline and replacement wattage. Calculated savings 4 ways: 1) Using wattage from application for replacement and wattage from technical assumptions excel workbook for baseline - used technical assumption adjustments for 24 our facility 2) Using wattage from application for replacement and wattage from technical assumptions excel workbook for baseline - usedTRM manufacturing facility adjustments 3) Using wattage for replacement and wattage for baseline from technical assumptions excel workbook - used technical assumption adjustments for 24 our facility 4) Using wattage for replacement and wattage for baseline from technical assumptions excel workbook - used TRM manufacturing facility adjustments Final choice: 3.	Calculations are manageable with more data from project files	Appropriate algorithms used
TRM/Workpaper Assessment				It is unknown if servers installed are High Performance or Bus Computing so it is impossible to calculate Load factor with certainty. Weighted average cooling interaction calculation should only use the peak kwh/ton cooling. HVAC system is unknown	ECM Operating Hours reference Table 5, while Table 7 contains the hours assumptions. No source provided for assumed ECM hours
Reasons for RR(s) <> 1	operating hours most likely; demand is 0 bc CF is 0 for exterior lights	Difference in operating hours, exterior lighting = demand = 0	Unable to replicate savings in tracking database. Unable to identify where difference occurs. Likely operating hours	several factors were unknown and assumed: (server type: high performance v bus computing); HVAC type (cooling interaction was averaged across all types in workpaper)	Appears to be rounding issue
Include any other important observations here		Based on the emails between Xcel Energy staff included in the project file, "the reason the savings are so high is because the "UNDER" equipment model is 812W so it is significantly higher than what they actually removed..." If you put in 812W for the pre fixture wattage, you'll get a rr rate of 1. The 400W that I've used comes directly from the project file application form.	Tracking data lists incorrect units. Tracking data lists 1 unit; application lists 228 units. Jake (peer review) - deferred to TRM for calculations, used manufacturing TRM hours for nuclear plant Updated to account for lighting savings claimed in project OID2712610. This project is for the occupancy sensors only.		

Project ID	OID2949003	OID2981799	OID2982022	OID2983562	OID2983786
Utility	SPS	SPS	SPS	SPS	SPS
Program	Business Comprehensive	Business Comprehensive	Business Comprehensive	Residential Cooling	Residential Cooling
Measure Type	Motors Efficiency - NM	Lighting - NM	Lighting - NM	EC Motor Furnace Fan	EC Motor Furnace Fan
Project Description	VFDs on Pumps in City Pump Station	2017 Retrofit -Interior LED Replacing High Bay HID fixtures	2017 Retrofit -Interior and exterior LED Replacing High Bay, screw in, area lighting, and exterior lamps and fixtures	EC Motor Furnace Fan	EC Motor Furnace Fan
Building Type	Other:	Office - Large	Other:	Residential - Single Family	Residential - Single Family
Other Building Type	Pump Station for City Water		Correctional Facility		
Site Visit Being Conducted	No			No	No
Gross Reported kWh	449,631	48,896	496,481	1,348	1,348
Gross Reported kW	68.42	11.14	11.48	0.13	0.13
Gross Verified kWh	449,631	80,508	500,784	1,348	1,348
Gross Verified kW	68.42	18.74	15.69	0.13	0.13
kWh Realization Rate	100%	165%	101%	100%	100%
kW Realization Rate	100%	168%	137%	99%	99%
Calculation Methodology	Prescriptive (TRM, Workpaper)	Prescriptive (TRM)	Prescriptive (TRM)	Prescriptive (TRM, Workpaper)	Prescriptive (TRM, Workpaper)
Other Calculation Methodology					
Savings Source	Utility Workpaper	New Mexico TRM - 2016	New Mexico TRM - 2016	Utility Workpaper	Utility Workpaper
Other Savings Source					
Calculation Assessment	Appropriate algorithms applied	Lighting Retrofit formula in 2016 TRM Note - Deemed Savings Technical Assumptions document "NMx Lighting Efficiency.pdf" lists algorithms on page 4. Demand Savings algortihm does not include CF. This may account for difference in Demand savings estimates. Replicated savings using both Technical Assumptions document and TRM values. Tab 2 includes table for both approaches. Reported Technical Assumption derived savings in Row 41/42.	Lighting Retrofit formula in 2016 TRM Note - Deemed Savings Technical Assumptions document "NMx Lighting Efficiency.pdf" lists algorithms on page 4. Demand Savings algortihm does not include CF. Replicated savings 4 ways to attempt verification 1) Using wattage from application and adjustments from technical assumption document 2) Using wattage from technical assumption document and adjustments from technical assumption document 3) Using wattage from application and adjustments from TRM 4) Using wattage from technical assumption xls and adjustments form TRM. Final choice: 2.	Appropriate algorithms used	Appropriate algorithms used
TRM/Workpaper Assessment	VFD algorithms do not use actual motor efficiencies, potentially overstating savings if efficient motors are used	N/A	N/A	ECM Operating Hours reference Table 5, while Table 7 contains the hours assumptions. No source provided for assumed ECM hours	ECM Operating Hours reference Table 5, while Table 7 contains the hours assumptions. No source provided for assumed ECM hours
Reasons for RR(s) <> 1	RR = 1	operating hours most likely. Jake - used TRM and not tech assumptions	1) kwh: Unable to identify the HVAC factor used, or confirm specific hours of use used in tracking database. Difference is likely a result of one or both f these varying slightly frm the technical assumptions.	Appears to be rounding issue	Appears to be rounding issue
Include any other important observations here		Documentation is confusing. IT is difficult to confirm the total number of fisctures installed based on the rebate materials. Page 8of10 in the rebate materials lists quantity 76 but this is crossed out with typed xxxx and replaced by "7". The invoices list two line items on two different pages with the same equipment, one with 24 ESI 125 W fixtures and the second page lists 76 ESI 125W fixtures.	Reported wattage on the application form and technical assumption document wattage vary significantly		

Project ID	OID2984492	OID2989180	OID2995424	OID3011186	OID3023196
Utility	SPS	SPS	SPS	SPS	SPS
Program	Business Comprehensive	Business Comprehensive	Residential Cooling	Business Comprehensive	Residential Cooling
Measure Type	Custom Efficiency - NM	Lighting - NM	EC Motor Furnace Fan	Lighting - NM	EC Motor Furnace Fan
Project Description	Replace existing jet pumps to beam pumps (well/mining application)	2017 Retrofit -Interior LED Replacing T8 Fluorescent	EC Motor Furnace Fan	2017 Retrofit -Exterior LED Replacing MH HID	EC Motor Furnace Fan
Building Type	Other:	Retail - Single-Story Large	Residential - Single Family	Other:	Residential - Single Family
Other Building Type	Exterior industrial equipment - no building type			Nighttime Exterior	
Site Visit Being Conducted	No		No		No
Gross Reported kWh	693,706	10,309	1,348	110,700	1,227
Gross Reported kW	79.15	2.66	0.13	0.00	0.09
Gross Verified kWh	693,181	14,028	1,348	90,922	1,348
Gross Verified kW	79.15	2.66	0.13	0.00	0.13
kWh Realization Rate	100%	136%	100%	82%	110%
kW Realization Rate	100%	100%	99%	100%	147%
Calculation Methodology	Custom Spreadsheet	Prescriptive (TRM)	Prescriptive (TRM, Workpaper)	Prescriptive (TRM)	Prescriptive (TRM, Workpaper)
Other Calculation Methodology					
Savings Source	Custom Analysis	New Mexico TRM - 2016	Utility Workpaper	New Mexico TRM - 2016	Utility Workpaper
Other Savings Source					
Calculation Assessment	Reliable approach but lacking significant post-retrofit data. Also, outlier month during transition to new system was used to calculate savings	Lighting Retrofit formula in 2016 TRM Note - Deemed Savings Technical Assumptions document "NMx Lighting Efficiency.pdf" lists algorithms on page 4. Demand Savings algortihm does not include CF. Replicated savings 4 ways to attempt verification 1) Using wattage from application and adjustments from technical assumption document 2) Using wattage from technical assumption document and adjustments from technical assumption document 3) Using wattage from application and adjustments from TRM 4) Using wattage from technical assumption xls and adjustments form TRM. Final choice: 2.	Appropriate algorithms used	Lighting Retrofit formula in 2016 TRM Note - Deemed Savings Technical Assumptions document "NMx Lighting Efficiency.pdf" lists algorithms on page 4. Demand Savings algortihm does not include CF. Replicated savings 4 ways to attempt verification 1) Using wattage from application and adjustments from technical assumption document 2) Using wattage from technical assumption document and adjustments from technical assumption document 3) Using wattage from application and adjustments from TRM 4) Using wattage from technical assumption xls and adjustments form TRM. Final choice: 2.	Invoices show AC was installed based on model numbers listed, but savings were calculated assuming "w/o AC"
TRM/Workpaper Assessment	None	N/A	ECM Operating Hours reference Table 5, while Table 7 contains the hours assumptions. No source provided for assumed ECM hours	N/A	ECM Operating Hours reference Table 5, while Table 7 contains the hours assumptions. No source provided for assumed ECM hours
Reasons for RR(s) <> 1	Barring additional month's data, most reasonable savings value is that which was calculated for ex ante with small change to exclude October 2016 from calculation since that month was a production outlier as it was the month in which installation of the new system occurred.	Jake - Operating hours most likely; used TRM and not technical assumption	Appears to be rounding issue	Operating hours, Demand savings are 0 because they are exterior lights	Invoices show AC was installed based on model numbers listed - evaluator changed assumptions from "w/o AC" to "w/AC"
Include any other important observations here				Demand = 0 because they are exterior lights	

Project ID	OID3023835	OID3025107	OID3031541	OID3038054	OID3060677
Utility	SPS	SPS	SPS	SPS	SPS
Program	Business Comprehensive	Residential Cooling	Business Comprehensive	Residential Cooling	Business Comprehensive
Measure Type	Computer Efficiency - NMx	EC Motor Furnace Fan	Lighting - NM	EC Motor Furnace Fan	Recommissioning - NM
Project Description	Installation of new high-efficiency servers and desktop PCs	EC Motor Furnace Fan	2017 Retrofit - Exterior LED Replacing MH HID	EC Motor Furnace Fan	
Building Type		Residential - Single Family	Lodging - Hotel	Residential - Single Family	Office - Large
Other Building Type			Nighttime Exterior		
Site Visit Being Conducted		No		No	No
Gross Reported kWh	1,102	1,348	10,910	1,348	1,042,797
Gross Reported kW	0.14	0.13	0.00	0.13	6.32
Gross Verified kWh	1,029	1,348	13,616	1,348	1,048,140
Gross Verified kW	0.12	0.13	0.00	0.13	19.43
kWh Realization Rate	93%	100%	125%	100%	101%
kW Realization Rate	90%	99%	100%	99%	307%
Calculation Methodology	Utility Calculator	Prescriptive (TRM, Workpaper)	Prescriptive (TRM)	Prescriptive (TRM, Workpaper)	Other:
Other Calculation Methodology					Retrocommissioning study
Savings Source	Utility Workpaper	Utility Workpaper	New Mexico TRM - 2016	Utility Workpaper	Other:
Other Savings Source					Xcel RCx tool
Calculation Assessment	Calculations are manageable with more data from project files	Appropriate algorithms used	Lighting Retrofit formula in 2016 TRM Note - Deemed Savings Technical Assumptions document "NMx Lighting Efficiency.pdf" lists algorithms on page 4. Demand Savings algortihm does not include CF. Technical assumption document and TRM match for outdoor equipment The application baseline wattage were 250W and 100W. For this measure in the technical assumptions the assumed wattage values are 416W and 215W. Because of this calculated savings three ways. 1) Using wattage from application for both baseline and replacement 2) Using wattage from technical assumption for both baseline and replacement 3) Using wattage from application for baseline and technical assumption xls for replacement.. Final choice: 3.	Appropriate algorithms used	Xcel RCx tool appears accurate
TRM/Workpaper Assessment	It is unknown if servers installed are High Performance or Bus Computing so it is impossible to calculate Load factor with certainty. Weighted average cooling interaction calculation should only use the peak kwh/ton cooling. HVAC system is unknown	ECM Operating Hours reference Table 5, while Table 7 contains the hours assumptions. No source provided for assumed ECM hours		ECM Operating Hours reference Table 5, while Table 7 contains the hours assumptions. No source provided for assumed ECM hours	None
Reasons for RR(s) <> 1	several factors were unknown and assumed: (server type: high performance v bus computing); HVAC type (cooling interaction was averaged across all types in workpaper)	Appears to be rounding issue	Potenital difference in input wattages. Custom hours of use or HVAC factor may have been used. We use the TRM values.	Appears to be rounding issue	Actual baseline chilled water setpoint temperature range not included in calculation, rather a deemed value was used. Ex post savings account for the baseline setpoint range
Include any other important observations here			Demand is 0 because lighting is outdoors		

Project ID	OID3060732	OID3064060	OID3071322	OID3091577	OID3103529
Utility	SPS	SPS	SPS	SPS	SPS
Program	Business Comprehensive	Business Comprehensive	Business Comprehensive	Residential Cooling	Business Comprehensive
Measure Type	Motors Efficiency - NM	Motors Efficiency - NM	Motors Efficiency - NM	EC Motor Furnace Fan	Lighting - NM
Project Description	Pump Off Controllers at Petroleum Plant	VFD on non-HVAC pump	VFD on non-HVAC pump	EC Motor Furnace Fan	2017 Retrofit - Unable to confirm based on paperwork. 2 LED A Lamp 750-1049 lm. Unknown existing equipment. Incomplete paperwork,
Building Type	Manufacturing - Light Industrial	Manufacturing - Light Industrial	Manufacturing - Light Industrial	Residential - Single Family	Retail - Small
Other Building Type	Petroleum Plant				
Site Visit Being Conducted	No	No	No	No	
Gross Reported kWh	401,852	48,531	111,787	1,348	135
Gross Reported kW	53.36	7.74	15.39	0.13	0.03
Gross Verified kWh	401,853	48,531	100,608	1,348	136
Gross Verified kW	45.87	7.74	13.85	0.13	0.04
kWh Realization Rate	100%	100%	90%	100%	101%
kW Realization Rate	86%	100%	90%	99%	134%
Calculation Methodology	Prescriptive (TRM, Workpaper)	Prescriptive (TRM, Workpaper)	Prescriptive (TRM, Workpaper)	Prescriptive (TRM, Workpaper)	Prescriptive (TRM)
Other Calculation Methodology					
Savings Source	Utility Workpaper	Utility Workpaper	Utility Workpaper	Utility Workpaper	New Mexico TRM - 2016
Other Savings Source	Measure is in TRM and WP				2017 NMx Tech Assumptions Summary Round 4 - REGULATORY.xlsx for baseline wattage
Calculation Assessment	Evaluator generally followed TRM. Motor efficiencies taken from technical assumptions as they are more detailed. Coincidence factors used by implementer are unclear and appear to vary between pumps.	Proper algorithms from technical assumptions applied	Proper algorithms from technical assumptions applied. However, actual motor power is 90 HP, even if drive is 100 HP. Therefore using 90 HP in the savings is more representative of actual equipment.	Appropriate algorithms used	TRM algorithm
TRM/Workpaper Assessment	TRM kW savings algorithm does not include a coincidence factor, and essentially assumes TC = CF, which may be the case, but no support is provided WP does not state which CF should be used for POC. WP divides savings by baseline hours, however actual demand savings should be pump power x CF SPS Technical Assumptions have more detailed motor efficiencies Algorithms do not account for actual motor efficiencies	Algorithms do not account for actual motor efficiency - savings are overstated if efficient motor measure is used in addition to VFD measure	Algorithms do not account for actual motor efficiency - savings are overstated if efficient motor measure is used in addition to VFD measure	ECM Operating Hours reference Table 5, while Table 7 contains the hours assumptions. No source provided for assumed ECM hours	
Reasons for RR(s) <> 1	Evaluator used TRM demand savings algorithm instead of WP	RR = 1	Evaluator used actual motor power of 90 HP instead of 100 HP as used by implementer. This is actual motor rated power, as opposed to drive power or closest power listed in efficiency tables, and so better reflects actual savings achieved.	Appears to be rounding issue	Rounding error
Include any other important observations here					

Project ID	OID3120913	OID3125248	OID3127024	OID3130865	OID3160380
Utility	SPS	SPS	SPS	SPS	SPS
Program	Residential Cooling	Business Comprehensive	Business Comprehensive	Residential Cooling	Business Comprehensive
Measure Type	EC Motor Furnace Fan	Computer Efficiency - NMx	Motors Efficiency - NM	Premium Evap	Computer Efficiency - NMx
Project Description	EC Motor Furnace Fan	Installation of new high-efficiency servers and desktop PCs	HVAC Fan and Pump VFDs	Evaporative Cooler	Installation of new high-efficiency servers and desktop PCs
Building Type	Residential - Single Family		Education - University	Residential - Single Family	
Other Building Type					
Site Visit Being Conducted	No		No	No	
Gross Reported kWh	1,348	4,699	129,938	3,332	2,935
Gross Reported kW	0.13	0.60	15.24	2.38	0.38
Gross Verified kWh	1,348	4,566	159,388	3,332	2,855
Gross Verified kW	0.13	0.58	19.49	2.38	0.36
kWh Realization Rate	100%	97%	123%	100%	97%
kW Realization Rate	99%	97%	128%	100%	96%
Calculation Methodology	Prescriptive (TRM, Workpaper)	Utility Calculator	Prescriptive (TRM, Workpaper)	Prescriptive (TRM, Workpaper)	Utility Calculator
Other Calculation Methodology					
Savings Source	Utility Workpaper	Utility Workpaper	Utility Workpaper	New Mexico TRM - 2016	Utility Workpaper
Other Savings Source			Evaluator deferred to TRM when possible	Measure in WP directly references TRM	
Calculation Assessment	Model number listed on application is for evaporator coil, not furnace. However furnace model nubmer is listed on invoice.	Calculations are manageable with more data from project files	Evaluator deferred to TRM for HVAC VFDs 50HP and smaller. No documentation was provided showing what kinds of pumps and fans VFDs are installed on. Evaluator assumed equipment types based on comparison of TRM options and claimed savings.	Installed unit is on SPS list of qualified evaporative coolers	Calculations are manageable with more data from project files
TRM/Workpaper Assessment	ECM Operating Hours reference Table 5, while Table 7 contains the hours assumptions. No source provided for assumed ECM hours	It is unknown if servers installed are High Performance or Bus Computing so it is impossible to calculate Load factor with certainty. Weighted average cooling interaction calculation should only use the peak kwh/ton cooling. HVAC system is unknown	TRM and Xcel technical assumptions should be reconciled/consolidated - conflicts for HVAC VFDs 50HP and smaller.	TRM only lists savings, not baseline and proposed kWh and kW	It is unknown if servers installed are High Performance or Bus Computing so it is impossible to calculate Load factor with certainty. Weighted average cooling interaction calculation should only use the peak kwh/ton cooling. HVAC system is unknown
Reasons for RR(s) <> 1	Appears to be rounding issue	several factors were unknown and assumed: (server type: high performance v bus computing); HVAC type (cooling interaction was averaged across all types in workpaper)	Evaluator deferred to TRM for HVAC VFDs 50HP and smaller. No documentation was provided showing what kinds of pumps and fans VFDs are installed on. Evaluator assumed equipment types based on comparison of TRM options and claimed savings.	RR =1	several factors were unknown and assumed: (server type: high performance v bus computing); HVAC type (cooling interaction was averaged across all types in workpaper)
Include any other important observations here					

Project ID	OID3222238	OID3224665	OID3224674
Utility	SPS	SPS	SPS
Program	Business Comprehensive	Business Comprehensive	Business Comprehensive
Measure Type	Motors Efficiency - NM	Motors Efficiency - NM	Motors Efficiency - NM
Project Description	Industrial pump VFDs	VFD on industrial non-HVAC pump	VFD on industrial non-HVAC pump
Building Type	Manufacturing - Light Industrial	Manufacturing - Light Industrial	Manufacturing - Light Industrial
Other Building Type			
Site Visit Being Conducted	No	No	No
Gross Reported kWh	1,794,505	84,381	118,126
Gross Reported kW	247.86	11.61	18.85
Gross Verified kWh	1,794,375	84,381	117,741
Gross Verified kW	247.84	11.61	18.78
kWh Realization Rate	100%	100%	100%
kW Realization Rate	100%	100%	100%
Calculation Methodology	Prescriptive (TRM, Workpaper)	Prescriptive (TRM, Workpaper)	Prescriptive (TRM, Workpaper)
Other Calculation Methodology			
Savings Source	Utility Workpaper	Utility Workpaper	Utility Workpaper
Other Savings Source			
Calculation Assessment	Proper algorithms applied	Proper algorithms applied	Proper algorithms applied
TRM/Workpaper Assessment	Actual motor efficiencies should be collected and entered to mitigate overclaiming of savings when VFDs are installed on efficient motors	Actual motor efficiencies should be collected and entered to mitigate overclaiming of savings when VFDs are installed on efficient motors	Actual motor efficiencies should be collected and entered to mitigate overclaiming of savings when VFDs are installed on efficient motors
Reasons for RR(s) <> 1	RR = 1, only slight differences which appear to be due to rounding	RR = 1, only slight differences which appear to be due to rounding	RR's are very close to 1, source of slight discrepancy is unknown.
Include any other important observations here			

Appendix F – Additional Tables for SPS Annual Report

Table 9: PY2017 Participation, Savings, and Costs by Program/Category

Program	Participants or Units	Annual Net Savings (kWh)	Annual Net Savings (kW)	Lifetime Net Savings (kWh)	Total Program Costs
Business Comprehensive	270	10,006,414	1,274	154,237,091	$3,159,228.35
Home Lighting & Recycling	256,639	9,300,382	1,460	87,120,242	$1,859,661.24
Energy Feedback	21,462	3,762,044	940	3,762,044	$133,595.74
Residential Cooling	28	26,384	4	468,313	$48,008.01
School Education Kits	2,685	1,656,045	41	16,864,690	$157,625.81
Home Energy Services	8,288	8,403,339	641	137,528,729	$2,351,879.63
Saver's Switch	4,360	36,431	3,739	36,431	$251,419.53
Saver's Stat	532	0	377	0	$99,799.12
Business ICO	0	0	0	0	$48.31
Market Research	0	0	0	0	$35,111.74
Measurement & Verification	0	0	0	0	$6,402.14
Planning & Administration	0	0	0	0	$205,303.92
Product Development	0	0	0	0	$34,644.91
Total	**294,264**	**33,191,039**	**8,475**	**400,017,539**	**$8,342,728.45**

Table 10: PY2017 Net-to-Gross Ratios by Program

Program	NTG Ratio
Business Comprehensive	70.99%
Home Lighting & Recycling	71.00%
Energy Feedback	101.73%
Residential Cooling	66.00%
School Education Kits	100.00%
Home Energy Services	97.21%
Saver's Switch	100.00%
Saver's Stat	100.00%

Table 11: PY2017 Economic Benefits by Program/Category

Program/Category	Participants or Units	Cost per kWh Saved (Lifetime)	2017 Economic Benefits	Total Economic Benefits
Business Comprehensive	270	$0.02	$427,892.52	$6,595,459.39
Home Lighting & Recycling	256,639	$0.02	$607,007.32	$5,686,070.03
Energy Feedback	21,462	$0.04	$233,034.68	$233,034.68
Residential Cooling	28	$0.10	$1,020.96	$18,121.93
School Education Kits	2,685	$0.01	$53,549.04	$545,328.19
Home Energy Services	8,288	$0.02	$317,966.55	$5,203,828.82
Saver's Switch	4,360	$6.90	$738,322.84	$738,322.84
Saver's Stat	532	N/A	$74,182.42	$74,182.42
Business ICO	0	N/A	$0.00	$0.00
Market Research	0	N/A	$0.00	$0.00
Measurement & Verification	0	N/A	$0.00	$0.00
Planning & Administration	0	N/A	$0.00	$0.00
Product Development	0	N/A	$0.00	$0.00
Total	**294,264**	**$0.02**	**$2,452,976.33**	**$19,094,348.30**

Table 12: PY2017 Detailed Costs by Program/Category

Program/Category	Avoided Production Costs	Avoided Capacity Expansion Costs	Low-Income Non-Energy Benefits	Administration Costs	Incentives
Business Comprehensive	$4,839,677.55	$1,755,781.84	$0.00	$1,833,140.33	$1,326,088.02
Home Lighting & Recycling	$4,224,390.15	$1,451,104.41	$10,575.47	$1,246,247.87	$613,413.37
Energy Feedback	$115,204.61	$117,830.07	$0.00	$133,595.74	$0.00
Residential Cooling	$12,119.05	$6,002.88	$0.00	$44,933.01	$3,075.00
School Education Kits	$474,126.08	$71,202.10	$0.00	$97,704.12	$59,921.69
Home Energy Services	$4,081,305.34	$1,002,311.57	$120,211.92	$1,592,295.31	$759,584.32
Saver's Switch	$2,598.51	$735,724.33	$0.00	$86,537.97	$164,881.56
Saver's Stat	$0.00	$74,182.42	$0.00	$91,866.62	$7,932.50
Business ICO	$0.00	$0.00	$0.00	$48.31	$0.00
Market Research	$0.00	$0.00	$0.00	$35,111.74	$0.00
Measurement & Verification	$0.00	$0.00	$0.00	$6,402.14	$0.00
Planning & Administration	$0.00	$0.00	$0.00	$205,303.92	$0.00
Product Development	$0.00	$0.00	$0.00	$34,644.91	$0.00
Total	**$13,749,421.29**	**$5,214,139.62**	**$130,787.39**	**$5,407,831.99**	**$2,934,896.46**