Southwestern Public Service Company

2016 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)

July 3, 2017

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Glossary of Acronyms and Definition

Acronym/Defined Term	Definition
2016 Annual Report	SPS's 2016 Energy Efficiency and Load Management Annual Report
2016 Plan	SPS's 2016 Energy Efficiency and Load Management Plan
AAU	Attitude and Usage Study
ADM	ADM Associates – 2016 independent program evaluator for the State of New Mexico
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 by Senate Bill 418 (2007), House Bill 305 (2008), and House Bill 267 (2013) §§62-17-1 through 62-17-11 NMSA 1978
Evaluator	Independent Program Evaluator, the third-party contractor that will conduct all measurement & verification of the programs
GWh	Gigawatt hour

Acronym/Defined Term	**Definition**
HER	Home Energy Reports
ICO	Interruptible Credit Option
kW	Kilowatt
kWh	Kilowatt hour
LED	Light Emitting Diode
M&V	Measurement and Verification
NMGC	New Mexico Gas Company
Net Generator kW; Net Generator kWh	Demand and energy savings, respectively, measured at the generator, corrected for transmission line losses and free-rider/drivership
PY	Plan Year
Rule	Energy Efficiency Rule (17.7.2 NMAC)
SPS	Southwestern Public Service Company, a New Mexico Corporation
Staff	Commission's Utility Division Staff
Stipulation	Settlement Agreement between the parties to Case No. 15-00119-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") 2016 Energy Efficiency and Load Management ("EE/LM") Annual Report ("2016 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 stated in 17.7.2.14 NMAC;
- Section III provides the program descriptions including an explanation of deviations from goal and changes during 2016, organized into the Residential, Business, and Planning & Research Segments;
- Section IV provides compliance requirements set forth in the Stipulation Agreement in Case No. 15-00119-UT;[1] and
- Appendix A provides the Measurement and Verification ("M&V") Report of SPS's 2016 program year prepared by ADM Associates, Inc. ("ADM").

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 2016 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 1 of each year, a report on its energy efficiency and load management programs during the prior calendar year.[2] The specific reporting requirements of the Rule and Revised Rule are discussed in Section II.

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[1] *In the Matter of Southwestern Public Service Company's Application Requesting: (1) Acceptance of its 2014 Annual Energy Efficiency and Load Management ("EE/LM") Report; (2) Approval of its 2016 EE/LM Plan and Associated Programs; (3) Approval of a Financial Incentive for 2016; (4) Approval of its Cost Recovery Tariff Rider; and (5) A Determination Whether A Separate Process should be Established to Analyze a Smart-Meter Pilot Program,* Case No. 15-00119-UT, Final Order Adopting Certification of Stipulation (December 23,2015).

[2] On February 15, 2017, SPS requested a variance to file the 2016 Annual Report and 2018 NM EE/LM Filing on July 3, 2017. The Commission granted the variance on March 1, 2017.

Within this 2016 Annual Report, SPS provides the expenditures and savings results for 11 energy efficiency and load management direct impact programs in the Residential Segment (including Low-Income) and Business Segment (including Large Customer). In addition, the 2016 Annual Report includes a summary of the Planning and Research Segment, which supports the direct impact programs. The M&V Report for SPS's 2016 savings is included as Appendix A.

Background

SPS filed its 2016 Energy Efficiency and Load Management Plan ("2016 Plan") on May 1, 2015 (Case No. 15-00119-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 December 23, 2015. The Stipulation included the following revisions to the originally proposed 2016 Plan: review the potential for incremental participation in the Residential Energy Feedback program, offering residential cooling as a standalone program in 2016, offering of a new Smart Thermostat pilot program, and shifting of costs within the proposed budgets of several programs to maximize marketing initiatives and increasing savings achievements.

On August 24, 2016, SPS filed an unopposed Motion in its 2017 EE/LM Plan filing (Case No. 16-00110-UT) to modify its 2016 Plan Year Energy Efficiency and Load Management program budget after projections showed the 2016 Plan Year ("PY") budget would be more than 3% of its actual 2016 revenues. On August 25, 2016 the Hearing Examiner filed a Recommended Decision recommending approval of the motion and accompanying budget modifications. The Commission issued an order approving the unopposed motion on September 7, 2016.[3]

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 September 7, 2016.

In 2016, SPS achieved verified net electric savings of 8,486.13 kilowatts ("kW") and 34,384,659 kilowatt-hours ("kWh") at the customer, at a total cost of $8,570,538.45 (see Table 1 below.) This equals 118% of SPS's 2016 approved energy goal, while spending 94% of the approved budget. The portfolio was cost-effective with a UCT ratio of 1.76.

[3] Case No. 16-00110-UT, *In the Matter of Southwestern Public Service Company's Application Requesting Approval of: (1) its 2017 Energy Efficiency and Load Management Plan and Associated Programs; (2) Continuation of its Energy Efficiency Tariff Rider and Recovery of the Difference Between SPS's Plan Year 2015 Collections and Expenditures through its Energy Efficiency Tariff Rider; and (3) a Financial Incentive for Plan Year 2017 and Recovery of the Incentive through its Energy Efficiency Tariff Rider*, Order Adopting Recommend Decision Recommending Approval of Southwestern Public Service Company's Unopposed Motion to Modify its 2016 Plan Year Energy Efficiency and Load Management Program Budget (Sept. 7, 2016).

As shown in Table 1, most of the direct impact energy efficiency programs were cost-effective under the UCT. Five of the programs did not pass the UCT test in 2016. 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: For 2016, the program received a UCT of 0.08. This was due to low participation in the program. Past experience with high efficiency coolers has shown that there is a very limited market for the equipment in eastern New Mexico because of higher cost and also the ineffectiveness of the equipment due to high humidity in the area. During 2016, Xcel Energy Inc. ("Xcel Energy') partnered with New Mexico Gas Company ("NMGC") to offer electronically commutated motors ("ECM") as a second efficiency measure in the program. The launch was too late to encourage customers to participate in 2016, however, with the addition of ECMs in late 2016 and new efficiency measures such as mini-split heat pumps, air conditioners, and conventional heat pumps launching in 2017, SPS feels confident that participation will increase along with UCTs for 2017.

- Refrigerator Recycling: For 2016, the program received a UCT of 0.69. This was primarily due to lower than forecasted participation in the program.

- Interruptible Credit Option ("ICO"): ICO didn't have any participants in 2016, 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.

- Business Saver's Switch: For 2016, this program achieved a UCT of 0.82. The score improved over the prior years with lower marketing, hardware, and installation costs. The increases were not enough, however, to generate a passing UCT.

- Smart Thermostat Pilot: For 2016, this program achieved a UCT of .21. This was due to the pilot nature of this program that included some necessary upfront costs that would not be present in future years. The Pilot also did not achieve its participation goal of 1,500 enrollments in 2016, further increasing the negative impact of upfront costs on the UCT. Lastly, the observed load management reductions were lower than expected due to the Pilot dispatching test demand response ("DR") events late in the control season. The test events were called on days with cooler temperatures than what's historically typical for weather on days when DR events have been dispatched, which reduced the overall observed impact results.

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 2016

Program	2016 Estimated								2016 Reported and Verified							
	Forecasted 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	Actual 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	16,714	$184,890	380	3,151,742	453	3,573,404	$ 196,867	1.06	15,464	$152,699	651	2,418,997	777	2,742,627	$ 160,014	1.05
Residential Cooling	192	$120,448	74	138,492	88	157,020	$ 234,038	1.17	1	$61,812	2	3,332	3	3,778	$ 4,921	0.08
Home Energy Services: Residential & Low Income	1,850	$2,111,998	618	4,600,276	738	5,215,732	$ 4,985,032	1.92	1,559	$1,585,344	514	4,789,829	613	5,430,645	$ 2,940,565	1.85
Home Lighting & Recyling	173,500	$2,045,773	1,461	10,800,262	1,743	12,245,195	$ 6,722,375	2.64	270,230	$2,143,977	1,573	11,535,659	1,877	13,078,978	$ 4,227,420	1.97
Refrigerator Recycling	450	$74,138	21	300,076	25	340,222	$ 118,418	1.33	364	$73,987	17	263,776	20	299,066	$ 50,736	0.69
Residential Saver's Switch	910	$255,750	741	5,472	884	6,204	$ 1,041,678	3.15	4,140	$256,833	3,550	34,593	4,236	39,221	$ 503,681	1.96
School Education Kits	2,500	$158,186	22	824,099	26	934,353	$ 311,861	1.97	16,188	$138,353	17	766,423	20	868,960	$ 239,522	1.73
Residential Smart Thermostats	1,500	$483,000	1,255	410,389	1,498	465,294	$ 659,648	1.04	350	$314,253	198	123,084	237	139,551	$ 65,071	0.21
Residential Segment Total	**197,616**	**$5,434,183**	**4,571**	**20,230,808**	**5,455**	**22,937,424**	**$14,269,917**	**2.12**	**308,296**	**$4,727,257**	**6,522**	**19,935,693**	**7,783**	**22,602,827**	**$ 8,191,930**	**1.73**
Business Segment																
Business Comprehensive	601	$3,072,845	1,495	8,879,410	1,668	9,620,163	$ 7,949,790	2.08	1,692	$3,286,050	1,530	14,445,593	1,707	15,650,697	$ 6,826,008	2.08
Interruptible Credit Option	2	$13,391	789	7,000	881	7,584	$ 294,524	6.00	0	$101	0	0	0	0	$ -	0.00
Saver's Switch for Business	50	$110,827	314	2,068	350	2,240	$ 434,795	3.20	170	$69,787	434	3,373	484	3,654	$ 57,570	0.82
Business Segment Total	**653**	**$3,197,063**	**2,598**	**8,888,478**	**2,899**	**9,629,987**	**$ 8,679,109**	**2.17**	**1,862**	**$3,355,938**	**1,964**	**14,448,966**	**2,192**	**15,654,351**	**$ 6,883,579**	**2.05**
Planning & Research Segment																
Consumer Education		$117,146								$104,739						
Market Research		$42,650								$40,468						
Measurement & Verification		$12,000								$5,136						
Planning & Administration		$260,000								$253,362						
Product Development		$93,581								$83,639						
Planning & Research Segment Total		**$525,377**								**$487,344**						
2016 TOTAL	**198,269**	**$9,156,623**	**7,169**	**29,119,286**	**8,354**	**32,567,411**	**22,949,026**	**2.00**	**310,158**	**$8,570,538**	**8,486**	**34,384,659**	**9,975**	**38,257,178**	**15,075,509**	**1.76**

Table 2: Variance Comparison of 2016 Estimated and Reported/Verified Data

Program	2016 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	93%	83%	172%	77%	172%	77%	81%	99%
Residential Cooling	1%	51%	3%	2%	3%	2%	2%	7%
Home Energy Services: Residential & Low Income	84%	75%	83%	104%	83%	104%	59%	97%
Home Lighting & Recyling	156%	105%	108%	107%	108%	107%	63%	75%
Refrigerator Recycling	81%	100%	79%	88%	79%	88%	43%	52%
Residential Saver's Switch	455%	100%	479%	632%	479%	632%	48%	62%
School Education Kits	648%	87%	76%	93%	76%	93%	77%	88%
Smart Thermostat Pilot	23%	65%	16%	30%	16%	30%	10%	20%
Residential Segment Total	156%	87%	143%	99%	143%	99%	57%	82%
Business Segment								
Business Comprehensive	282%	107%	102%	163%	102%	163%	86%	100%
Interruptible Credit Option	0%	1%	0%	0%	0%	0%	0%	0%
Saver's Switch for Business	340%	63%	138%	163%	138%	163%	13%	26%
Business Segment Total	285%	105%	76%	163%	76%	163%	79%	95%
Planning & Research Segment								
Consumer Education		89%						
Market Research		95%						
Measurement & Verification		43%						
Planning & Administration		97%						
Product Development		89%						
Planning & Research Segment Total		93%						
2016 TOTAL	156%	94%	118%	118%	119%	117%	66%	88%

As shown in Tables 1 and 2 (above), SPS met or came close to meeting most of its program forecasts for 2016. 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 Saver's Switch, Home Energy Services, and Home Lighting programs far exceeded their savings forecasts. SPS also controlled its indirect spending costs primarily by focusing its spending on the Consumer Education program that improves customer awareness and education.

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 measurement and verification 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, measurement and verification 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 2016, SPS offered eight residential programs with opportunities for all residential customers, including low-income customers, to participate. In total, SPS spent $4,727,257.12 on these programs and achieved 6,522 kW and 19,935,693 kWh net savings at the customer level.

Overall, the Residential Segment of programs was cost-effective with a UCT of 1.73. The segment achieved 99% of the annual kWh goal with significant contributions from the Home Lighting 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 15,418 participants and ended with 14,105, which equals an annual attrition rate of 8.5%. 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 and the 2015 Refill group that started receiving Home Energy Reports ("HER") in the summer of 2015. 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. Over 500 customers logged in to the My Energy online tool, which is available to all residential customers served by SPS.

Table 4: 2016 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	15,464	16,714	$ 152,699	$ 184,890	651	380	2,418,997	3,151,742	1.05

Deviations from Goal
The Residential Energy Feedback Program did not achieve its estimated savings impact goals in 2016, yet it was still cost-effective under the UCT. Participants in the 2015 refill group continued to save a lower than expected amount of energy. This decline is attributed in large part to the small size of this group, which has been challenging to measure due to the statistical noise as reported by the third-party implementer. Thirty-seven customers elected to opt-out of the program, which was similar to the thirty-nine customers who chose to opt-out in 2015.

Changes in 2016
None.

Residential Cooling

The Residential Cooling Program provides a cash rebate to electric customers who purchase and permanently install high-efficiency evaporative cooling, or electronically commutated motors in air conditioning equipment for residential use in New Mexico. ICF International joined forces with Xcel Energy to promote the evaporative cooler and ECM rebates in a cooperative effort with rebates from NMGC.

Table 5: 2016 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	1	192	$ 61,812	$ 120,448	2	74	3,332	138,492	0.08

Deviations from Goal

In 2016, the Residential Cooling Program spent a little over 50% 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:

1. The elimination of Tier 1 Evaporative Coolers as a result of recommendations from ADM;
2. The HVAC contractor community tends to recommend central air conditioning over evaporative cooling;
3. Homeowner's Associations place restrictions on roof-mounted evaporative coolers;
4. New home construction uses refrigerated air systems, which makes retrofitting for evaporative coolers costly and technically difficult;
5. Premium systems are not stocked by any retailers or contractors in the service territory; and
6. Introduction of the ECM rebates 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 2017, SPS plans to:

- utilize available marketing and advertising dollars;
- continue trade incentives;
- meet with local distributors that stock the Tier 2 units; and
- coordinate with local retailers to further increase participation.

Changes in 2016

ECM and Mini-split heat pump measures were added to the program in 2016 and the name of the program changed to reflect the addition of new measures offered in the program.

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 multi-family sites prior to installation of any energy efficiency components for which an incentive will be requested.

Table 6: 2016 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	1,559	1,850	$ 1,585,344	$ 2,111,998	514	618	4,789,829	4,600,276	1.85

Deviations from Goal
The Home Energy Services Program exceeded its energy savings goals for 2016. The program was also highly cost-effective. SPS attributes this to an increased emphasis on multi-family facilities by new contractors in the program. SPS spent $912,017 on the Low Income portion of the program, which is approximately 11% 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 1,803,094 customer kWh.

Changes in 2016
None.

Home Lighting and Recycling

The Home Lighting and Recycling Program helps customers save energy and money by offering energy efficient compact fluorescent light ("CFL") and light emitting diode ("LED") bulbs at discounted prices at participating retailers. SPS works with retailers and manufacturers to buy down the prices of bulbs. The price of a general purpose CFL bulb is brought down to approximately $1.00 each. 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 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 leveraged the Refrigerator Recycling program and installed LEDs in customers' homes during the Refrigerator Recycling visit.
- SPS used Energy Works (a local contractor) to install LEDs in customers' homes; this tactic focused on reaching income-qualified customers.

Table 7: 2016 Program Achievements[4]

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 & Recyling	270,230	173,500	$ 2,143,977	$2,045,773	1,573	1,461	11,535,659	10,800,262	1.97

Deviations from Goal
In 2016, the Home Lighting and Recycling Program exceeded its energy and demand savings goals. A large part of this success can be attributed to the increased promotional efforts in the community. SPS made the promotion of LED bulbs a focus of its 2016 program and will continue to increase this promotion in the future.

Changes in 2016
None

Refrigerator Recycling
The Refrigerator Recycling Program is designed to decrease the number of inefficient secondary refrigerators, primary refrigerators, and freezers in residential households. The product reduces energy usage by allowing customers to dispose of their operable, inefficient appliances in an environmentally safe and convenient manner. Customers receive a $50 incentive and free pick-up and recycling of their old freezer or refrigerator. This product is primarily marketed by bill inserts, direct mailers, radio, and on-line/social media efforts.

[4] In its report, the Independent Evaluator recorded the total number of measures issued through the program. SPS does not forecast the number of measures in its plans, only the number of forecasted participants.

Table 8: 2016 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
Refrigerator Recycling	364	450	$ 73,987	$ 74,138	17	21	263,776	300,076	0.69

Deviations from Goal
Despite strong outreach efforts, including bill inserts, the Refrigerator Recycling Program did not achieve its energy savings goal in 2016. Additional outreach efforts such as direct mailers and a promotional incentive were not pursued due to a decrease in the program budget.

Changes in 2016
The program was closed down at the end of 2016 due to budget decreases in the portfolio and is not being offered in 2017.

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 2016 program year was the sixth operational year for the Saver's Switch program. In 2016, there were two control events.

Table 9: 2016 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	4,140	910	$ 256,833	$ 255,750	3,550	741	34,593	5,472	1.96

Deviations from Goal
In 2016, 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 2016
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 10: 2016 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	16,188	2,500	$ 138,353	$ 158,186	17	22	766,423	824,099	1.73

Deviations from Goal
The program fell short of its kWh savings goal primarily due to lower than expected installation rates of some measures. The program continues to be very popular with teachers in the SPS service territory. More than 95% of the teachers continue to participate in the program each year it is offered.

Changes in 2016
None.

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 energy efficiency ("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 11: 2016 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	350	1,500	$ 314,253	$ 483,000	198	1,255	123,084	410,389	0.21

Deviations from Goal
The pilot did not reach the target goal of 1,500 participants in 2016, nor was the pilot able to dispatch the anticipated 10 test DR events. The pilot encountered delays due to technology challenges, longer than expected waiting periods between program enrollment and device installation, and slower than expected program enrollments. These delays limited the pilot population, and further delayed dispatching test DR events until late August. The pilot was able to dispatch five test events in 2016, but the outdoor temperature on these event days did not reach the highs normally observed on days when DR events have been dispatched, thus limiting the potential of measured load reduction.

Changes in 2016
None, as the pilot program launched in 2016.

Business Segment

SPS's Business Segment in New Mexico consists of nearly 24,000 commercial, industrial, and agricultural customer premises. In 2016, SPS offered three business programs with opportunities for all commercial and industrial customers to participate.

In total, SPS spent $3,355,938 on these programs and achieved 1,964 kW and 14,448,966 kWh savings at the net customer level.

Overall, the Business Segment of programs was cost-effective with a UCT of 2.05. Achievements were 163% 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 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 12: 2016 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	1,692	601	$ 3,286,050	$3,072,845	1,530	1,495	14,445,593	8,879,410	2.08

Deviations from Goal
The Business Comprehensive Program achieved 163% of its savings goal. The program also enjoyed a greater breadth of participation, as non-energy sector customers represented more than two-thirds of the product's savings. Schools, municipalities, and hospitals were strong performers. Projects for various small businesses and large natural gas midstream operators also helped to offset a sharp decline in participation among oil producers.

In coordination with NMGC, SPS realized over 250,000 kWh savings in 2016 through the direct install program. The savings included Carlsbad, Clovis, Artesia public schools, New Mexico Military Institute, and Eastern New Mexico University – Roswell. Over 348 aerators were installed in a variety of businesses.

Program expenditures were substantially driven by SPS's third and fourth quarter customer incentives, which helped accelerate project installation schedules.

Changes in 2016
SPS introduced Building Tune-Up at the end of 2016 as an indirect product to provide recommissioning studies to discover and prompt installation of measures and drive participation in other products.
The Lighting Efficiency program added LED area lighting fixtures that replace High Intensity Discharge fixtures to the retrofit rebate offering.

For customers with electric water heating systems, SPS introduced the direct installation of flow control aerators for restroom and kitchen faucets and kitchen pre-rinse spray valves at the end of 2016.

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 13: 2016 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	$ 101	$ 13,391	0	789	0	7,000	0.00

Deviations from Goal
The ICO Program did not have any participants during 2016. The ICO 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 2016:
None.

Saver's Switch for Business

Saver's Switch for Business is a demand response program that offers bill credits as an incentive for commercial customers to allow SPS to control operation of their central air conditioners on days when the 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 product is activated, a control signal is sent to interrupt the air conditioning load during peak periods, typically in the afternoon on weekdays. SPS utilizes a cycling strategy to determine how a customer's air conditioning is being operated in order to achieve a 50% reduction in load. Due to limitations in available paging systems, the program is currently available only in the cities of Portales, Hobbs, Clovis, Roswell, Artesia, and Carlsbad.

The 2016 program year was the sixth operational year for the Saver's Switch program. In 2016, there were two control events.

Table 14: 2016 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
Saver's Switch for Business	170	50	$ 69,787	$ 110,827	434	314	3,373	2,068	0.82

Deviations from Goal
After struggling to be cost effective for a number of years, the program was closed as of the end of 2016. Similar to the Residential Saver's Switch program, the Business program struggled with switch installations. More than half of the customers who signed up for the program ended up not having a switch installed due to changing their minds or having ineligible equipment.

Changes in 2016
The program was closed at of the end of 2016 due to budget decreases in the portfolio and is not being offered in 2017.

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 Consumer Education, Demand Side Management ("DSM") Planning & Administration, Market Research, Measurement & Verification, and Product Development. Each Planning and Research program is discussed below.

Consumer Education

Consumer Education is an indirect program that focuses primarily on creating public awareness of energy efficiency while providing residential customers with information on what they can do in their daily lives to reduce their energy usage. The program also supports the various energy efficiency and load management products. SPS employs a variety of resources and channels to communicate conservation and energy efficiency messages, including: the Xcel Energy website, community outreach events, customer feedback surveys, social media channels, digital kiosks, public library partnerships, and seasonal bill inserts.

The Consumer Education Program is targeted at all SPS New Mexico residential electric customers. In spreading its messages, the Consumer Education program focuses on:

- web presence on xcelenergy.com;
- social media (Facebook, Twitter, blogs, etc.);
- digital kiosks featuring "How to" energy efficiency videos;
- Power Check meters and materials placed in public libraries;
- community-based marketing events;
- sponsorship of community events supporting residential conservation and energy efficiency;
- customer feedback surveys and customized post-event emails following outreach events;

- targeted communications to address seasonal usage challenges;
- conservation messaging through newsletters and bill inserts to residential customers; and
- publication of reference education materials (in English and Spanish).

Deviations from Goal
None.

Changes in 2016
The program was closed at of the end of 2016 due to budget decreases in the portfolio and is not being offered in 2017.

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 2016
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 2016, the Market Research group oversaw the SPS portion of several Xcel Energy-wide projects such as the Awareness, Attitude & Usage Study ("AAU"), E-Source Membership, Home Use Study, and the Dun & Bradstreet list purchase.

Deviations from Goal
SPS spent less than the forecasted budget due to changes in how the AAU study costs were split between different jurisdictions to match the smaller budget for the New Mexico DSM programs.

Changes in 2016
None.

Measurement & Verification

The Measurement & Verification 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. All New Mexico utilities have contracted with ADM Associates, Inc. as their Evaluator for 2016 programs. The 2016 M&V Report is provided as Appendix A of this document. In compliance with the reporting requirements, the 2016 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 2016

None.

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 2016
Four food service measures were developed in 2016 and added to the 2017 Business Comprehensive program: demand controlled ventilation, commercial dishwasher – under counter, commercial dishwasher – door type, and hot food holding cabinet. Two cooling measures were developed in 2016 and added to the 2017 Business Comprehensive program; mini-split heat pumps for heating and cooling, and cooling-only mini-splits for data closets. A mini-split cooling and heating measure was also added to the 2017 Residential Cooling program.

Section IV: 2016 Incentive Mechanism True-Up

In Case No. 15-00119-UT, SPS indicated that it would provide the reconciliation of its 2016 PY incentive in its annual report. The Commission authorized SPS to collect a baseline financial incentive of $622,650. Interest was to be symmetrically applied to the over- or under-collected monthly balance, applied at the customer deposit interest rate. In 2016, SPS collected $492,356.28, compared to the baseline financial incentive of $622,650. Interest of $11,298.40 was applied, for a net under-recovery balance of $141,592.13.

Next, SPS compared its baseline incentive to its Commission-approved earned incentive. As shown in Table 1-4 in Appendix A, SPS exceeded its 2016 achievement goal of 29.139 Giga-watt hour ("GWh") by 5.2 GWh, resulting in an earned incentive of $651,036. When compared to the baseline incentive ($622,650), SPS needs to collect an additional $28,386 related to the 2016 incentive.

SPS will account for both of these reconciliations in its 2018 Plan filing.

Appendix A: Measurement & Verification Report:

SPS 2016 Program Year

Provided by ADM Associates, Inc., June 2017

Southwestern Public Service Company DSM Portfolio Program Year 2016

Prepared for:

Xcel Energy

June 2017

Final

Prepared by:

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1. Executive Summary

This report is to provide a summary of the evaluation effort of the 2016 Demand Side Management (DSM) portfolio by the Southwestern Public Service Company (Xcel, a division of Xcel Energy).

1.1 Summary of Xcel Energy Efficiency Programs

New Mexico Investor-Owned Utilities (IOUs) are required to develop cost-effective DSM programs, using ratepayer funds to reduce energy demand and consumption. IOUs submit their portfolios to the New Mexico Public Regulatory Commission (NMPRC) for approval. In 2016, the Xcel DSM portfolio contained the following programs:

- Residential Cooling
- Residential Home Energy Services
- Low Income Home Energy Services;
- Energy Feedback Program
- Home Lighting & Recycling
- School Education Kits
- Residential Refrigerator Recycling
- Business Comprehensive
- Large Customer Self-Direct[1]
- Residential Saver's Switch
- Smart Thermostat Pilot
- Business Saver's Switch
- Interruptible Credit Option[2]

For 2016, ADM Associates, Inc. (the Evaluators) evaluated a subset of the portfolio. The programs evaluated for this program year include:

- Business Comprehensive;
- Energy Feedback Program;
- Home Energy Services;
- Low Income Home Energy Services;

[1] No participants in 2016

[2] No participants in 2015

- Evaporative Cooling; and
- Smart Thermostat Pilot.

1.2 Evaluation Objectives

The objectives of this evaluation include:

- Development of program-specific evaluation plans;
- Design a sample allowing for 90% confidence and +/- 10% statistical precision for each program;
- Conduct onsite verification inspections, telephone surveying, and onsite metering as needed;
- Evaluate gross savings by program;
- Provide net savings totals through evaluation of free-ridership;
- Evaluate cost-effectiveness of each program using the Total Resource Cost (TRC) test; and
- Evaluate programs within the portfolio and make recommendations for amendments and improvements.

1.3 Summary of Findings

Gross savings were estimated by engineering analysis, simulation modeling, participant surveying, and on-site monitoring where appropriate for the program and measure type. The Evaluators then estimated free-ridership and associated net-to-gross ratios (NTGRs) for the evaluated programs Table 1-1 and 1-2 below present the gross and net impact by program[3]. It should be noted that these tables include both evaluated and non-evaluated programs. Non-evaluated programs are shown as having 100% gross and net realization rates.

[3] Savings in Table 1-1 and Table 1-2 both reflect customer kWh savings; no line-losses are included in these values.

Table 1-1 Gross Impact Summary

Program	Peak Demand Savings (kW)		Annual Energy Savings, (kWh)		Lifetime Energy Savings (kWh)		Gross Realization Rate
	Expected	Realized	Expected	Realized	Expected	Realized	
Home Energy Services	481.66	251.32	2,680,608	2,105,414	56,292,017	43,153,650	78.54%
Home Lighting	1,754.43	1,754.43	12,800,267	12,800,267	99,074,065	99,074,065	100.00%
Business Comprehensive	2,295.75	1,670.52	16,047,941	15,750,486	199,444,241	197,133,237	98.84%
Energy Feedback Program	511.00	651.15	2,785,975	2,418,997	2,785,975	2,418,997	86.80%
Residential Cooling	2.38	2.38	3,332	3,332	49,980	49,980	100.00%
Low Income Home Energy Services	343.59	273.84	3,011,776	2,931,307	52,337,538	47,447,376	97.33%
Low Income Kits	1.21	1.21	55,428	55,428	527,675	527,675	100.00%
Refrigerator Recycling	24.63	24.63	391,928	391,928	1,959,640	1,959,640	100.00%
School Education Kits	16.85	16.85	766,423	766,423	7,296,347	7,296,347	100.00%
Residential Saver's Switch	3,550.00	3,550.00	34,593	34,593	34,593	34,593	100.00%
Business Saver's Switch	434.00	434.00	3373	3373	3373	3373	100.00%
Smart Thermostat Pilot[4]	198.30	198.30	123,084	123,084	1,230,840	1,230,840	100.00%
Total	9,613.80	8,828.63	38,704,728	37,384,632	421,036,284	400,329,773	96.59%

[4] There was no ex ante claim of kW for this program due to its status as a pilot. The Evaluators'' verified kW is entered as both ex ante and ex post.

Table 1-2 Net Impact Summary

Program	Peak Demand Savings (kW)		Annual Energy Savings, (kWh)		Lifetime Energy Savings (kWh)		Net Realization Rate
	Expected	Realized	Expected	Realized	Expected	Realized	
Home Energy Services	376.95	239.04	2,549,336	1,803,094	53,533,708	32,490,697	70.73%
Home Lighting	1,573.01	1,573.01	11,535,659	11,535,659	89,285,998	89,285,998	100.00%
Business Comprehensive	1,829.21	1,529.77	12,580,208	14,445,592	159,077,773	180,637,241	113.55%
Energy Feedback Program	511	651.15	2,785,975	2,418,997	2,785,975	2,418,997	86.80%
Residential Cooling	2.38	2.38	3,332	3,332	49,980	49,980	100.00%
Low Income Home Energy Services	343.59	273.84	3,011,776	2,931,307	52,337,538	47,447,376	97.33%
Low Income Kits	1.209	1.209	55,428	55,428	527,675	527,675	100.00%
Refrigerator Recycling	16.58	16.58	263,776	263,776	1,318,880	1,318,880	100.00%
School Education Kits	16.85	16.85	766,423	766,423	7,296,347	7,296,347	100.00%
Residential Saver's Switch	3550	3550	34,593	34,593	34,593	34,593	100.00%
Business Saver's Switch	434	434	3373	3373	3373	3373	100.00%
Smart Thermostat Pilot[5]	198.3	198.3	123,084	123,084	1,230,840	1,230,840	100.00%
Total	8,853.08	8,486.13	33,712,963	34,384,658	367,482,680	362,741,997	101.99%

The Evaluators estimated cost-effectiveness of the 2016 programs and overall portfolio using the Utility Cost (UCT) test. System benefits were scaled by line-loss values provided by Xcel. They are detailed in Table 1-3.

Table 1-3 Line Loss Factors Used in UCT Tests

Segment	kWh	kW
Residential	11.8%	16.2%
Non-Residential	7.7%	10.4%

The UCT results are provided in Table 1-4[6].

[5] There was no ex ante claim of kW for this program due to its status as a pilot. The Evaluators'' verified kW is entered as both ex ante and ex post.

[6] Benefits calculations incorporate line losses for energy and demand; UCT scores reflect net-at-generator savings.

Table 1-4 Cost Effectiveness Testing by Program

Program	*NPV of UCT Benefits*	*NPV of UCT Costs*	*UCT*
Home Energy Services (Regular & LI)	$2,940,564.84	$1,585,343.52	1.85
Home Lighting	$4,227,419.83	$2,143,976.52	1.97
Business Comprehensive	$6,826,008.44	$3,286,049.73	2.08
Energy Feedback Program	$160,014.14	$152,699.19	1.05
Residential Cooling	$4,921.32	$61,812.28	0.08
Refrigerator Recycling	$50,735.54	$73,986.66	0.69
School Education Kits	$239,521.98	$138,353.04	1.73
Residential Saver's Switch	$503,681.35	$256,832.81	1.96
Business Saver's Switch	$57,570.30	$69,786.64	0.82
Smart Thermostat Pilot	$65,071.46	$314,253.10	0.21
Interruptible Credit Option	$0	$101.23	-
Consumer Education	$0	$104,739.21	-
Market Research	$0	$40,467.54	-
Measurement & Verification	$0	$5,135.54	-
Planning & Administration	$0	$253,361.98	-
Product Development	$0	$83,639.46	-
Total	$15,075,509.20	$8,570,538.45	1.76

1.4 Recommendations

1.4.1 Home Energy Services

- **Provide SEER and HSPF values for duct sealing and air infiltration.** SEER and HSPF values are needed to accurately calculate duct sealing savings and air infiltration savings.
- **Provide pre- and post-retrofit CFL wattages.** Current tracking data provides quantity of lamps install in each location and in certain wattage ranges. Pre- and post-retrofit CFL wattages are needed to accurately CFL savings.
- **Include application questions on the pre-existing heating system and whether it was functioning.** In order to claim electric resistant heating as the baseline, it needed to be functional prior to the retrofit. Misuse of this baseline resulted in significant savings reductions for the program.

1.4.2 Residential Cooling

- **Schedule a 2017 evaluation.** The program had two participants in 2016 and as such the Evaluators did not conduct EM&V for this program.

1.4.3 Business Comprehensive

- **Continue the pre-project M&V with the new EM&V Contractor.** With the program savings becoming increasingly concentrated in a small number of large projects, it is crucial that the BCP maintain the pre-M&V process.

1.4.4 Smart Thermostat Pilot

- **Continue to develop this load management resource.** The pilot findings showed this to be a successful DLC mechanism with lower M&V costs than the load control switches used in Residential Saver's Switch.
- **Test more aggressive cycling strategies.** The pilot data showed that the cycling events had much lower reductions in duty cycling than thermostat setback; program staff should consider testing 30% cycling events in 2017.
- **If feasible, test adaptive cycling events.** Adaptive cycling events (in which the thermostat "learns" if the AC is over- or under-sized and normalizes the cycling to comfort level) would account for sizing issues that mar the effectiveness of fixed cycling events. If the ecobee thermostat can support this, Xcel should consider testing this type of cycling strategy.
- **Use best-case values from this pilot in future planning.** The events were called during lower temperature days than typical due to the timing of the pilot. The hottest average event temperature was 89 degrees, and during this time the pilot provided a reduction of .35 kW/ton controlled.

2. General Methodology

This chapter details general impact evaluation methodologies by program-type as well as data collection methods applied. This chapter will present full descriptions of:

- Gross Savings Estimation;
- Sampling Methodologies;
- Free-Ridership determination; and
- Data Collection Procedures.

2.1 Glossary of Terminology

As a first step to detailing the evaluation methodologies, the Evaluators provide a glossary of terms to follow:

- *Ex Ante* – A program parameter or value used by implementers/sponsoring utilities in estimating savings before implementation
- *Ex Post* – A program parameter or value as verified following completion of the evaluation effort
- *Deemed Savings* – A savings estimate for homogenous measures, in which an assumed average savings across a large number of rebated units is applied (e.g., assuming 398 kWh savings for a low-flow showerhead)
- *Gross Savings* – Energy or demand savings as determined through engineering analysis and verification
- *Gross Realization Rate* – Ratio of Ex Post Savings / Ex Ante Savings (e.g. If the Evaluators verify 300 kWh per showerhead, Gross Realization Rate = 300/398 = 75%)
- *Free-Ridership* – Percentage of participants who would have implemented the same energy efficiency measures in a similar timeframe absent the program
- *Net Savings* – Gross savings factoring off free-ridership, (erg., if Free-Ridership for low-flow showerheads = 50%, net savings = 300 kWh x 50% = 150 kWh)
- *Net-to-Gross-Ratio (NTGR)* = (1 – Free-Ridership %), also defined as Net Savings / Gross Savings
- *Ex Ante Net Savings* = Ex Ante Gross Savings x Ex Ante Free-Ridership Rate
- *Ex Post Net Savings* = Ex Post Gross Savings x Ex Post Free-Ridership Rate
- *Net Realization Rate* = Ex Post Net Savings / Ex Ante Net Savings

- *Effective Useful Life (EUL)* – The average lifetime of a measure, denominated in years
- *Gross Lifetime kWh* = Ex Post Gross Savings x EUL
- *TRC* – Total Resource Cost Test, taking the ratio of net benefits over net costs, including both participant and utility costs
- *UCT* – Utility Cost Test, taking the ratio of net benefits over net utility costs.

2.2 Overview of Methodology

The Evaluators' methodology in the evaluation of the 2016 Xcel DSM Portfolio is intended to provide:

- Net impact results at the 90% confidence and +/-10% precision level;
- Program feedback and recommendations via process evaluation; and
- Cost effectiveness testing at the program and portfolio level.

In doing so, this evaluation will provide the NMPRC with verified net savings results, provide the sponsoring utilities with recommendations for program improvement, and ensure cost-effective use of ratepayer funds.

2.3 Sampling

Sampling is necessary to evaluate savings for the Xcel DSM portfolio insomuch as verification of a census of program participants is typically cost-prohibitive. As per NMPRC requirements, samples are drawn in order to ensure 90% confidence at the +/-10% precision level. Programs are evaluated on one of three bases:

- Census of all participants
- Simple Random Sample
- Stratified Random Sample

2.3.1 Census of Participants

A census of participant data was used for select programs where such review is feasible. An example of this is the statistical analysis of billing data associated with the Energy Feedback Program. .

2.3.2 Simple Random Sampling

For programs with relatively homogenous measures (largely in the residential portfolio), the Evaluators conducted a simple random sample of participants. The sample size for verification surveys is calculated to meet 90% confidence and 10% precision (90/10). The sample size to meet 90/10 requirements is calculated based on the coefficient of variation of savings for program participants. Coefficient of Variation (CV) is defined as:

$$CV = \frac{Mean_x}{Standard\ Deviation_x}$$

Where x is the average kWh savings per participant. Without data to use as a basis for a higher value, it is typical to apply a CV of .5 in residential program evaluations. The resulting sample size is estimated at:

$$n_0 = \left(\frac{1.645 * CV}{RP}\right)^2$$

Where,

1.645 = Z Score for 90% confidence interval in a normal distribution

CV = Coefficient of Variation

RP = Required Precision, 10% in this evaluation

With 10% required precision (RP), this calls for a sample of 68 for programs with a sufficiently large population. However, in some instances, programs did not have sufficient participation to make a sample of this size cost-effective. In instances of low participation, the Evaluators then applied a finite population correction factor, defined as:

$$n = \frac{n_0}{1 + {}^{n_0}/_N}$$

Where

n_0 = Sample Required for Large Population

N = Size of Population

n = Corrected Sample

For example, if a program were to have only 100 participants, the finite population correction would result in a final required sample size of 41. The Evaluators applied finite population correction factors in instances of low participation in determining samples required for surveying or onsite verification.

2.3.3 Stratified Random Sampling

For the Xcel business portfolio, Simple Random Sampling is not an effective sampling methodology as the CV values observed in business programs are typically very high because the distributions of savings are generally positively skewed. Often, a relatively small number of projects account for a high percentage of the estimated savings for the program.

For example, the 2016 Xcel Business Comprehensive Program had a CV of 4.19 at year's end. Using the base simple random sample function, this would call for a sample

of 4,751. This program had 156 participating facilities, and as such, a finite population adjustment is needed. Adjusting for the population, the required simple random sample is 151, which would be prohibitively expensive.

To address this situation, we use a sample design for selecting projects for the M&V sample that takes such skewness into account. With this approach, we select a number of sites with large savings for the sample with certainty and take a random sample of the remaining sites. To further improve the precision, non-certainty sites are selected for the sample through systematic random sampling. That is, a random sample of sites remaining after the certainty sites have been selected is selected by ordering them according to the magnitude of their savings and using systematic random sampling. Sampling systematically from a list that is ordered according to the magnitude of savings ensures that any sample selected will have some units with high savings, some with moderate savings, and some with low savings. Samples cannot result that have concentrations of sites with atypically high savings or atypically low savings. As a result of this methodology, the required sample for this component of the Small Business Lighting program was reduced to 29, with one certainty stratum and 4 sample strata.

2.3.4 Free-Ridership

In determining ex post net savings for the Xcel DSM portfolio, the Evaluators provide estimates of free-ridership for individual programs. Free-riders are program participants that would have implemented the same energy efficiency measures at nearly the same time absent the program. Rather than apply a binary scoring (0% vs. 100% free-ridership), the Evaluators applied a free-ridership probability to program participants, based upon four factors:

(1) Financial ability to purchase high efficiency equipment absent the rebate

(2) Importance of the rebate in the decision-making process

(3) Prior planning to purchase high efficiency equipment

(4) Demonstrated behavior in purchasing similar equipment absent a rebate

In this methodology, Part (1) is essentially a gateway value, in that if a participant does not have the financial ability to purchase energy efficient equipment absent a rebate, the other components of free-ridership become moot. As such, if they could not have afforded the high efficiency equipment absent the rebate, free-ridership is scored at 0%. If they did have the financial capability, we then examine the other three components, each contributing an equal scoring of 33% to free-ridership. It should be noted that having financial ability does not necessarily imply free-ridership; it just opens the possibility that other factors could contribute. A participant that was financially able to purchase high efficiency lighting, for example, could still be scored at 0% free-ridership if it is demonstrated that:

(1) The rebate factored into their decision-making process;

(2) They did not have prior plans to install high efficiency equipment before learning of the available rebates; and

(3) They did not demonstrate prior behavior of purchasing similar equipment absent a rebate.

There are other contributing factors to free-ridership, specifically in instances of programs that provide outreach to customers. For example, if in a large commercial retrofit, a sponsoring utility provides assistance in energy efficiency measure recommendation, or in providing cost-benefit analysis of a measure to a business, these could factor into the decision-making in ways that mitigate free-ridership, in that there are cases where a participant did not need a rebate to participate, but was induced to participate by the sponsoring utility's efforts in recommending and/or evaluating energy efficiency measures for them. Additional issues such as this are addressed on a program-by-program basis in methodology sections to follow.

For residential programs, free-ridership is calculated as the average score determined for the sample of participants surveyed. For business programs, a weighted average is taken of verified kWh savings, as the free-ridership scores of high-savers contribute a larger share of the overall free-ridership rate. Once free-ridership is determined, the Evaluators then estimate the Net-to-Gross Ratio (NTGR), calculated as:

NTGR = 1 – % Free-Ridership

2.4 Data Collection

This subsection provides descriptions of The Evaluators' data collection procedures, including:

- Telephone Surveying;
- Residential On-Site Verification; and
- Business On-Site Verification & Metering.

2.4.1 Telephone Surveying

The Evaluators conducted a large volume of telephone surveys in in this effort. These surveys were designed to collect a variety of data needed in the evaluation effort, including:

- Verification of installation of rebated equipment;
- Parameters used in gross savings calculations (room of installation for residential CFLs, whether a refrigerator was used indoors vs. outdoors, etc.);

- Data on decision-making to be used in determining program free-ridership; and
- Feedback from participants from their experiences with the program.

Surveys with business program participants, rebate consultancies, CFL distributing agencies, and trade allies were conducted by ADM staff. Surveys with residential program participants were conducted by Research & Polling, an experienced survey firm, with ADM performing quality control checking on the survey programming and monitoring a sample of phone calls. This ensured that interviewers were adhering to the survey script and that all questions were read correctly.

2.4.2 Onsite Surveys

On-site data collection procedures varied by program. For residential programs, site visits constituted a verification inspection of rebated equipment. For business participants, the Evaluators conducted onsite metering at facilities where factors contributing to energy savings, including lighting schedule and motor load factors, were subject to high uncertainty.

2.5 Cost Effectiveness Testing

The Evaluators performed the Utility Cost (UCT) test as part of the 2016 EM&V effort.

2.5.1 Utility Cost Test

The UCT test is defined as:

$$UCT = \frac{\text{Electric Cost Decrease} + \text{Capacity Credit}}{\text{Utilty Equipment Expenditures} + \text{Utility Administrative Costs}}$$

The parameters for this equation are defined in Table 2-1.

‘

Table 2-1 Parameters for Cost-Effectiveness Testing

Parameter	***Definition***
UEPCD	Utility Electric Cost Decrease: The Net Present Value (NPV) of avoided production costs. Estimated by taking NPV of net kWh savings multiplied by $/kWh production costs over the life of the measure.
UGCC	Utility Generation Capacity Credit: The NPV of avoided capacity expansion costs. Estimated by taking NPV of net demand reduction multiplied by $/kW capacity expansion costs over the life of the measure.
UEE	Utility Equipment Expenditures: Incentives paid to program participants for energy efficient equipment.
UAC	Utility Administrative Costs: Costs accrued by Xcel for running the program. Costs include internal administration costs, marketing, and third-party implementation costs. Rebates are not considered a cost as they represent transfer payments from Xcel to program participants.

3. Home Energy Services

3.1 Program Description

The Home Energy Services Program (HESP) provides incentives to energy efficiency service providers (EESPs or "contractors") to install a range of residential upgrades to existing homes that save energy and reduce energy costs. Professionally trained technicians use field tested protocols and advanced diagnostic equipment to determine the most cost-effective energy savings measures appropriate for each home. Typical upgrade services include installing insulation in the attic; stopping heat loss around windows, doors, and other infiltration points; repairing leaky ducts; and installing high efficiency central air conditioner and heat pumps. The main program provides services to all Xcel residential customers. There is also a low income version of the program that provides a wider range of measures free of charge.

For the main HESP, the following is provided free-of-charge:

- Duct sealing;
- Air Sealing; and
- Low flow showerhead

Ceiling insulation is provided with customer co-pay.

The program also provided rebates for installing and installing high efficiency central air conditioner and heat pumps.

3.2 Program Participation

The HESP had 635 participants in 2016 and installed a total of 1,198 measures.

Figure 3-1 summarizes the share of program savings contributed by each measure. Most savings came from duct sealing, air sealing, and ceiling insulation. On average each premise installed 1.89 measures and saved 4,228 kWh annually.

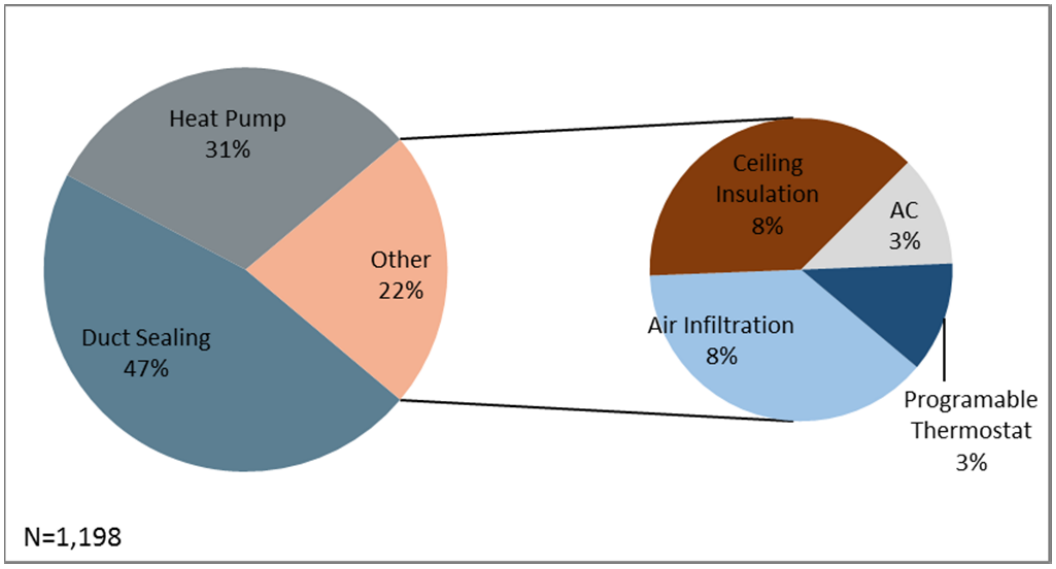


Figure 3-1 HESP Program Savings Share by Measure

Figure 3-2 summarizes the premises by month as determined by the date of rebate delivery as well as the cumulative savings from the program.

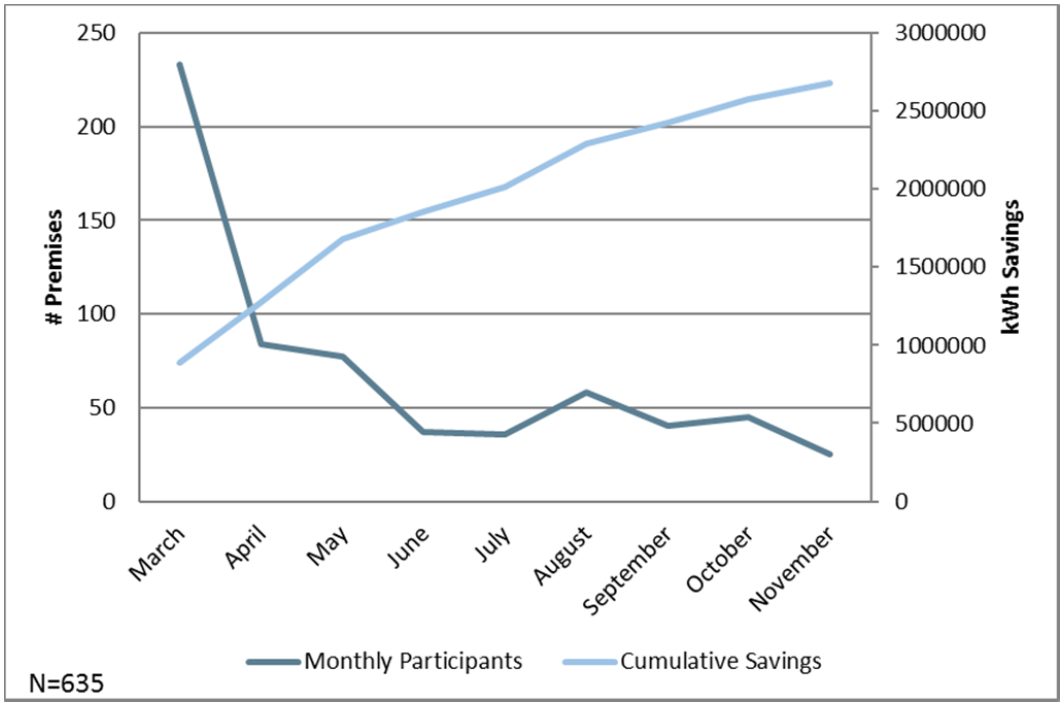


Figure 3-2 HESP Premises by Month

3.3 M&V Methodology

The M&V approach for the Residential Home Energy Services Program is aimed at the following:

- Verifying participation through participant surveying;
- Verifying post-retrofit duct leakage and infiltration at a sample of participants; and
- Providing estimates of net-to-gross savings and free-ridership.

Table 3-1 below summarizes the inputs needed for gross savings calculations and the source of each input.

Table 3-1 Data Sources for Gross Impact Parameters –Home Energy Services

Parameter	***Source***
Home Specifications	Tracking Data & Onsite Verification
Post Installation Duct Leakage & Infiltration	On-site Measurement

3.3.1 Review of Deemed Savings Estimates

The Evaluators reviewed the deemed savings estimates for measures rebated through the program in 2016. The deemed savings assumptions were based upon 2016 NM TRM.

3.3.2 Verification of Installed Measures

Verification of the weatherization measures installed included the following;

- Desk Review of the tracking data;
- Surveys of customers who installed rebated equipment; and
- On-site measurement of duct leakage and infiltration

3.3.3 On-Site Measurement Procedures

To measure duct leakage, evaluation field staff performed duct pressurization testing (using Duct Blasters®) on the ducting for central air conditioning systems. System static pressure (SSP) on the duct system was first measured, where SSP is a measurement of static pressure at the supply side plenum of the duct system when the supply fan is on and operating with registers in their normal position. This pressure is unique for each system. The ducts were then pressurized by means of a Duct Blaster® connected to the return side of the system. Total duct leakage was measured with the registers sealed and the Duct Blaster® pressurizing the duct system. Total Duct leakage at 50 Pa was then recorded.

An additional step was required to measure duct leakage to unconditioned space. A Blower Door® was set up in an exterior doorway and used to pressurize the house to the same pressure as the ducts. This prevented any leakage to other conditioned spaces within the residence; all leakage measured, once the home was pressurized, would therefore be only to unconditioned spaces. Duct leakage to unconditioned space was then measured at 25 Pa, where possible.

Finally, total home infiltration, measured in CFM, was calculated. One-time measurements of pressure differential between the conditioned and unconditioned space were taken to calculate a snap shot of total home infiltration, in CFM. However, this measurement of infiltration will not remain constant throughout the year, as it is a function of pressure differential between the interior and exterior of the home. As pressure varies, with changing wind and outdoor temperatures, infiltration of the residence's envelope will also change.

3.3.4 Data Review & Sampling

The Evaluators reviewed tracking data for anomalous entries and to ensure that savings were calculated according to the methodologies outlined in Xcel tech assumptions. Having validated the tracking data, the evaluators verified installation of rebated measures through telephone surveys with program participants. The evaluators visited 11 premised for HESP.

3.4 Impact Evaluation

3.4.1 Tracking Review

The impact evaluation began with a review of program tracking data. Every premise in the program had a unique identifier, and thus one premise could have multiple rows to reflect the different measures completed. Table 3-2 summarizes ex ante savings by measure for the HESP.

Table 3-2 HESP Ex Ante Summary

Measure	Count	Ex Ante kWh	Ex Ante kW
Duct Sealing	409	1,249,975	102.24
Air Infiltration	341	228,175	26.48
Ceiling Insulation	78	227,397	22.09
Heat Pump	138	834,239	285.70
AC	62	70,612	32.23
Programmable Thermostat	170	70,210	12.92
Total	1198	2,680,608	481.66

The Evaluators conducted a tracking review on a census of measures in the HESP. This review entailed recreating the deemed savings calculations from the New Mexico

TRM using the ex ante input values (such as leakage, SEER, etc.). The results of this are presented in the "Validated kWh" entry in the table below.

Table 3-3 HESP Tracking Review – kWh

Measure	Ex Ante kWh	Validated kWh
Duct Sealing	1,249,975	1,359,636
Air Infiltration	228,175	222,549
Ceiling Insulation	227,397	227,397
Heat Pump	834,239	179,322
AC	70,612	46,300
Programmable Thermostat	70,210	70,210
Total	2,680,608	2,105,414

Table 3-4 HESP Tracking Review – kW

Measure	Ex Ante kW	Validated kW
Duct Sealing	102.24	101.26
Air Infiltration	26.48	26.39
Ceiling Insulation	22.09	22.10
Heat Pump	285.70	66.02
AC	32.23	22.64
Programmable Thermostat	12.92	12.92
Total	481.66	251.32

There were significant adjustments made to heat pumps and air conditioners. The tracking data provided by Xcel indicated that only one heat pump retrofit replaced an electric resistant heating system (either an electric forced air furnace or a radiant heating system). The Evaluators concluded that this revision in savings is due to erroneous use of the electric forced air furnace baseline instead of the air source heat pump baseline.

3.4.2 Field Verification

The Evaluators conducted field verifications at 30 premises. The field verification sample included the following measures:

- 26 duct sealings;
- 19 air sealings.

For all measure types requiring on-site measurements, the square footage and heating and cooling types were verified. To verify ceiling insulation, the insulation type and measured depth were recorded.

3.4.2.1 Duct Sealing Field Results

The Evaluators found that 19 out of 26 tested sites had post-retrofit leakage which differed from values listed in program tracking data by more than 20%. Figure 3-3

summarizes the differences in field test values. The line in this figure presents the Evaluators' tested post-retrofit CFM leakage minus the trade allies' post-retrofit CFM leakage. The data is presented in ascending order, based on lowest ex ante post-retrofit CFM to highest ex ante post-retrofit CFM.

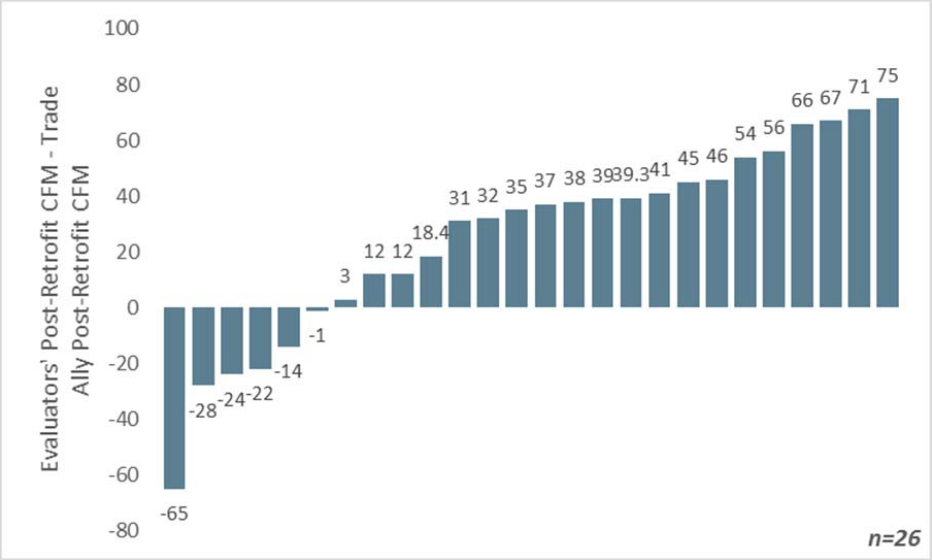


Figure 3-3 Difference in Expected and Evaluated Ex-Post Duct Sealing CFM

Of the values that differed by more than 20%, 71% deviated in a manner which would potentially overstate savings. Twenty-nine percent underestimated savings. The data displays a general trend of there being greater differences at high and low extremes for ex-ante post-retrofit CFM, with values in the middle of the distribution performing more favorable in the Evaluators' field results.

The field verification rate for duct sealing projects was 90.8%.

3.4.2.2 Air Sealing Field Results

The Evaluators found that two homes tested had ex ante pre- and post-retrofit measurements that were the same as the duct sealing measurements. The Evaluators believe there were input errors for this site and did not include in the field results. One of the 19 valid tested homes had post-retrofit air leakage values that differed from program tracking data more than 20%. This tested home would have potentially over overestimated the savings. The field test differences are summarized in Figure 3-4.

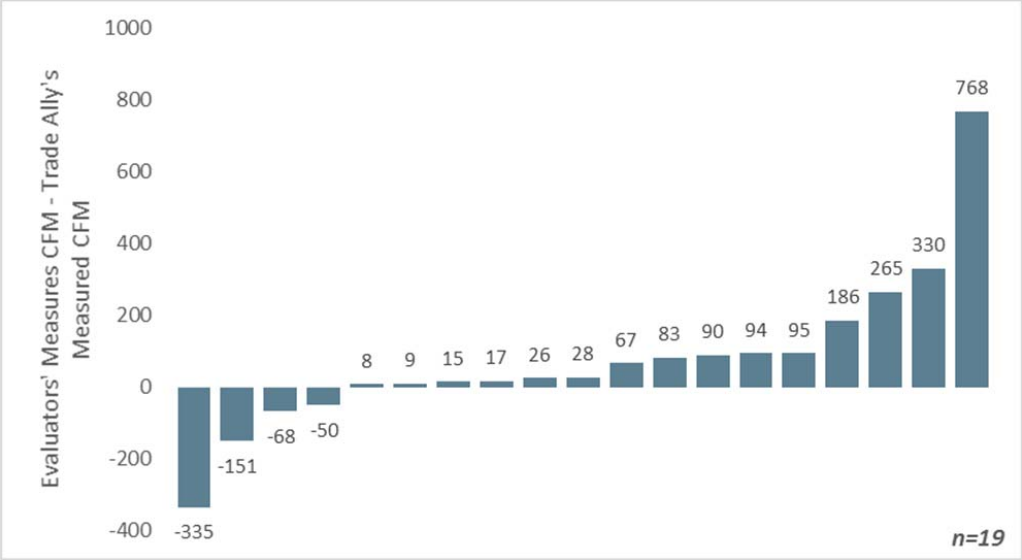


Figure 3-4 Difference in Expected and Evaluated Ex-Post Air Sealing CFM

In aggregate, the Evaluators found that ex ante test values underestimated program savings. The field verification rate was 88.7%. The gross realization rate was 86.5%.

3.4.3 Summary of Gross Savings Adjustments

Figure 3-5 summarizes the gross savings adjustments made for the HESP.

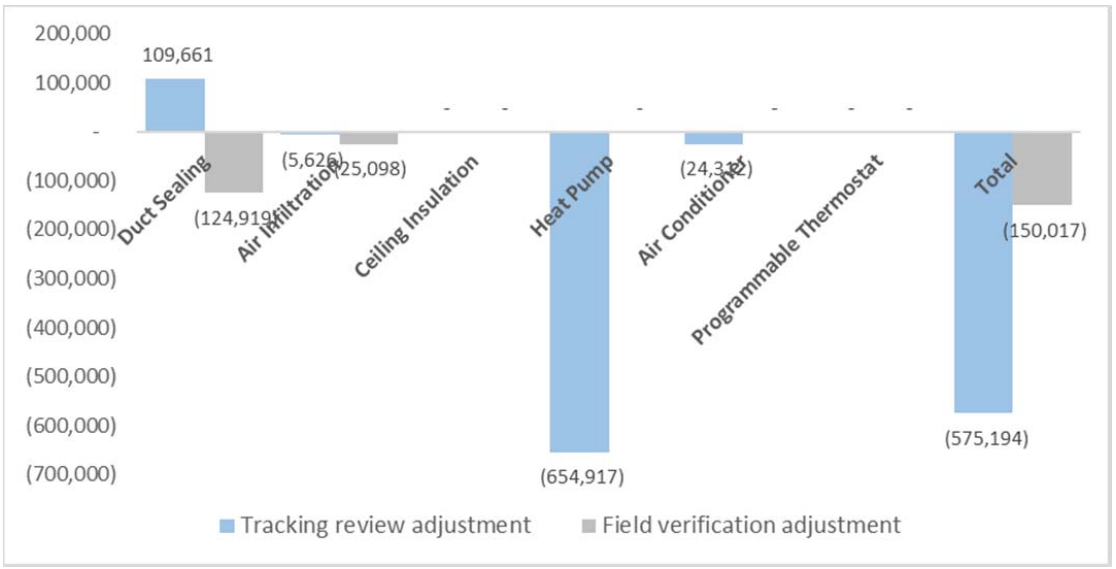


Figure 3-5 Summary of Gross kWh Adjustments

3.4.4 Net Savings

3.4.4.1 Home Energy Services Residential Weatherization Net Savings Estimates

The purpose of the Home Energy Services Program is to assist customers who would benefit from energy efficiency measures such as ceiling insulation, home infiltration, and duct sealing. However, some homes that were part of the program might have installed the same measures without the program. These homes would represent free-ridership. Thus the question to be addressed in the net savings analysis was what proportion of gross savings resulting from the implemented measures was directly attributable to the HES Program. Rather than apply a binary scoring (0% vs. 100% free-ridership), ADM applied a free-ridership probability to program participants, based upon four factors below with the survey questions included that pertain to them:

3.4.4.2 Financial Ability to purchase weatherproofing measures absent program assistance

FA1: Would you have been financially able to install these energy efficiency measures without the Home Energy Services Program from Xcel?

If the customer answered “No” to this, then they are assigned 0% free-ridership, as without the financial ability to purchase the measures in the kit, other factors in the decision making process are not relevant. Having financial ability does not inherently make one a free-rider, however, as they could still have been program-induced.

3.4.4.3 Importance of program assistance in the decision-making process

IP1: On a scale of 0 to 10, how likely would you have been to install the measure in your home on your own if the HES Program were not available?

If the respondent gives a value greater than six, then the respondent is considered a partial free-rider.

3.4.4.4 Prior Planning to purchase weatherproofing measures

PP1: Did you have plans to add the measure to your home before participating in the HES Program?

PP2: When did you learn of the HES Program?

If the respondent answers “Yes” in PP1 and says they “had already installed some amount of the measure” in PP2, then the respondent is considered a partial free-rider.

3.4.4.5 Program alters customer’s behavior

B1: Did you install these energy efficient measures earlier than you otherwise would have without the program?

B2: When would you otherwise have installed the measures?

If the respondent indicates in B1 “Yes”, and for B2 chooses an option of “over 1 year”, then they are considered to have been motivated by the energy efficiency program and are thus a 0% free-rider for this component. If respondents who indicated in B2 “less than 6 months” or “6-12 months”, then these respondents are considered partial free-riders. If the respondent indicated in B1 “No”, then they are a free-rider for this component because the program retrofit did not affect timing of purchase and installation of measures.

Table 3-5 Free Ridership Rate by Measure

Measure Type	Free Ridership Rate
Ceiling Insulation	0%
Air Sealing	7.25%
Duct Sealing	3.50%

In order to calculate spillover savings that are attributable to the HES Program, the participant survey included questions related to any additional energy efficiency purchases that have been made due to the customers’ experience with the program. The survey asked the following questions in order to identify additional purchases made:

- SO1: Because of your experience with the HES Program, have you bought, or are you likely to buy, additional energy efficient items on your own without a financial rebate?
- SO2: Please indicate whether you have purchased any of the following items on your own since participating in the program, and indicate how many you have purchased.

Participants indicating one or more energy efficiency purchases were then asked two questions in order to determine whether the energy savings resulting from that measure may be attributed to the program:

- SO3: On a scale of 0 to 10, where 0 represents “not at all important” and 10 represents “extremely important”, how important was your experience with the Home Weatherproofing Program in your decision to purchase the items you just mentioned?
- SO4: On a scale of 0 to 10, where 0 represents “not at all likely” and 10 represents “extremely likely” how likely would you have been to make the additional purchases you just mentioned even if you had not participated in the program?

Participants responding to question SO3 with a rating of 7 or higher, and responding to question SO4 with a rating of 3 or lower, are considered to have been motivated by the program to make these additional purchases, and the energy savings from these items were attributed to the program. The survey identified one customer (1.25%) who purchased 6 LED Light Bulbs as a direct result of the program. Savings for spillover measures similar to those offered through the program were calculated and then extrapolated to the population of respondents.

Once free-ridership and spillover were determined, ADM then estimated the Net-to-Gross Ratio (NTGR), calculated as:

$$NTGR = 1 - \%\ Free\text{-}Ridership + Spillover$$

3.5 Home Energy Services Residential Cooling Net Savings Estimates

First, customers are asked as to any plans they had to install high efficiency equipment. This is addressed in the following questions:

Question 3: Did you have specific plans to purchase an air conditioner before you talked with anyone about the program?

Question 4: When did you learn about the program?

If the respondent indicates that they did have prior plans, and that they learned about the Program after selecting or installing the new air conditioner, then they can be considered a partial-free rider on this component.

3.5.1.1 Importance of Rebate in Decision Making

Next, customers were asked how important the rebate was in their decision to participate in the program:

Question 15A: On a scale of 0 to 10, how important was the financial incentive in your decision to participate in the Cooling Program?

Question 15A addresses how important the rebate was to the decision-making process. Customers for whom the rebate was unimportant are more likely to have installed the same type of energy efficient equipment in the absence of the program.

3.5.1.2 Likelihood of Installing Similar Equipment without Rebate

Finally, customers are asked whether they would have installed high efficiency equipment if the rebate were not available. This is addressed with four questions:

Question 10: If the incentive for high efficiency air conditioning was not available, would you have installed different equipment?

If the respondent indicates on Question 10 that they would not have installed different equipment, then they can be considered a partial free-rider on this component.

3.5.1.3 Assignment of Free-Ridership and Partial Free-Ridership Scores

Based upon the answers to these four categories of questions, the respondents are placed in Free-Ridership Quartiles, with scores of 0%, 33%, 67%, and 100% Free-Ridership. The scoring is based upon all possible interactions between the three components. Table 3-6 presents the associated free-ridership score for each permutation of answers in the three free-ridership components. The table provides scoring at the individual participant level. Taking the average of these scores results in a Program-Level-Free-ridership of 40.89%

Table 3-6 Free-Ridership Scoring

Prior Planning	Rebate Unimportant	Likely to Install Similar Equipment w/o Rebate	Aggregated Category	Free-Ridership Score
Y	N	Y	YNY	1.00
N	N	N	NNN	0.00
Y	N	Y	YNY	1.00
N	N	Y	NNY	0.33
N	N	N	NNN	0.00
N	N	Y	NNY	0.33
N	N	Y	NNY	0.33
N	N	N	NNN	0.00
N	N	Y	NNY	0.33
N	N	N	NNN	0.00
N	N	N	NNN	0.00
Y	N	Y	YNY	1.00
N	N	N	NNN	0.00
N	N	Y	NNY	0.33
N	N	Y	NNY	0.33
N	N	N	NNN	0.00
Y	N	Y	YNY	1.00
N	N	N	NNN	0.00
N	Y	Y	NYY	0.67
N	N	Y	NNY	0.33
N	N	N	NNN	0.00
Y	Y	N	YYN	1.00
N	N	Y	NNY	0.33
N	Y	Y	NYY	0.67
N	Y	Y	NYY	0.67
N	N	Y	NNY	0.33
Y	N	Y	YNY	1.00
N	N	Y	NNY	0.33
N	Y	Y	NYY	0.67
N	N	Y	NNY	0.33
Y	N	N	YNN	0.67
N	Y	Y	NYY	0.67
N	N	Y	NNY	0.33
N	N	Y	NNY	0.33
N	N	N	NNN	0.00

3.6 Home Energy Services Verified Savings

To validate savings from the HESP, the Evaluators desk reviewed savings calculations provided by Xcel to correspond to the recently-approved New Mexico TRM. The Evaluators then applied field finding to desk reviewed savings calculations. Program-level realization by measure category is summarized in Table 3-7 below.

Table 3-7 Home Energy Services Gross Realization Summary

Measure	Expected kWh	Verified kWh	Expected kW	Verified kW	Expected Lifetime kWh	Verified Lifetime kWh
Duct Sealing	1,249,975	1,229,103	102.24	91.53	31,249,375	30,727,575.40
Air Infiltration	228,175	186,049	26.48	22.06	2,509,925	2,046,543.47
Ceiling Insulation	227,397	227,397	22.09	22.10	5,684,925	5,684,925.00
Heat Pump	834,239	179,322	285.70	66.02	15,016,302	3,227,796.00
AC	70,612	46,300	32.23	22.64	1,059,180	694,500.00
Programmable Thermostat	70,210	70,210	12.92	12.92	772,310	772,310.00
Total	2,680,608	2,105,414	481.66	251.32	56,292,017	43,153,650

Table 3-8 Home Energy Services Net kWh Realization Summary

Measure	Ex Ante NTGR	Ex Post NTGR	Expected Net kWh Savings	Realized Net kWh Savings	Net Realization Rate
Duct Sealing	95.10%	96.50%	1,188,763	1,191,502	100.23%
Air Infiltration	95.10%	92.80%	217,001	183,136	84.39%
Ceiling Insulation	95.10%	100.00%	216,261	227,397	105.15%
Heat Pump	95.10%	59.10%	793,386	105,997	13.36%
AC	95.10%	59.10%	67,154	27,368	40.75%
Programmable Thermostat	95.10%	96.40%	66,772	67,694	101.38%
Total	95.10%	79.50%	2,549,336	1,803,094	70.73%

Table 3-9 Home Energy Services Net kW Realization Summary

Measure	Ex Ante NTGR	Ex Post NTGR	Expected Net kW Savings	Realized Net kW Savings	Net Realization Rate
Duct Sealing	95.10%	96.50%	84.59	91.95	108.70%
Air Infiltration	95.10%	92.80%	21.91	23.42	106.89%
Ceiling Insulation	95.10%	100.00%	21.01	22.1	105.19%
Heat Pump	95.10%	59.10%	206.5	66.02	31.97%
AC	95.10%	59.10%	30.65	22.64	73.87%
Programmable Thermostat	95.10%	96.40%	12.29	12.92	105.13%
Total	95.10%	79.50%	376.95	239.04	63.41%

3.7 Process Evaluation

The Evaluators conducted a process evaluation of the HESP in order to address a range of issues:

- Is the program successfully engaging the necessary stakeholders?
- Are participants and trade allies satisfied with their experience with the program?
- What can be done to increase uptake of secondary program measures?

3.7.1 Market Description

This section presents key background data on the target market for the ECRP. Data for this section are provided by the Energy Efficiency Potential Study for the State of New Mexico[7] and the American Community Survey (ACS)[8], and surveys with participating market actors.

3.7.2 Market Characteristics

To provide estimates of available market for Xcel service territory, the evaluators combined ACS results for the following counties:

- Chaves
- Curry
- Eddy
- Lea
- Quay
- Roosevelt

Data from the most recent available ACS indicates that there was a total of 107,710 residences in Xcel-served counties as of 2011. Of these, 85.0% are occupied, and of that, 42.7% are low income. In theory, these participants would be directed to the Low Income Home Energy Services program, but in practice, many participate in the standard program instead due to income documentation requirements. As such, the evaluators have included those homes in the available market for HES. Overall, 19.6%

[7] Global Energy Partners, 2011. "Energy Efficiency Potential Study for the State of New Mexico. Volume 2: Electric Energy Efficiency Analysis". Prepared for the Department of Energy under management of the State of New Mexico's Energy, Minerals, and Natural Resources Department's Energy, Conservation, and Management Division.

[8] Bureau of the Census. 2011. *American Community Survey, One-Year Data.*

of these customers used evaporative cooling[9]. The result is an effective market of 86,301 residences that would be eligible for weatherization services. The breakdown of housing by type is summarized in Figure 3-6.

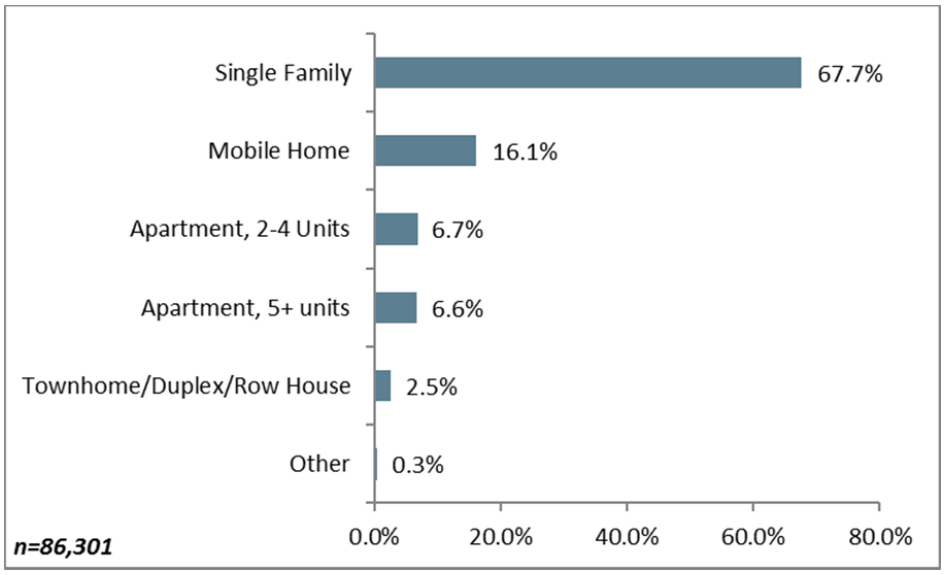


Figure 3-6 Distribution of Residential Buildings Types in Xcel Service Territory

In addition, it was found that the available market for the HESP is:

- Occupied at a typical rate for New Mexico. 85.9% of housing was occupied at the time of data collection, compared to 85.0% occupancy statewide.
- Slightly higher in rental occupancy. 31.2% of occupied residencies are occupied by renters, compared to 30.4% statewide.

3.7.3 Market Barriers

In reviewing the program offerings and theory, the evaluators identified the following market barriers:

Weatherization:

- **Skepticism of the services offered.** The HESP provides weatherization services free of charge to end-use customers. Program staff indicated that this is received with some degree of skepticism from their residential customers, in that many do not believe that an electric utility would provide a free service to help customers use less energy.
- **High share of renters.** 31.2% of Xcel residential customers are renters[10]. As a result, the program needs to go through landlords to obtain permission for

[9] As per the GEP Market Potential Study, Saturation varied from 18.0% for single family homes to 26.9% for multifamily.

work on these homes. The homes can still be serviced, with no difference in service or incentive level, however.

- **Use of evaporative cooling units.** 19.6% of Xcel residential customers use evaporative cooling. For these customers, weatherization services do not provide viable electric savings.
- **Program theory that supports only high-return measures.** The program theory is based around marketing outreach by contractors that will result in installation of a comprehensive suite of measures for Xcel residential customers. In practice, the contractors have instead identified the highest return measures that can be effectively provide free of charge.
- **Lack of necessary training in the contractor community.** Duct sealing and air sealing have specific skills and certifications required in order to correctly perform the work. This expertise was lacking in the Xcel service territory and as such it was necessary for Xcel to train the contractors to perform the work.

High-Efficiency Air Conditioning

- **Lower Income Level.** Median income in Xcel service territory is $41,949, compared to $44,631 statewide.
- **High first-cost barrier.** The incremental cost of high efficiency cooling equipment can be a difficult barrier to overcome, with estimates of $119/ton and $357/ton for Tier I and Tier II units, respectively[11].

3.8 Process Results & Findings

This section will present the results and key findings from the data collection activities. These findings are based upon interviews with utility staff, implementation staff, surveys with participants, and a thorough and in-depth literature review.

3.8.1 Program Theory & Design

The Home Energy Services Program was designed to engage and train the local contractor community in pushing a comprehensive suite of home efficiency improvements for residential customers. The program provides incentives for a range of measures, including:

- Duct sealing;
- Infiltration control;

[10] Bureau of the Census. 2011. *American Community Survey, Five-Year Data.*

[11] Incremental cost estimates from State of Ohio Technical Reference Manual, Pg. 30. Vermont Energy Investment Corporation, 2010.

- Ceiling insulation;
- Low flow showerheads; and
- Central air conditioning.

The program was designed to train contractors to provide an extended suite of services, and then leave it to these contractors to market the program to end-users.

3.8.2 Program Administration

The HESP is overseen by a Product Manager at Xcel. The manager's responsibilities include leading contractor outreach and as well as other marketing efforts along with handling the day-to-day program administration. Much of the managerial needs of the HESP are focused on the handling of the trade ally network, ensuring that participating HVAC contractors receive adequate training and marketing materials in order to push the program. The Product manager for the HESP is also responsible for administration of the Low Income HESP, though the evaluators found that these programs are essentially different channels of the same offering and thus having one manager for both makes sense from an organizational standpoint.

3.8.3 Program Implementation and Delivery

The HESP is implemented by participating trade allies. The participation process is as follows:

- *Customer recruitment*. The customer is contacted by a participating trade ally. When agreeing to participate, the contractor establishes an appointment time with the customer.
- *In-home audit*. At the first site visit, the trade ally conducts duct blast and blower door testing on the home, providing baseline values for potential duct sealing and air infiltration improvement. Further, the contractor reviews the residence's ceiling insulation level.
- *Installation*. After the audit, it is determined whether the customer's residence would benefit from the three building envelope measures. Duct sealing and infiltration improvement are provided free of charge. Ceiling insulation requires a copayment. The agreed-upon, qualifying measures are then performed on the home. In the cases of duct sealing and air infiltration control, the contractor then performs a post-retrofit test.
- *Application Submittal*. The contractor and customer work out the details on the application, though this is largely filled out by the contractor which the customer then reviews and signs. At the end of the month, the contractor enters the information from their completed applications into the Frontier

Associates savings calculation database, the results of which are sent to Xcel for review.

- *Application Review*. Xcel rebate processing staff review the application, and ensure eligibility of the customer and of the measures installed. Any discrepancies are then worked out between Xcel and the contractor. When this is completed, the final rebate is then calculated.
- *Rebate Payment*. Rebate payment occurs 4-6 weeks after receipt of the accepted application. The rebates are mailed directly to the participating contractor, and encompass the total rebates for all projects completed in that month.

3.8.4 Tracking Data Review

The Evaluators received a tracking database developed internally by Xcel. The initial gathering and compiling of tracking data is crucial in facilitating a smooth evaluation effort, and as such the evaluators reviewed this tracking data in order to verify that it contained the required data to:

(1) Recreate energy savings calculations;

(2) Contact participants and trade allies; and

(3) Ensure proper rebate payment amounts;

3.8.4.1 Energy Savings Calculation Data

The Evaluators received tracking data from Xcel. The tracking spreadsheet was found to contain:

- Measures installed;
- Pre- and post-installation measurements (duct leakage, air leakage, etc.);
- Quantity installed (CFLs)
- Expected savings.

3.8.4.2 Participant and Trade Ally Contact Information

After reviewing the data, the Evaluators found that it contained full and comprehensive tracking data for all participants, including contact name, address, phone number, and a unique identifying number. However, the tracking data did not include information on the installing trade ally. The evaluators would recommend that the installing contractor be included in tracking data exports, so as to allow analysis of specific contractors' performance.

3.8.5 Participant Survey Response

A survey was conducted in 2017 to collect data about customer decision-making, preferences, and perspective of the Home Energy Services Program. In total, 80 participants responded to the survey questionnaire.

3.8.5.1 Program Awareness

As shown in Figure 3-7, the most common ways respondents first learned about the program was through a newspaper ad (28%), friends or colleagues (19%), and direct mail (15%).[12] Other common sources of awareness included, social media, or the Xcel website (www.electricides.com).

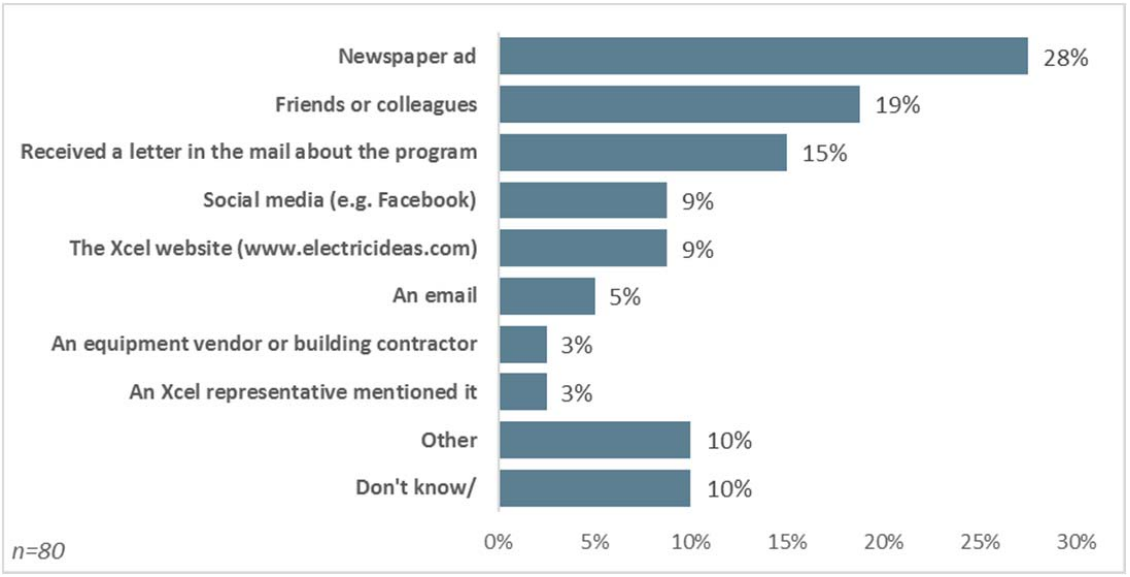


Figure 3-7 Sources of Program Awareness

3.8.5.2 Decisions to Participate

Participants were then asked to provide the primary factor in their decision to participate in the program. The majority of respondents said it was to save money on energy bills (55%), while 16% said they did it to make improvements to their home or simply to make their home more energy efficient[13].

[12] Newspaper ad and social media were not in the list of available responses, but were provided by open-ended feedback. Respondents were able to choose more than one response, so the total percentage may add to over 100%.s

[13] Home improvement/make home more energy efficient was not in the list of available responses and was provided by open-ended feedback.

Table 3-10 Reason for Participation

What is the main reason you decided to participate in the program?	***Percent of Respondents (n = 80)***
To save money on energy bill(s)	55%
Environmental reasons	9%
Xcel paid a portion of the total cost of the items installed	8%
Home improvement/Make home more energy efficient	16%
Other	6%
Don't know/Prefer not to answer	6%

Next, respondents were asked how likely they would have been to hire a contractor to perform a home audit similar to the HES program if Xcel did not offer the program. Seventy-six percent said they probably or definitely would not have, while 23% said they probably or definitely would have done so.

Table 3-11 Timeframe for Installation without the Program

How likely is it that you would have hired a professional contractor to perform a home audit like the Home Energy Services program offers IF Xcel did not offer the Home Energy Services Program?	***Percent of Respondents (n = 80)***
Definitely would have	10%
Probably would have	13%
Probably would not have	45%
Definitely would not have	31%
Don't know/Prefer not to answer	1%

3.8.5.3 Participant Satisfaction

Respondents were next asked to rank various aspects of the program on a scale of 1 to 5, with 1 being very dissatisfied and 5 being very satisfied. Overall program satisfaction was very high, with 95% of respondents being satisfied or very satisfied. Respondents were least satisfied with the savings on their monthly bill, with 47% saying they were satisfied, 46% being neither satisfied or dissatisfied, and 7% saying they were dissatisfied.

Respondents who reported dissatisfaction with any of the program elements were asked to provide open-ended feedback, and below is a sample of some of their comments:

"My bill did not go down."

"It didn't seem like [the contractors] did very much."

"It did no good; there was no difference."

"I didn't feel like there have been savings on my monthly bill."

However, the program received high marks from most respondents, and there were very few instances of dissatisfaction with the program overall. Sample comments by participants who were satisfied with the program overall are shown below:

"They're doing a great job. I appreciate this very much."

"The program was really easy to sign up for; the contractors were wonderful and skilled."

"The contractors they used were very good. They were professional and courteous."

"It's an outstanding program and I really appreciate the service."

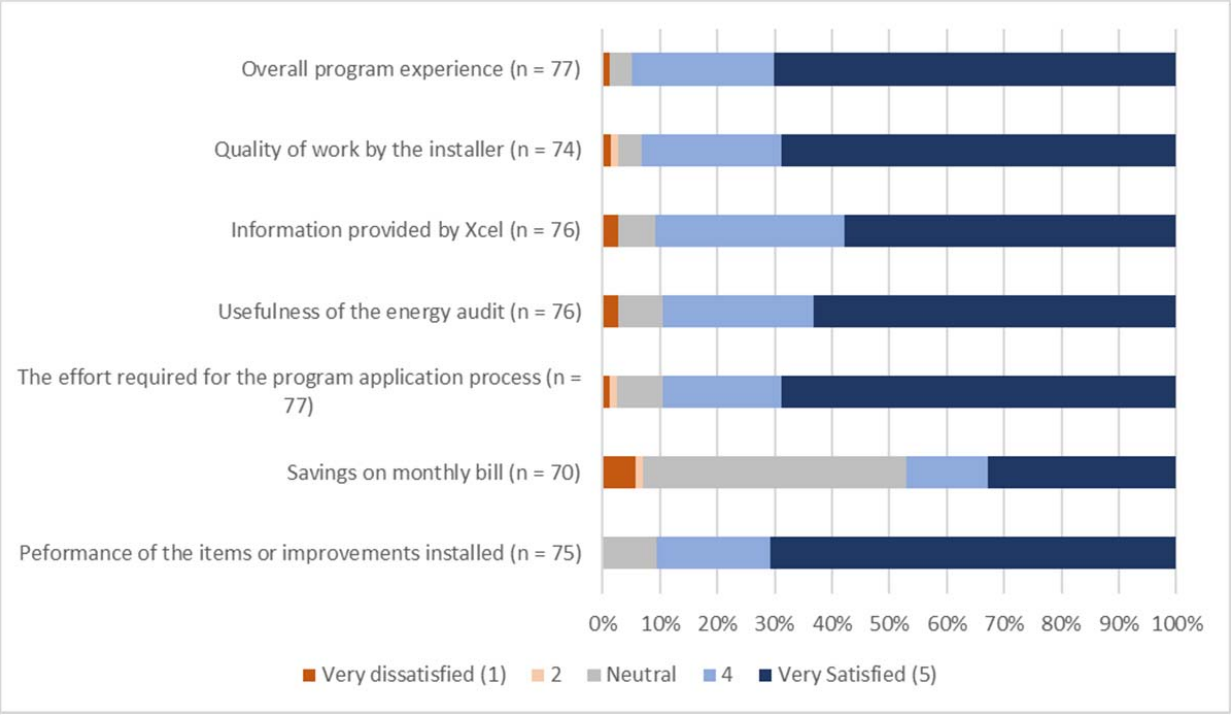


Figure 3-8 Participant Program Satisfaction

3.8.5.4 Participant Demographics

Finally, respondents were asked to respond to questions relating to their home and household income. This information can be used to better understand the program's demographics and provide insight into who is ending up in the program. As Table 3-12 Participant Home Type shows, 90% of respondents have a single-family home. In addition, 50% of respondents have homes built prior to 1980.

Table 3-12 Participant Home Type

Which of the following best describes your home?	***Percent of Respondents (n = 80)***
Single-family home, detached	90%
Mobile or manufactured home	1%
A townhouse, duplex or row house	3%
An apartment or condo in a building with 2 to 4 units	0%
An apartment or condo in a building with 5 or more units	0%
Other	0%
Don't know	1%
Prefer not to answer	5%

Table 3-13 Participant Home Age

When was your home built?	***Percent of Respondents (n = 80)***
Before 1970's	36%
1970's	14%
1980's	15%
1990's	8%
2000-2009	13%
2010 or newer	6%
Don't know	4%
Prefer not to answer	5%

Table 3-14 Participant Water Heater Type

What type of water heater do you have in your home?	***Percent of Respondents (n = 80)***
Natural gas water heater	40%
Electric water heater	50%
Other	0%
Don't know	5%
Prefer not to answer	5%

Table 3-15 Participant Household Income

What is your approximate total household income?	***Percent of Respondents (n = 80)***
Less than $10,000	3%
$10,000 to $29,999	3%
$30,000 to $49,999	15%
$50,000 to $74,999	30%
$75,000 to $99,999	13%
$100,000 to $150,000	18%
Greater than $150,000	1%
Don't know	3%
Prefer not to answer	16%

3.9 Conclusions & Recommendations

3.9.1 Conclusions

Based on the 2016 EM&V, the Evaluators concluded the following:

- **Participants are generally satisfied with the work completed by the program contractors.** High satisfaction was indicated with the quality of the work by the contractor as well as with the energy savings observed following the completion of the retrofit.
- **Savings for central air conditioners and heat pumps were overstated and did not comply with the New Mexico TRM.** Xcel includes an indicator in their tracking for whether a home replaced an electric resistant heating system; the tracking indicated this was not the case but savings calculations still used this baseline.

3.9.2 Recommendations

The Evaluators' recommendations are as follows:

- **Provide SEER and HSPF values for duct sealing and air infiltration.** SEER and HSPF values are needed to accurately calculate duct sealing savings and air infiltration savings.
- **Provide pre and post retrofit CFL wattages.** Current tracking data provides quantity of lamps install in each location and in certain wattage ranges. Pre and post retrofit CFL wattages are needed to accurately CFL savings.
- **Include application questions on the pre-existing heating system and whether it was functioning.** In order to claim electric resistant heating as the baseline, it needed to be functional prior to the retrofit.

4. Low Income Home Energy Services

4.1 Program Description

The Low Income Home Energy Services Program (LIHESP) is an extension of the HESP program, through which income-qualified customers identified by HESP contractors are eligible for extra incentives and measures. Participants in the LIHESP are similar to those in the standard HESP with the exception that they received direct installation of CFLs.

4.2 Program Participation

The HESP had 924 premises in 2016 and installed a total of 1,970 measures. Twenty-six percent of premises were multi-family units and 74% were single family units.

Figure 4-1 summarizes the share of program savings contributed by each measure. Most savings came from duct sealing, air sealing, and ceiling insulation.

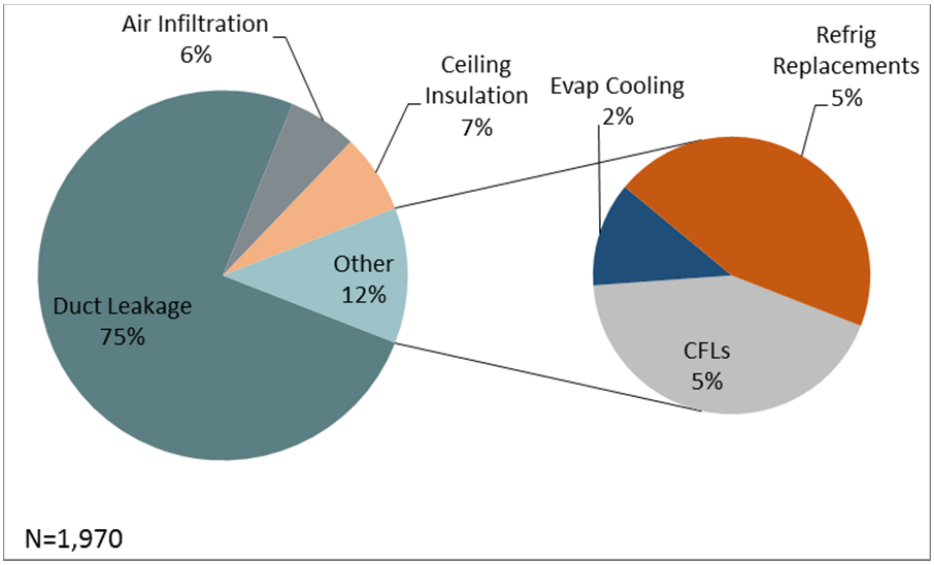


Figure 4-1 Program Savings Share by Measure

Figure 4-2 summarizes the premises by month as determined by the date of rebate delivery as well as the cumulative savings from the program.

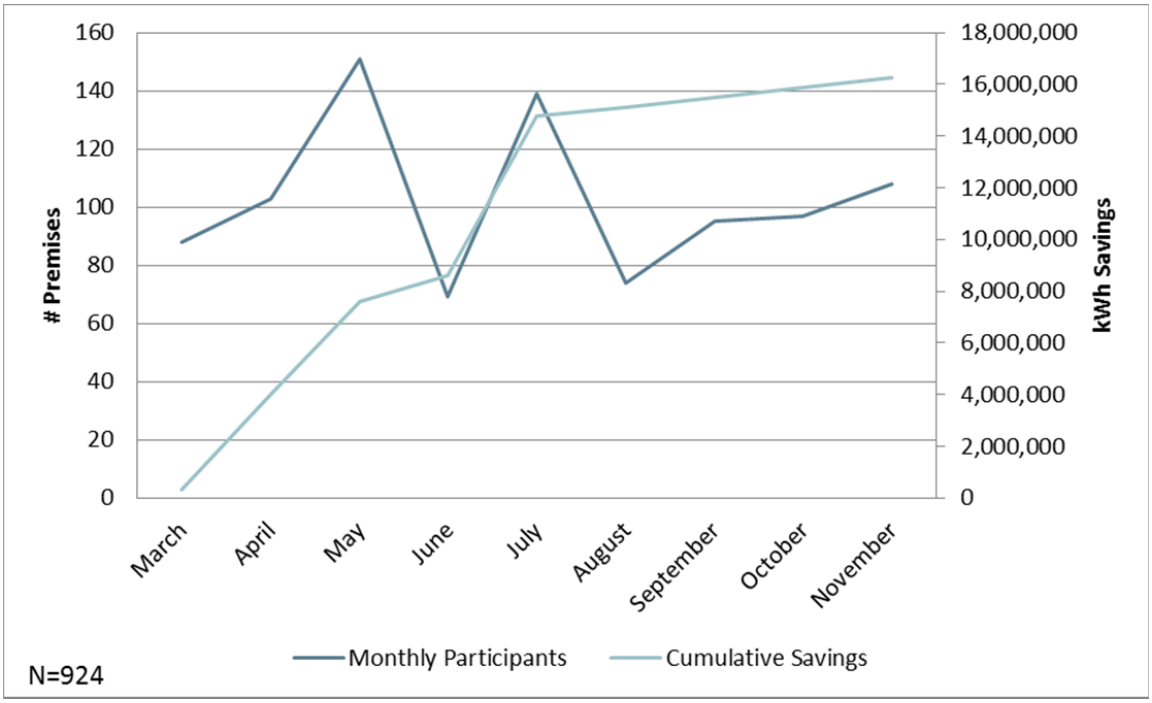


Figure 4-2 HESP Premises by Month

4.3 M&V Methodology

The M&V approach for the Residential Home Energy Services Program is aimed at the following:

- Verifying participation through participant surveying; and
- Updating calculations to reflect new TRM values and federal codes for lighting.

Table 4-1 below summarizes the inputs needed for gross savings calculations and the source of each input.

Table 4-1 Data Sources for Gross Impact Parameters – Home Energy Services

Parameter	***Source***
Home Specifications	Tracking Data & Onsite Verification
Post Installation Duct Leakage & Infiltration	On-site Measurement

4.3.1 Review of Deemed Savings Estimates

The Evaluators reviewed the deemed savings estimates for measures rebated through the program in 2016. The deemed savings assumptions were based upon 2016 NM TRM.

4.3.2 Verification of Installed Measures

Verification of the weatherization measures installed was done in two steps;

- Desk Review of the tracking data;
- Surveys of customers who installed rebated equipment; and
- On-site measurement of duct leakage and infiltration

The Evaluators reviewed tracking data for anomalous entries and to ensure that savings were calculated according to the methodologies outlined in NM TRM. Having validated the tracking data, the evaluators verified installation of rebated measures through telephone surveys with program participants.

For CFLs, savings were calculated using New Mexico TRM guidelines for hours of use as well as updated baselines in accordance with EISA.

4.3.3 Field Verification

The LIHESP used the sample field sample as the HESP for duct sealing and air sealing and had the same field adjustments applied to final kWh and kW savings for those measures. In addition, ADM conducted field inspection of CFLs and refrigerators installed thoruhg the program and found in-service-rates of:

- CFLs: 89.3%
- Refrigerators: 100.0%

4.4 Impact Evaluation Results

4.4.1 Tracking Review

The impact evaluation began with a review of program tracking data. Every premise in the program had a unique identifier, and thus one premise could have multiple rows to reflect the different measures completed. Table 4-2 summarizes ex ante savings by measure for the LIHESP.

Table 4-2 LIHESP Ex Ante Summary

Measure	Count	Ex Ante kWh	Ex Ante kW
Duct Sealing	690	2,265,436	223.94
Air Infiltration	338	181,167	25.84
Ceiling Insulation	88	208,577	22.00
CFLs	631	153,120	19.03
Evaporative Coolers	13	43,316	30.94
Refrigerator Replacement	210	160,160	21.84
Total	**1,970**	**2,265,436**	**343.59**

The Evaluators conducted a tracking review on a census of measures in the LIHESP. This review entailed recreating the deemed savings calculations from the New Mexico TRM using the ex ante input values (such as leakage, EFLH, etc.). The results of this are presented in the “Validated kWh” entry in the table below.

Table 4-3 LIHESP Tracking Review – kWh

Measure	Ex Ante kWh	Validated kWh
Duct Sealing	2,265,436	2,250,892
Air Infiltration	181,167	200,735
Ceiling Insulation	208,577	208,577
CFLs	153,120	136,715
Evaporative Coolers	43,316	43,316
Refrigerator Replacement	160,160	160,160
Total	**3,011,776**	**3,000,395**

Table 4-4 LIHESP Tracking Review – kW

Measure	Ex Ante kW	Validated kW
Duct Sealing	223.94	184.32
Air Infiltration	25.84	24.63
Ceiling Insulation	22.00	21.95
CFLs	19.03	17.01
Evaporative Coolers	30.94	30.94
Refrigerator Replacement	21.84	21.84
Total	**343.59**	**301.69**

4.4.2 Low Income Home Energy Services Gross Savings Estimates

To validate savings from the HESP, the Evaluators updated savings calculations provided by Xcel to correspond to the recently-approved New Mexico TRM. Across all measures, the values applied by Xcel in ex ante estimates had understated kWh savings when compared to the TRM. Program-level realization by measure category is summarized in able 4-5.

able 4-5 Home Energy Services kWh Realization Summary

Measure	***Expected kWh***	***Verified kWh***	***kWh Realization Rate***
Duct Sealing	2,265,436	2,223,416	98.8%
Air Infiltration	181,167	173,706	95.9%
Ceiling Insulation	208,577	208,577	100.0%
CFLs	153,120	122,132	79.8%
Evaporative Coolers	43,316	43,316	100.0%
Refrigerator Replacement	160,160	160,160	100.0%
Total	**3,011,776**	**2,931,307**	**97.3%**

Table 4-6 Home Energy Services kWh Realization Summary

Measure	***Expected kW***	***Verified kW***	***kW Realization***

			Rate
Duct Sealing	223.94	165.87	90.0%
Air Infiltration	25.84	18.04	73.3%
Ceiling Insulation	22.00	21.95	100.0%
CFLs	19.03	15.19	89.3%
Evaporative Coolers	30.94	30.94	100.0%
Refrigerator Replacement	21.84	21.84	100.0%
Total	**343.59**	**273.84**	**91.1%**

Table 4-7 Home Energy Services kWh Realization Summary

Measure	***EUL***	***Expected Lifetime kWh***	***Verified Lifetime kWh***
Duct Sealing	18	40,777,848	36,461,274.66
Air Infiltration	11	1,992,837	1,617,570.98
Ceiling Insulation	25	5,214,425	5,214,425
CFLs	6.4	979,968	781,645.14
Evaporative Coolers	15	649,740	649,740
Refrigerator Replacement	17	2,722,720	2,722,720
Total	**18**	**52,337,538**	**47,447,376**

NTG for this program is 100% because this program is income-qualified, gross savings equals net savings.

4.4.3 Summary of Gross Savings Adjustments

Figure 4-3 summarizes the gross savings adjustments made for the HESP.

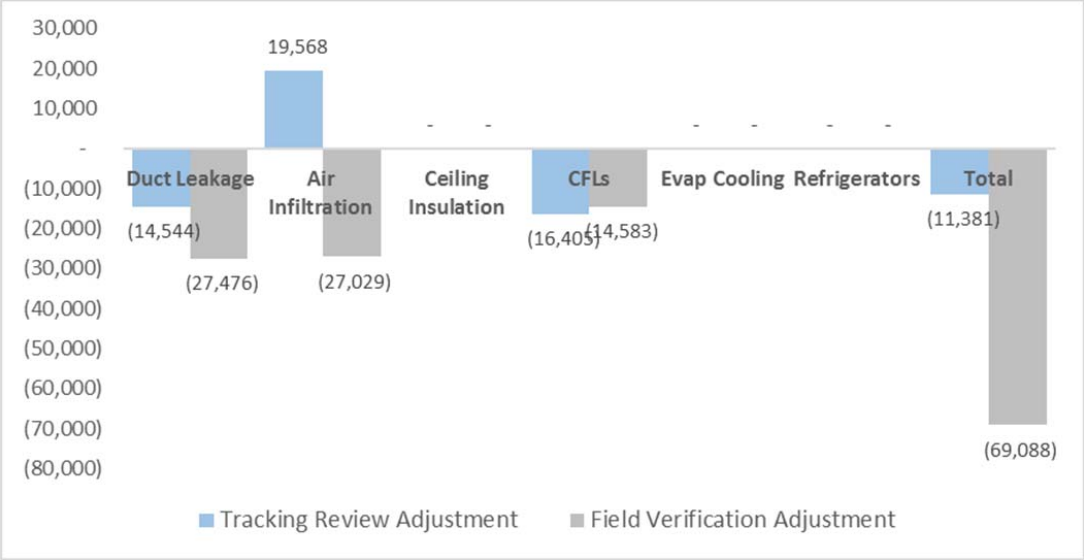


Figure 4-3 Summary of Gross kWh Adjustments

4.5 Process Evaluation

The Evaluators conducted a process evaluation of the LIHESP in order to address a range of issues:

- Is the program successfully engaging the necessary stakeholders?
- Are participants satisfied with their experience with the program?

4.5.1 Participant Survey Response

A survey was conducted in 2017 to collect data about customer decision-making, preferences, and perspective of the Home Energy Services Program. In total, 80 participants responded to the survey questionnaire.

4.5.1.1 Program Awareness

As shown in Figure 4-4, the most common ways respondents first learned about the program was through social media (2%), friends or colleagues (19%), and newspaper ads (11%).[14] Other common sources of awareness included, direct mail, or the Xcel website (www.electricides.com).

[14] Newspaper ad and social media were not in the list of available responses, but were provided by open-ended feedback. Respondents were able to choose more than one response, so the total percentage may add to over 100%.s

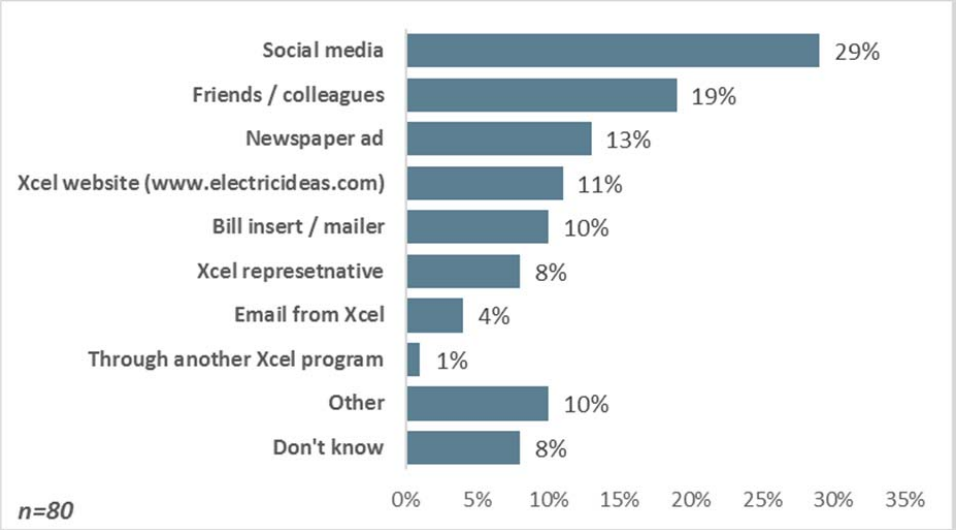


Figure 4-4 Sources of Program Awareness

4.5.1.2 Decisions to Participate

Participants were then asked to provide the primary factor in their decision to participate in the program. The majority of respondents said it was to save money on energy bills (66%), while 10% said they did it to make improvements to their home or simply to make their home more energy efficient[15].

Table 4-8 Reason for Participation

What is the main reason you decided to participate in the program?	*Percent of Respondents (n = 80)*
To save money on energy bill(s)	66%
Environmental reasons	9%
Xcel paid a portion of the total cost of the items installed	5%
Home improvement/Make home more energy efficient	10%
Other	10%
Don't know/Prefer not to answer	0%

Next, respondents were asked how likely they would have been to hire a contractor to perform a home audit similar to the HES program if Xcel did not offer the program. Eighty-four percent said they probably or definitely would not have, while 14% said they probably or definitely would have done so.

[15] Home improvement/make home more energy efficient was not in the list of available responses and was provided by open-ended feedback.

Table 4-9 Likelihood for Installation without the Program

How likely is it that you would have hired a professional contractor to perform a home audit like the Home Energy Services program offers IF Xcel did not offer the Home Energy Services Program?	***Percent of Respondents (n = 80)***
Definitely would have	5%
Probably would have	9%
Probably would not have	43%
Definitely would not have	41%
Don't know/Prefer not to answer	3%

4.5.1.3 Participant Satisfaction

Respondents were next asked to rank various aspects of the program on a scale of 1 to 5, with 1 being very dissatisfied and 5 being very satisfied. Overall program satisfaction was very high, with 87% of respondents being satisfied or very satisfied. Respondents were least satisfied with the savings on their monthly bill, the quality of work by the installer, and the usefulness of the energy audit.

Respondents who reported dissatisfaction with any of the program elements were asked to provide open-ended feedback, and below is a sample of some of their comments:

"The guy who performed the [work] had a bad attitude and was not very helpful."

"I haven't really seen a whole lot of savings."

"It took multiple calls for them to respond."

"I didn't see much difference in my bill."

However, the program received high marks from most respondents, and there were very few instances of dissatisfaction with the program overall. Sample comments by participants who were satisfied with the program overall are shown below:

"It is a tremendous program. The technicians were knowledgeable and efficient."

"I think it is a good program. It saves a lot of money."

"I thought it was great. The guys that came were all nice and professional."

"Very pleased with the opportunity to [participate] in this program."

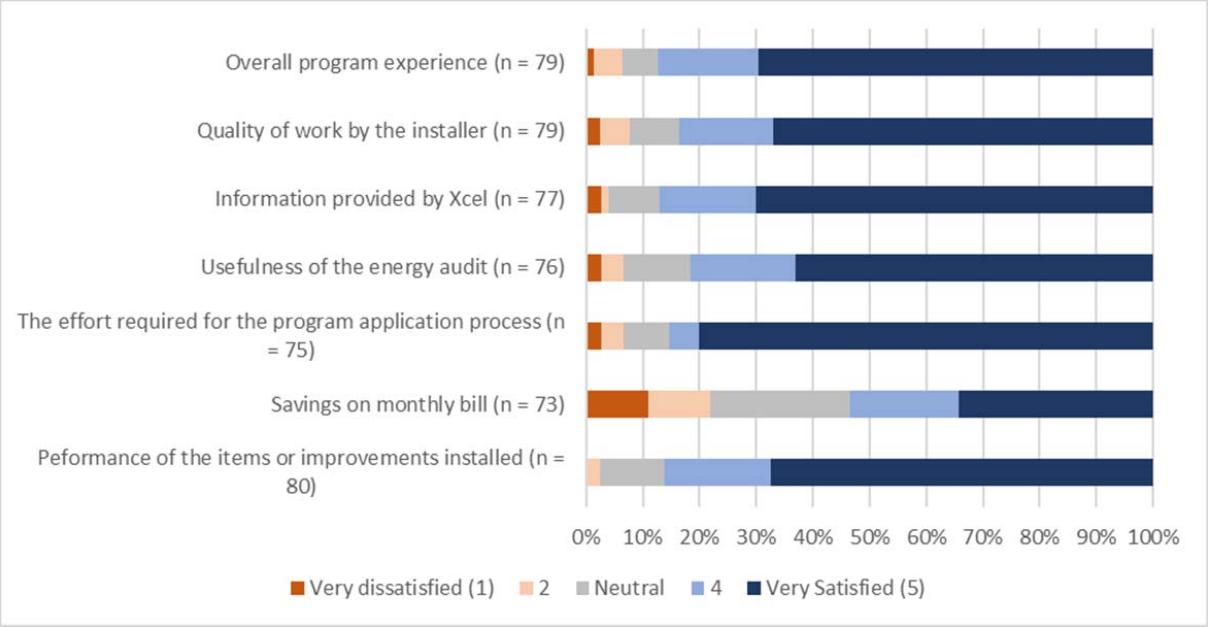


Figure 4-5 Participant Program Satisfaction

4.5.1.4 Participant Demographics

Finally, respondents were asked to respond to questions relating to their home and household income. This information can be used to better understand the program's demographics and provide insight into who is ending up in the program. As Table 4-10 shows, 95% of respondents have a single-family home. In addition, 50% of respondents have homes built prior to 1980.

Table 4-10 Participant Home Type

Which of the following best describes your home?	***Percent of Respondents (n = 80)***
Single-family home, detached	95%
Mobile or manufactured home	1%
A townhouse, duplex or row house	1%
An apartment or condo in a building with 2 to 4 units	1%
An apartment or condo in a building with 5 or more units	0%
Other	0%
Don't know	0%
Prefer not to answer	1%

Table 4-11 Participant Home Age

When was your home built?	Percent of Respondents (n = 80)
Before 1970's	35%
1970's	18%
1980's	10%
1990's	6%
2000-2009	10%
2010 or newer	8%
Don't know	13%
Prefer not to answer	1%

Participants provided information on the type of water heater use in their home, and as Table 4-12 shows, the majority (58%) use an electric water heater; 35% use a natural gas water heater. Lastly, respondents were asked to provide their home's heating system. As Table 4-13 shows, the most common heating systems were electric or natural gas.

Table 4-12 Participant Water Heater Type

What type of water heater do you have in your home?	Percent of Respondents (n = 80)
Natural gas water heater	35%
Electric water heater	58%
Other	4%
Don't know	3%
Prefer not to answer	1%

Table 4-13 Participant Heating System

What type of heating system do you have in your home?	Percent of Respondents (n = 80)
Natural gas heating	26%
Heat	8%
Electric heating	41%
Combination of types	9%
Other	13%
Don't know	3%
Prefer not to answer	1%

4.6 Conclusions & Recommendations

4.6.1 Conclusions

Based on the 2016 EM&V, the Evaluators concluded the following:

- **The program has adequate quality control procedures.** The program had 97% kWh realization and the field data collection found that leakage rates were for the most part aligned with tracking data.
- **Respondents indicated high program satisfaction.** In particular, respondents indicated gratitude for the no-cost program offering.

4.6.2 Recommendations

The Evaluators' recommendations are as follows:

- **Provide SEER and HSPF values for duct sealing and air infiltration.** SEER and HSPF values are needed to accurately calculate duct sealing savings and air infiltration savings.
- **Provide pre and post retrofit CFL wattages.** Current tracking data provides quantity of lamps install in each location and in certain wattage ranges. Pre and post retrofit CFL wattages are needed to accurately CFL savings.

5. Energy Feedback Program

The Energy Feedback Program is an educational program run by Oracle, a third-party implementer for Xcel. The program provides educational materials to a sample of Xcel residential customers, in which their usage is compared against similar households. The program is designed to encourage behavioral change and program participation on the part of the recipients of the Home Energy Report.

The program began with a first wave launched in March 2012. A second supplementary wave was launched in July 2015. In addition, the program has introduced an online opt-in portal.

5.1 Data Cleaning Procedures

All screening procedures exist to reduce variability in the model and ensure an accurate savings estimate. The procedure to remove duplicate observations consists of checking for duplicate observations for each customer that appear on the same date, and ensuring only one of those observations remains. This does not remove any customers from the sample, but will remove observations as necessary. Further, Observations with abnormally short or long meter read cycles were filtered from the model. This procedure removed observations where the meter read length was less than 10 or greater than 70 days.

5.2 Regression Model Specification & Results – Wave 1 & 2

The Evaluators utilized a fixed-effects specification. This model controls for exogenous factors that cannot be explicitly accounted for via use of household-specific dummy variables (where each variable is equal to “1” when the observation belongs to that household and “0” otherwise).

The model specification is as follows:

$$Usage_{it} = \alpha_0 + \beta * treatment\_Post_i + \alpha_1 * Post_i + \gamma * mm_t + \gamma * Cust\_ID + \varepsilon_{it}$$

Where

- *i* denotes the *i*th customer
- *t* denotes the first, second, third, etc. month of the analysis period

- *Usage*$_{it}$ is the average daily use for read *t* for household *i* during the analysis period
- *mm*$_t$ is a vector of month-year dummies
- *Cust_ID* is a vector of household specific dummy variables

And parameter definitions are:

- α_0 is an intercept term
- α_1 is the effect of the *Post*$_i$ control variable.
- ε_{it} is an error term.

The results of the regression model for Wave 1 and Wave 2 are listed in Table 5-1 and Table 5-2 respectively.

Table 5-1 Regression Coefficients & Model Details - Wave 1

Variable Description	***Regression Coefficient***	***Standard Error***	***T-Stat***	***PR > |T|***
POST	-13.1474	0.0857	-153.4700	<.0001
TREAT_POST	-0.6035	0.0676	-8.9300	<.0001
Mar_11	-23.7441	0.1319	-180.0400	<.0001
Apr_11	-25.5400	0.1319	-193.6600	<.0001
May_11	-17.2498	0.1319	-130.8000	<.0001
Jun_11	0.2730	0.1319	2.0700	0.0384
Jul_11	6.5715	0.1319	49.8300	<.0001
Aug_11	4.4866	0.1319	34.0200	<.0001
Sep_11	-13.4055	0.1319	-101.6500	<.0001
Oct_11	-23.8402	0.1319	-180.7700	<.0001
Nov_11	-14.1983	0.1319	-107.6600	<.0001
Dec_11	2.8115	0.1319	21.3200	<.0001
Jan_16	-2.7838	0.1319	-21.1000	<.0001
Feb_16	-8.7608	0.1321	-66.3300	<.0001
Jan_16	11.2839	0.1268	88.9800	<.0001
Feb_16	-3.4850	0.1271	-27.4200	<.0001
Mar_16	-13.8729	0.1275	-108.8200	<.0001
Apr_16	-16.3584	0.1279	-127.9400	<.0001
May_16	-11.3346	0.1281	-88.4500	<.0001
Jun_16	4.2668	0.1284	33.2200	<.0001
Jul_16	14.7155	0.1289	114.2000	<.0001
Aug_16	2.9198	0.1291	22.6200	<.0001

Variable Description	*Regression Coefficient*	*Standard Error*	*T-Stat*	*PR > |T|*
Sep_16	-9.2059	0.1294	-71.1300	<.0001
Oct_16	-16.7157	0.1297	-128.8800	<.0001
Nov_16	-9.7225	0.1299	-74.8400	<.0001
Dec_16	5.8357	0.1303	44.7900	<.0001
R-Square = .503				

Table 5-2 Regression Coefficients & Model Details - Wave 2

Variable Description	*Regression Coefficient*	*Standard Error*	*T-Stat*	*PR > |T|*
POST	2.9163	0.1866	15.6300	<.0001
TREAT_POST	0.0423	0.1477	0.2900	0.7747
Jul_14	6.4301	0.2572	25.0000	<.0001
Aug_14	3.5562	0.2547	13.9600	<.0001
Sep_14	-9.8634	0.2524	-39.0700	<.0001
Oct_14	-15.3176	0.2497	-61.3400	<.0001
Nov_14	5.1712	0.2476	20.8900	<.0001
Dec_14	22.3174	0.2454	90.9400	<.0001
Jan_15	28.8336	0.2437	118.3300	<.0001
Feb_15	19.1303	0.2421	79.0100	<.0001
Mar_15	-0.2122	0.2411	-0.8800	0.3789
Apr_15	-17.6683	0.2411	-73.2900	<.0001
May_15	-14.8873	0.2413	-61.6900	<.0001
Jun_15	-2.8526	0.2423	-11.7700	<.0001
Jan_16	19.4996	0.2168	89.9300	<.0001
Feb_16	-1.0915	0.2185	-4.9900	<.0001
Mar_16	-16.1682	0.2203	-73.4000	<.0001
Apr_16	-20.5283	0.2223	-92.3300	<.0001
May_16	-16.3802	0.2239	-73.1600	<.0001
Jun_16	-1.3082	0.2260	-5.7900	<.0001
Jul_16	8.7581	0.2280	38.4200	<.0001
Aug_16	-2.4975	0.2302	-10.8500	<.0001
Sep_16	-14.5257	0.2322	-62.5500	<.0001
Oct_16	-22.0816	0.2336	-94.5200	<.0001
Nov_16	-11.2252	0.2350	-47.7700	<.0001
Dec_16	10.8227	0.2368	45.7100	<.0001

Variable Description	*Regression Coefficient*	*Standard Error*	*T-Stat*	*PR > |T|*
R-Square = .602				

5.3 Regression Model Specification & Results – Online Opt-in

The Evaluators utilized a fixed-effects specification. This model controls for exogenous factors that cannot be explicitly accounted for via use of household-specific dummy variables (where each variable equals "1" when the observation belongs to that household and "0" otherwise).

The model specification is as follows:

$$Usage_{it} = \alpha_0 + \beta * treatment\_Post_i$$
$$+\alpha_1 * Post_i$$
$$+CDD\_Day_t$$
$$+HDD\_Day_t$$
$$+CDD\_Day\_Post_t$$
$$+HDD\_Day\_Post_t$$
$$+\gamma * Cust\_ID$$
$$+\varepsilon_{it}$$

Where

- *i* denotes the *i*th customer
- *t* denotes the first, second, third, etc. month of the analysis period
- $Usage_{it}$ is the average daily use for read *t* for household *i* during the analysis period
- CDD_day and HDD_day are daily cooling and heating degrees for period *t*
- CDD_day_post and HDD_day_Post are the CDD and HDD variables interacted with the Post dummy.
- *Cust_ID* is a vector of household specific dummy variables

The model specification differs from that used for the randomized control trial Wave 1 and Wave 2. The evaluators tested usage of month-year dummies but found that the model lacked precision (with an R-square of .12). The specification using CDD and HDD achieved an R-square of .77

The results of the regression model for Wave 1 and Wave 2 are listed in Table 5-1 and Table 5-2 respectively.

Table 5-3 Regression Coefficients & Model Details - Wave 1

Variable Description	*Regression Coefficient*	*Standard Error*	*T-Stat*	*PR > |T|*
POST	-0.01872	1.64979	-0.01	0.9909
TREAT_POST	-1.04203	1.28454	-0.81	0.4173
CDD_DAY	1.19134	0.03621	32.9	<.0001
HDD_DAY	1.67232	0.04536	36.86	<.0001
CDD_POST_DAY	-0.00104	0.00251	-0.42	0.6777
R-Square = .773				

The coefficient for TREAT_POST is negative but not statistically significant. The Evaluators verified the following for the online opt-in group:

- There were 530 valid treatment group accounts;
- The average post-treatment period was 178.6 days.

The resulting kWh savings is:

kWh(Online) = 1.0423 kWh saved/account/day * 178.6 days * 530 accounts = 98,636 kWh.

The confidence interval for this savings estimate is ±121,592 kWh.

5.4 Overall Savings Results

The Evaluators were provided a summary of monthly opt-outs and active accounts for the EFP. Regression results from Table 5-1 and Table 5-2 were converted to kWh savings on a monthly basis using past savings load shapes and monthly recipient tallies. The resulting monthly savings are summarized in Table 5-4.

The Evaluators verified that the weighted average monthly participants by wave were as follows:

- Wave 1: 10,958
- Wave 2: 3,976
- Online: 530
- Total: 15,464

These program savings are summarized in Table 5-4.

Table 5-4 Energy Feedback Program Savings Summary

Group	***2016 kWh Savings Per Treatment Household***	***2016 Participants***	***2016 Program kWh Savings***	***kW Savings***
Wave 1	217.15	10,958	2,379,519	640.51
Wave 2	-14.88	3,976	-59,158	-15.91
Online	186.1	530	98,636	26.55
Total	156.43	15,464	2,418,997	651.15

Wave 1 continued to produce positive savings. Wave 2 produced negative savings in 2016, a finding confirmed in analysis by both Oracle and ADM.

6. Business Comprehensive

The Business Comprehensive Program (BCP) is the aggregation of Business Lighting, Small Business Lighting, Business Cooling, Business Custom, Business Computers, and Business Motor & Drive Efficiency.

6.1 Business Comprehensive Program

The channels within the Business Comprehensive Program are detailed below.

6.1.1 Business Lighting Efficiency

Xcel is offering the Lighting Efficiency product to facilitate the implementation of cost-effective efficient lighting in non-residential facilities. This program is available to existing nonresidential customers as well as new construction and offers prescriptive and custom incentives.

- Prescriptive incentives are offered on a per unit basis for lamps and fixtures for the following lighting types:
  - Compact fluorescent
  - T8 & T5 Fluorescent
  - Ceramic Metal Halide
  - Pulse-Start Metal Halide
  - LED exit signs
- In addition to lamp and fixtures, prescriptive incentives are offered on a per-unit basis for the following measures:
  - Occupancy Sensors
  - Photocells
  - T8 Delamping

In addition, the Business Lighting channel provides technical assistance and increased

6.1.2 Business Cooling Efficiency

The Business Cooling Efficiency Program is designed to help non-residential customers reduce their energy consumption by installing high efficiency cooling equipment. Xcel is offering the Business Cooling Efficiency Program in New Mexico to facilitate the implementation of cost-effective cooling efficiency improvements in businesses. This program is available to existing nonresidential customers as well as new construction applications and offers prescriptive and custom incentives.

Prescriptive incentives are offered on a per-ton basis for common several classes of cooling equipment. These include the following:

- Condensing Units
- Split Systems
- Rooftop Units
- PTAC
- Water-Source Heat Pumps
- Chillers

Custom incentives are available as well, and are determined based on the estimated amount of electrical energy and peak demand savings, calculated at rates per kWh for on peak or non-peak hour time frames.

6.1.3 Business Custom Efficiency

The Business Custom Efficiency Program is designed to help customers reduce their energy consumption by providing rebates for a wide variety of unique or unusual equipment and process improvements that are not covered by available prescriptive programs. This program is available to existing nonresidential customers as well as new construction applications.

The measures covered by this program fall outside of the scope of other Xcel business programs; Business Lighting Efficiency, Business Cooling Efficiency, and Business Motor & Drive Efficiency each have custom components in addition to prescriptive measures, and cover a large amount of custom measures.

Businesses can receive rebates of up to $400 per kW saved. Participants must receive pre-approval for a measure before installation. Xcel targets customers with aggregated annual consumption greater than 7 GWh in order to increase awareness of the program. Xcel intends to:

- Increase awareness of energy conservation measures;
- Identify specific conservation opportunities;
- Drive customers to participate in existing prescriptive and customized rebate programs; and
- Drive customers to implement low-capital or short payback measures, even though they may not qualify for an implementation rebate under existing programs.

6.1.4 Business Motor and Drive Efficiency

Xcel is offering the Business Motor & Drive Efficiency Program in New Mexico to facilitate the implementation of cost-effective energy efficiency improvements in businesses. This program is available to existing nonresidential customers as well as new construction applications and offers prescriptive and custom incentives.

- Prescriptive incentives are offered on a per HP or kW basis for the following measure types:
  - 1-500 HP motors meeting or exceeding NEMA Premium Efficiency standards;
  - Variable frequency drives (VFDs);
  - Constant speed motor controllers;
  - Energy efficient compressed air equipment upgrades; and
  - No-loss air drains.
- Custom incentives are determined based on the estimated amount of electrical energy and peak demand savings, calculated at rates per kWh for on peak or non-peak hour time frames.

Businesses participating in the Motor & Drive Efficiency Program can receive:

- Cash incentives to help alleviate the costs of installing efficient motors/controls;
- Custom measures that address customers specific needs;
- Cost reductions in electricity bills; and
- Education via a motor inventory assessment.

In addition, participants will benefit from reduced downtime due to motor failure and lower maintenance expenses as NEMA Premium Efficiency Motors are manufactured with high quality materials and standards.

6.1.5 Business Computer Efficiency

The Business Computer Efficiency Program provides incentives for high efficiency plug loads. Measures eligible for the program include:

- High efficiency desktop PCs;
- High efficiency servers;
- Network PC management software; and
- Virtual Desktop Infrastructure.

6.2 M&V Methodologies

6.2.1 Business Lighting Efficiency

Evaluation of the Business Lighting Efficiency Program (BLEP) requires the following:

- Stratified random sampling, selecting large saving sites with certainty;
- Review of deemed savings parameters; and
- Onsite verification inspection, with metering in facilities where lighting runtime is uncertain;

Parameters required for evaluation of the BLEP are presented in Table 6-1.

Table 6-1 Data Sources for Gross Impact Parameters – Business Lighting Efficiency Program

Parameter	***Source***
Project Details	Program Tracking Data
Fixture Wattage Review	Manufacturer's Literature
Hours of Operation	Comparison of deemed values with CA DEER values, on-site metering for projects with uncertainty
HVAC Interactive Factors	Simulations of archetypical buildings using Roswell NM TMY weather data
Peak Coincident Factor	Review of deemed values, assignment of new values based upon facility operating hours should deemed values not provide accurate estimates
Effective Useful Life	Comparison against CA DEER values
Net-to-Gross Ratio (NTGR)	Participant Surveying

6.2.1.1 Business Lighting Efficiency Gross Savings Estimates

The 2016 BLEP encompassed lighting retrofits, occupancy sensors retrofits, and installation of high efficiency lighting as part of new construction projects. The subsections below present the savings calculation methodology for each of these measure types.

6.2.1.2 Gross Savings Methodology for High Efficiency Lighting Retrofits

To calculate annual savings from lighting retrofits, the Evaluators applied the following equation:

$$Annual\ kWh\ Savings = \left(kW_{base} - kW_{post}\right) * Hours * HCEF$$

Parameters for this equation are defined in Table 6-2.

Table 6-2 Parameters for kWh Savings Calculation of Lighting Retrofit Measures

Parameter	Definition
kW_{base}	Total Baseline Fixtures x $W/Fixture_{base}$ / 1000W/kW
kW_{post}	Total Installed Fixtures x $W/Fixture_{post}$ / 1000W/kW
Hours	Annual Hours of Operation
HCEF	Heating/Cooling Energy Interactive Factor

Following this, the Evaluators calculated peak kW savings. This is based upon an Xcel-defined peak of 3:00 – 6:00 PM during the hottest summer weekdays. To provide the peak savings estimate for lighting, the facility's average runtime during the period of 3:00 – 6:00 PM on all summer weekdays was applied, in order to better reflect typical operation during the occurrence of a system peak. Peak kW savings are calculated as:

$$Peak\ kW\ Savings = (kW_{base} - kW_{post}) * HCDF * PCF$$

Parameters for this equation are defined in *Table 6-3*.

Table 6-3 Parameters for Peak Demand (kW) Savings Calculation of Lighting Retrofit Measures

Parameter	Definition
kW_{base}	Total Baseline Fixtures x $W/Fixture_{base}$ / 1000W/kW
kW_{post}	Total Installed Fixtures x $W/Fixture_{post}$ / 1000W/kW
PCF	Peak Coincident Factor: % Time During Peak Period in Which Lighting is Operating
HCDF	Heating/Cooling Demand Interactive Factor

6.2.1.3 Gross Savings Methodology for High Efficiency Lighting in New Construction Applications

The 2016 BLEP provided rebates to participating facilities for energy efficient lighting in new construction applications. Calculations of savings for lighting in new construction applications differs from retrofits in that the baseline is denominated in W/ft^2 for the space type. This is to capture the reduction in Lighting Power Density (LPD) generated by the project. Annual savings from an LPD reduction are calculated as:

$$Annual\ kWh\ Savings = \left(\frac{kW}{ft^2}_{base} - \frac{kW}{ft^2}_{post}\right) * Hours * HCEF * ft^2$$

Parameters for this equation are defined in Table 6-4.

Table 6-4 Parameters for kWh Savings Calculation of Lighting New Construction Measures

Parameter	Definition
kW/ft^2_{base}	Baseline LPD as Set by Building Code or Industry Standard
kW/ft^2_{post}	Total Installed Fixtures x $W/Fixture_{post}$ / 1000W/kW / Sq. Ft.
Hours	Annual Hours of Operation
HCEF	Heating/Cooling Energy Interactive Factor
Ft^2	Square Footage of the Facility

In a manner similar to lighting retrofits, the Evaluators then calculated peak savings for the measure. Peak kW savings are calculated as:

$$Peak\ kW\ Savings = \left(\frac{kW}{ft^2}_{base} - \frac{kW}{ft^2}_{post}\right) * PCF * HCDF * ft^2$$

The parameters for this equation are defined in Table 6-5.

Table 6-5 Parameters for Peak Demand (kW) Savings Calculation of Lighting New Construction Measures

Parameter	Definition
kW/ft^2_{base}	Baseline LPD as Set by Building Code or Industry Standard
kW/ft^2_{post}	Total Installed Fixtures x $W/Fixture_{post}$ / 1000W/kW / Sq. Ft.
PCF	Peak Coincident Factor: % Time During Peak Period in Which Lighting is Operating
HCDF	Heating/Cooling Demand Interactive Factor
Ft^2	Square Footage of the Facility

6.2.1.4 Gross Savings Methodology for Lighting Controls in Retrofit & New Construction Applications

The methodology to be detailed encompasses The Evaluators' gross savings methodology for all lighting control measures, including:

- Occupancy Sensors;
- Photocell Controls; and
- Daylighting Controls;

The methodology for this measure does not differ between retrofit and new construction applications as in a new construction application, the measure is considered as a retrofit to the installed lighting. Annual kWh savings from lighting controls are calculated as follows:

$$Annual\ kWh\ Savings = \left(Hours_{base} - Hours_{post}\right) * kW_{post} * HCEF$$

When occupancy sensors and interior daylighting controls are present, post operating hours are derived with the following equation:

$$\mathrm{OperatingHours_{POST}} = \mathrm{OperatingHours_{BASE}} * (1 - \mathrm{ControlFactor})$$

Lighting Controls Reduction in Operating Hours

Occupancy Sensor	30%
Daylighting, continuous dimming	30%
Daylighting, multi-step dimming	20%
Daylighting, On/Off	10%

This captures savings attributable to a reduction in operating hours as a result of the lighting controls. In instances where controls are installed alongside a lighting retrofit, savings from occupancy sensors are calculated using the installed kW of the energy efficient lighting, in order to account for dissynergies (i.e., a simultaneous lighting retrofit and lighting control installation saves less than each of the two measures would have individually). The Evaluators then calculated peak savings for lighting controls as:

$$Peak\ kW\ Savings = \left(PCF_{base} - PCF_{post}\right) * kW_{post} * HCDF$$

Savings from lighting controls are attributable to a reduction in the facility's Peak Coincident Factor, that is, after installation of lighting controls, the facility lighting operates for fewer hours within the 3:00 – 6:00 PM range.

6.2.2 Business Cooling Efficiency

Evaluation of the Business Cooling Efficiency Program (BCEP) requires the following:

- Stratified random sampling, selecting large saving sites with certainty;
- Review of deemed savings parameters;
- Onsite verification inspections;
- DOE-2 Simulation of large, complicated retrofits and use of Equivalent Full Load Hours (EFLH) values for smaller projects.

Parameters required for evaluation of the BCEP are presented in Table 6-6

Table 6-6 Data Sources for Gross Impact Parameters – Business Cooling Efficiency Program

Parameter	Source
Project Details	Program Tracking Data
Facility Billing Data (For Calibration of Large Retrofit Simulation Models)	Xcel
Equipment Specifications (Size, Efficiency, etc.)	Manufacturer's Literature
Equivalent Full-Load Hours (EFLH)	Xcel Deemed values, reviewed by the Evaluators through simulation of archetypical facilities with Roswell NM TMY Weather Data
Effective Useful Life	Comparison against CA DEER values
Net-to-Gross Ratio (NTGR)	Participant Surveying

6.2.2.1 Business Cooling Efficiency Gross Savings Estimates

As stated above, gross savings estimates for facilities participating in the 2016 BCEP are evaluated by one of two methodologies:

- Calibrated DOE-2 simulation, for large retrofits; and
- Equivalent Full Load Hour calculations for smaller retrofits.

6.2.2.2 DOE-2 Simulation Modeling

In evaluating the 2016 BCP, the Evaluator performed DOE-2 simulation modeling of large cooling retrofits for a range of facility types using eQuest software. Before making the analytical runs for each sample site with HVAC measures, we prepare a Model Calibration Run. This is a base case simulation to ensure that the energy use estimates from the simulations have been reconciled against actual data on the building's energy use. This run is based on the information collected in an on-site visit pertaining to types of equipment, their efficiencies and capacities, and their operating profiles. Current operating schedules are used for this simulation, as are local weather data covering the study period. The Model Calibration Run is made using actual weather data for a time period corresponding to the available billing data for the site.

The goal of the model calibration effort is to have the results of the DOE-2 simulation come within approximately 10% of the patterns and magnitude of the energy use observed in the billing data history. In some cases, it may not be possible to achieve this calibration goal because of idiosyncrasies of particular facilities (e.g., multiple buildings, discontinuous occupancy patterns, etc.).

Once the analysis model has been calibrated for a particular facility, there are three steps in our procedure for calculating estimates of energy savings for HVAC measures installed or to be installed at the facility.

- First, we perform an analysis of energy use at a facility under the assumption that the energy efficiency measures are not installed.
- Second, we analyze energy use at the facility with all conditions the same but with the energy efficiency measures now installed.
- Third, we compare the results of the analyses from the preceding steps to determine the energy savings attributable to the energy efficiency measure.

Following this, the Evaluator determines peak kW savings by examining the reduction observed in the summer peak provided in the Typical Meteorological Year (TMY) dataset. The time picked is set to match the conditions under which Xcel observes its typical system peaks.

6.2.2.3 EFLH Calculations

For simpler cooling measures, including Package Terminal Heat Pumps (PTHPs) and Roof Top Units (RTUs), the Evaluators applied deemed EFLH values from the New Mexico TRM along with specifications of installed capacity and efficiency in evaluating savings. Parameters for EFLH calculations are defined in Table 6-7.

Table 6-7 Parameters for kWh Savings Calculation of HVAC Retrofits

Parameter	***Definition***
#Units	Quantity of Rebated HVAC Units
Cap	Unit Capacity (Measured in Tons)
$SEER_{base}$	Baseline SEER
$SEER_{Post}$	Installed SEER
EFLH	Equivalent Full Load Hours (Encompassing both heating and cooling hours in cases of heat pumps)

EFLH values are provided in Xcel's technical assumptions for business cooling measures. The Evaluators tested these values via DOE-2 simulation modeling of archetypical building types using Roswell NM TMY weather data, and revises EFLH by facility type where appropriate.

6.2.3 Business Custom Efficiency

Projects in Business Custom Efficiency have site-specific measurement and verification (M&V) plans developed, in a manner appropriate for the specific project's level of uncertainty and expected savings. Project reports in Appendix A detail site-specific approaches, applying IPMVP.

6.2.4 Business Motor & Drive Efficiency

Evaluation of the Business Motor & Drive Efficiency Program (BMEP) requires the following:

- Stratified random sampling, selecting large saving sites with certainty;
- Review of deemed savings parameters; and
- Onsite verification inspections;

Parameters required for evaluating savings from the BMEP are detailed in Table 6-8.

Table 6-8 Data Sources for Gross Impact Parameters – Business Motor & Drive Efficiency Program

Parameter	***Source***
Project Details	Program Tracking Data
Load Factor	Xcel deemed values & one-time readings for simple applications, power metering for larger, complicated applications.
Equipment Specifications (Size, Efficiency, etc.)	Manufacturer's Literature
Equivalent Full-Load Hours for HVAC Pumps & Ventilation Fans (EFLH)	Xcel Deemed values, reviewed by the Evaluators through simulation of archetypical facilities with Roswell NM TMY Weather Data
Hours of Operation for Industrial Motors & Drives	Xcel deemed values for simple applications, end-use metering & facility staff interviews for complicated applications
Effective Useful Life	Comparison against CA DEER values
Net-to-Gross Ratio (NTGR)	Participant Surveying

6.2.4.1 Business Motor & Drive Efficiency Gross Savings Estimates

The 2016 BMEP provided rebates to participating facilities for projects including:

- NEMA Premium Efficiency Motors;
- Pump-Off Controllers (POCs);
- Variable Frequency Drives (VFDs) for Air Handler Units (AHUs) in HVAC Applications;
- VFDs in industrial pumping applications; and
- VFDs for compressed air systems.

6.2.4.2 Gross Savings for NEMA Premium Efficiency Motors

Savings from NEMA Premium Efficiency Motors are calculated as:

$$Annual\ kWh\ Savings = HP\ x\ LF\ x\ .746\ \ kW/HP * \left(\frac{1}{Eff_{std}} - \frac{1}{Eff_{prem}}\right) * Hrs$$

Parameters for this equation are detailed in Table 6-9.

Table 6-9 Parameters for kWh Savings Calculation of Premium Efficiency Motor Retrofits

Parameter	Definition
HP	Motor Horsepower
LF	Load Factor
Eff_{std}	Efficiency Rating of a Standard Efficiency Motor of the Specified HP
Eff_{prem}	Efficiency Rating of a Premium Efficiency Motor of the Specified HP
Hrs	Hours of Operation Per Year

Following this, peak demand (kW) reduction is calculated. Peak Coincident Factors for NEMA Premium Efficiency Motors are taken from Xcel technical assumptions, which the Evaluators determined to be reasonable estimates of PCF. Demand savings are calculated as:

$$Peak\ kW\ Savings = HP\ x\ LF\ x\ .746\ \ kW/HP * \left(\frac{1}{Eff_{std}} - \frac{1}{Eff_{prem}}\right) * PCF$$

6.2.4.3 Gross Savings for HVAC VFDs

Savings from VFDs are calculated as:

$$Annual\ kWh\ Savings = HP\ x\ LF\ x\ .746\ \ kW/HP * \left(\frac{1}{Eff_{std}}\right) * Hrs * \%_{Savings}$$

Parameters for this equation are detailed in Table 6-10.

Table 6-10 Parameters for kWh Savings Calculation of Premium Efficiency Motor Retrofits

Parameter	Definition
HP	Motor Horsepower
LF	Load Factor
Eff_{std}	Efficiency Rating of a Standard Efficiency Motor of the Specified HP
Hrs	Hours of Operation Per Year
$\%_{savings}$	Average Savings Achieved by the VFD

Following this, peak demand (kW) reduction is calculated. Peak Coincident Factors for VFDs are taken from Xcel technical assumptions, which the Evaluators determined to be reasonable estimates of PCF. Demand savings are calculated as:

$$Peak\ kW\ Savings = HP\ x\ LF\ x\ .746\ \ kW/HP * \left(\frac{1}{Eff_{std}}\right) * \%_{savings} * PCF$$

6.3 Impact Evaluation Results

The main features of the approach used for the impact evaluation are as follows:

- Data for the study have been collected through review of program materials, on-site inspections, and end-use metering. Based on data provided by Xcel, sample designs were developed for on-site data collection for the impact evaluation. Sample sizes were determined that provide savings estimates for the program with ±10% precision at the 90% confidence level.
- On-site visits were used to collect data for savings impacts calculations. The on-site visits were used to verify installations and to determine any changes to the operating parameters since the measures were first installed. Facility staff were interviewed to determine the operating hours of the installed system and to locate any additional benefits or shortcomings with the installed system. For some sites, monitoring of lighting or HVAC equipment was conducted to obtain more accurate information on operating characteristics.

Gross savings were estimated using proven techniques, including engineering calculations using industry standards and verification of computer simulations developed by program contractors to determine energy savings. Table 6-11 summarizes the total participation in the 2016 BCP.

Table 6-11 2016 BCP Participation Summary

Program	# Projects	Expected kWh	Expected kW
Business Custom	76	13,247,646	1,846.89
Business Lighting	184	2,030,902	306.35
Business Motors & Drives	7	281,935	38.90
Business Cooling	23	232,713	71.67
Business Computers	13	246,736	31.94
Small Building Tune-Up	1	8,009	0.00
Total	304	16,047,941	2,295.75

Data provided by Xcel showed that during 2016, there were 304 projects in total for all program components, which were initially expected to provide gross savings of 16,047,941 kWh. The resulting overall sample is presented in Table 6-12.

Table 6-12 BCP Sample Summary

Component	# Sites in Population	M&V Sample Size	# Interviews
Business Custom	76	14	9
Business Lighting	184	6	26
Business Motors & Drives	7	0	1
Business Cooling	23	1	1
Business Computers	13	0	0
Small Building Tune-Up	1	0	0
Total	304	21	37

6.3.1 BCP Gross Savings Estimates

Sampling for evaluation of Xcel's BCP was developed using the Stratified Random Sampling procedure detailed in Section 2.3.3. This procedure provides 90% confidence and +/- 10% precision with a significantly reduced sample than random sampling would require, by selecting the highest saving facilities with certainty, thereby minimizing the variance that non-sampled sites can contribute to the overall results.

Due to the diversity of participation in the BCP, the Evaluators opted to develop samples stratified first by measure category and then by expected kWh savings. This approach constrains the extrapolation of results from a sampled project only to non-sampled projects for the same or similar technology.

All measure-level samples provided for 90% confidence and +/- 15% precision. When aggregated to the program-level, achieved precision is +/- 6%.

6.3.1.1 Sample Design

Table 6-13 summarizes the sample Business Comprehensive downstream rebates.

Table 6-13 Business Comprehensive Sample Design

	Stratum 1	***Stratum 2***	***Stratum 3***	***Stratum 4***	***Stratum 5***	***Totals***
Strata boundaries (kWh)	<10,000	10,000 – 30,000	30,000-120,000	120,000-500,000	> 500,000	
Number of sites	187	63	27	8	6	291
Total kWh savings	749,129	1,057,124	1,343,365	1,914,570	10,737,017	15,801,205
Average kWh	4,006	16,780	49,754	239,321	1,789,503	54,300
Standard deviation of kWh savings	2,873	5,688	21,347	119,089	1,392,459	314,649
Coefficient of variation	0.72	0.34	0.43	0.50	0.78	5.79
Final sample	4	4	3	4	6	21

In addition to this, there was 246,736 kWh and 31.94 kW from Business Computer Efficiency.

The on-site sample represented 76.7% of program expected gross kWh.

6.3.1.2 Site-Level Realization

Sites chosen within each stratum are visited in order to verify installation of rebated measures and to collect data needed for calculation of ex post verified savings. The realization rates for sites within each stratum are then applied to the non-sampled sites within their respective stratum.

Table 6-14 presents results at the site level.

Table 6-14 Expected and Realized Savings by Project

Project ID(s)	Facility Type	Program Category	Expected kWh Savings	Realized kWh Savings
OID1980910	Industrial	Custom	4,368,371	4,368,371
OID2314956	Industrial	Custom	2,272,709	2,307,746
OID1980906	Industrial	Custom	1,376,104	1,376,104
OID 0153611	Industrial	Custom	1,339,613	1,339,613
OID2646754	Industrial	Custom	790,185	789,146
OID1980914	Industrial	Custom	590,035	590,035
OID2587707	Hotel/Motel	Lighting	412,364	138,849
OID2803122	Industrial	Custom	399200	399,200
OID2528734	Hotel/Motel	Custom	312,842	338,605
OID2384763	Retail/Service	Custom	145,515	126,109
OID2580661	Government	Custom	117,187	116,314
OID2431426	School/K-12	Custom	48,649	62,070
OID2538582	Retail/Service	Custom	35,491	40,089
OID2472350	Medical	Custom	28,934	24,375
OID2528760	Retail/Service	Lighting	20,358	19,985
OID2537846	Office	Custom	14,686	14,421
OID2588812	Hotel/Motel	Lighting	12,931	779
OID2469017	Agricultural	Lighting	1,416	2,835
OID2588745	Retail/Service	Lighting	1,090	1,135
OID2523908	Retail/Service	Cooling	1,035	1,211
OID2573057	Retail/Service	Lighting	894	934

From these site-level analyses, realization rates by stratum were developed. These are summarized in Table 6-15 and

Table 6-16 for kWh and kW, respectively.

Table 6-15 Gross kWh Realization by Stratum

Stratum	Expected kWh Savings	Realized kWh Savings	Realization Rate
5	10,737,017	10,771,015	100.32%
4	1,387,108	1,119,077	80.687%[16]
3	84,140	102,159	121.42%
2	62,223	45,139	72.54%
1	19,121	20,536	108.65%
Business Computers	246,736	246,736	100.0%
Business Cooling	1,035	1,211	117.0%

Table 6-16 Gross kW Realization by Measure Category

Stratum	Expected kW Savings	Realized kW Savings	Realization Rate
5	1,258.14	1,270.08	100.95%
4	141.97	81.59	57.47%[17]
3	45.04	12.37	27.46%
2	13.86	0.08	0.58%
1	4.19	1.14	27.21%
Business Computers	31.94	31.94	100.0%
Business Cooling	.76	1.02	134.21%

The Evaluators found low kW realization due to erroneous designation of lighting as interior lighting when it was found to be exterior lighting operating from dusk until dawn. Such projects had 0% kW realization. Due to this finding, the Evaluators concluded that the Business Cooling projects should be disaggregated from the program at-large as the kW impacts associated with the M&V sample would reduce savings in a manner that is not applicable to cooling projects. The M&V findings from Business Cooling were disaggregated and extrapolated separately from the remaining sample.

[16] The overall realization rate for stratum 4 is 80.7%. This includes a project that has 100% realization rate because ADM was involved it creating ex ante savings. The project was excluded from calculating the realization rate for the stratum, 72.9%, which was applied to all projects in stratum 4.

[17] The overall realization rate for stratum 4 is 57.5%. This includes a project that has 100% realization rate because ADM was involved it creating ex ante savings. The project was excluded from calculating the realization rate for the stratum, 36.5%, which was applied to all projects in stratum 4.

6.3.1 Business Comprehensive Net Savings Estimates

In evaluating the 2016 BCP, the Evaluators were tasked with providing net savings estimates. The net savings attributable to a program may differ from gross savings because of free-ridership. Free ridership impacts are the energy savings impact attributable to the installation of energy efficiency measures by participants who would have installed the energy efficient measures without the Xcel rebate.

We used information collected through surveys of program participants to develop estimates of free-ridership. In these surveys, customers were questioned regarding their knowledge of energy efficiency, their reasons for participating, and the measure implementation decisions they would have made had they not participated in an IOU's program.

Our approach to estimating free-ridership using self-reported survey data has the following main features:

- We ask respondents two related sets of questions: (1) How much of the savings or measures would have been installed without the program, and (2) what was the likelihood that measures of the same or better efficiency would have been installed without the program. Using a combination of questions, we can derive the base value by filling in missing data with a hierarchy of responses.
- We use a variety of survey methods to help confirm the validity or consistency of responses provided to questions about free ridership. Asking related questions about the importance of incentives, prior plans to install, increases in efficiency and timing of investment allows examination of the consistency of self-reports on free ridership.

The factors are then combined to assign individuals a probability of free-ridership. The assignments are split into quartiles, with respondents labeled as having a 0%, 33%, 67%, or 100% chance of free-ridership. The categories of free-ridership are detailed in the subsections to follow.

6.3.1.1 Financial Ability

For Part 1, customers were asked:

> Question 14: Would you have been able to install the measure without the financial incentive from Xcel?

If the customer answered No to this, then they are assigned 0% free-ridership, as without the financial ability to purchase high efficiency equipment, other factors in the decision making process cannot contribute to the decision making absent the available rebate. This value essentially serves as a free-ridership "gateway". Respondents that

lacked financial ability are definitely not free-riders, but being financially able to install a measure is not sufficient to label as a free-rider.

6.3.1.2 Prior Planning

Following this, customers are asked as to any plans they had to install high efficiency equipment. This is addressed in the following questions:

> Question 19: When did you learn of Xcel's energy efficiency program?
>
> Question 9: Did you have plans to install the equipment before participating in the program?

If the respondent indicates that they did have prior plans, or that they had not learned of the program until after having selected the equipment, then they can be considered a partial-free rider on this component.

6.3.1.3 Importance of Rebate in Decision Making

Once customers learn of the rebate, it is possible that this knowledge will sway their decision making process to install standard vs. high efficiency equipment. To address this, we examined responses to the following two questions:

> Question 5: How important was Xcel' rebate in your decision to buy high efficiency equipment?
>
> Question 8: Before participating in the energy efficiency program, had you installed any equipment similar to [Equipment/Measure] at your facility?

Question directly addresses the importance of the rebate, by having the respondent weigh its importance in the decision-making process for the project. Question 8 also addresses how important the rebate was to the decision making process as if the respondent had installed the same measure elsewhere at the facility then the rebate was likely not required to induce them to install the rebated project

6.3.1.4 Likelihood of Installing Similar Equipment without Rebate

Finally, customers are asked whether they would have installed high efficiency equipment if the rebate were not available. This is addressed with four questions:

> Question 17: If the financial incentive from the lighting efficiency program had not been available, how likely is it that you would have installed [Equipment/Measure] anyway?
>
> Question 18: How did availability of information and financial incentives through the lighting efficiency program affect the quantity (or number of units) of [Equipment/Measure] that you purchased and installed? Did you purchase and install more [Equipment/Measure] than you otherwise would have without the program?

> Question 22: How did availability of information and financial incentives through the Business Comprehensive efficiency program affect the timing of your purchase and installation of [Equipment/Measure]? Did you purchase and install more [Equipment/Measure] earlier than you otherwise would have without the program?

If the respondent indicates on Question 17 that they "Probably would have installed" or "Definitely would have installed" the same equipment without the rebate, their answers to the three questions to follow are examined. Questions 18 and 22 address whether the project was modified due to available rebates from the program. If the respondent indicates that they did not modify the project, then they are likely a free-rider on this component. If they had modified the project, then that is an indicator that the program did affect their decision making, even if this runs counter to their response in Question 19.

6.3.1.5 Assignment of Free-Ridership and Partial Free-Ridership Scores

Based upon the answers to these four categories of questions, the respondents are placed in Free-Ridership Quartiles, with scores of 0%, 33%, 67%, and 100% Free-Ridership. The scoring is based upon all possible interactions between the four questions. Part 1 of free-ridership, Financial Ability, essentially serves as a gateway; if it does not equal "Yes" then other aspects of free-ridership are irrelevant. Table 6-17 presents the associated free-ridership score for each permutation of answers in the four free-ridership components. The table provides scoring at the individual participant level. Program-level free-ridership is then derived by aggregating the participant-level scores.

Table 6-17 Free-Ridership Scoring

Financial Ability	Prior Planning	Rebate Was Important	Likely to Install w/o Rebate	Aggregated Category	Free-Ridership Score
Y	N	Y	N	YNYN	0
N	N	Y	N	NNYN	0
N	N	Y	N	NNYN	0
Y	N	Y	N	YNYN	0
Y	Y	N	N	YYNN	0.67
Y	N	Y	N	YNYN	0
N	N	Y	Y	NNYY	0
Y	N	N	Y	YNNY	0.67
Y	N	Y	N	YNYN	0
Y	N	Y	N	YNYN	0
Y	N	Y	N	YNYN	0
Y	N	Y	Y	YNYY	0.33
N	N	N	Y	NNNY	0
Y	Y	N	N	YYNN	0.67
Y	N	N	N	YNNN	0.33
N	N	Y	N	NNYN	0

Y	N	Y	N	YNYN	0
Y	N	Y	N	YNYN	0
Y	N	N	N	YNNN	0.33
N	N	Y	N	NNYN	0
N	N	Y	N	NNYN	0
N	N	N	N	NNNN	0
Y	N	N	Y	YNNY	0.67
Y	N	N	Y	YNNY	0.67
N	Y	N	N	NYNN	0
Y	N	N	N	YNNN	0.33
Y	N	Y	N	YNYN	0
N	N	Y	N	NNYN	0
Y	Y	N	N	YYNN	0.67
Y	N	N	Y	YNNY	0.67
Y	N	Y	N	YNYN	0
Y	Y	N	Y	YYNY	1
N	N	Y	N	NNYN	0
Y	N	N	Y	YNNY	0.67
N	N	Y	Y	NNYY	0

6.3.2 Business Comprehensive Net Savings Estimates

The Evaluators estimated net savings for all Xcel business programs via detailed participant surveying of a representative sample of decision makers from each program. These questionnaires were used to provide estimates of free-ridership, with a separate estimate developed for each measure category. The subsections to follow will present the Evaluators' NTGR estimates by measure category for each program component, and the associated net savings. With verified savings compiled by stratum and by measure, the Evaluators then applied measure-category NTGRs to estimate program net savings. These are summarized in Table 6-18. For this table, the Custom Efficiency projects were calculated with the NTGRs associated with the larger measure category, but then separated into the Custom Efficiency line item.

Table 6-18 Verified Net Savings by Component

Program	*Expected NTGR*	*Verified NTGR*	*Verified Gross kWh*	*Verified Net kWh*	*Verified Gross kW*	*Verified Net kW*
Business Custom	80.00%	92.00%	13,123,785	12,073,882	1,460.01	1,343.21
Business Lighting	75.00%	92.90%	1,822,489	1,693,092	91.37	84.88
Business Motors & Drives	80.00%	80.00%	280,506	224,405	12.57	10.06
Business Cooling	87.50%	87.50%	241,564	211,369	17.58	15.38
Business Computers	88.00%	88.00%	246,736	217,128	31.94	28.11
Building Tune-up	80%	80%	8,602	6,882	0	0.00
Total	79.60%	91.70%	15,723,682	14,426,757	1,613.47	1,481.64

After evaluating the program components, the Evaluators compiled net savings to provide an overall net realization rate. These results are summarized in Table 6-19 and

Table 6-20.

Table 6-19 Xcel Business Comprehensive Gross Realization Summary

Component	Peak Demand Reduction (kW)		Annual Energy Savings (kWh)		Lifetime Energy Savings (kWh)		Net Realization Rate
	Ex Ante	Ex Post	Ex Ante	Ex Post	Ex Ante	Ex Post	
Custom	1,846.89	1,453.31	13,247,646	13,123,037	173,981,166	172,988,242	99.43%
Business Lighting	306.35	76.68	2,030,902	1,819,394	16,247,216	14,555,150	89.59%
Motors & Drives	38.90	12.41	281,935	280,476	4,885,180	4,694,634	96.10%
Cooling	71.67	96.19	232,713	272,285	3,303,690	3,865,477	117.00%
Computers	31.94	31.94	246,736	246,736	986,944	986,944	100.00%
Building Tune-up	0.00	0.00	8,009	8,558	40,045	42,788	106.85%
Total	2,295.75	1,670.52	16,047,941	15,750,486	199,444,241	197,133,237	98.84%

Table 6-20 Xcel Business Comprehensive Net Realization Summary

Component	Peak Demand Reduction (kW)		Annual Energy Savings (kWh)		Lifetime Energy Savings (kWh)		Net Realization Rate
	Ex Ante	Ex Post	Ex Ante	Ex Post	Ex Ante	Ex Post	
Custom	1,477.51	1,336.32	10,598,117	12,066,654	139,184,933	159,062,970	114.28%
Business Lighting	229.76	71.25	1,522,366	1,690,622	12,185,412	13,524,972	110.99%
Motors & Drives	31.12	9.92	0	224,381	3,908,144	3,755,708	96.10%
Cooling	62.71	84.16	203,624	238,250	2,890,729	3,382,292	117.00%
Computers	28.11	28.11	256,102	217,128	868,511	868,511	100.00%
Building Tune-up	0.00	0.00	0	8,558	40,045	42,788	106.85%
Total	1,829.21	1,529.77	12,580,208	14,445,592	159,077,773	180,637,241	113.55%

6.4 Process Evaluation Findings

This chapter presents the results of the process evaluation of the Business Comprehensive Program.[18] The process evaluation focuses on aspects of program policies and organization, as well as the program delivery framework.

The process chapter begins with an overview of the program and the key program changes that occurred during the 2016 program year. This is followed by a discussion of the overall progress of the program and potential for meeting its goals. The chapter also includes discussion relating to certain issues that are critical to the future success of the program. This discussion is followed by an analysis of strategic planning and process recommendations, and concludes by highlighting key findings from the surveys of trade partners and customer participants.

6.4.1 Program Overview

The Business Comprehensive Program offers rebates and incentives for the following types of equipment:

Computers

Incentives for efficient computers are provided through rebates to end-users as well as upstream incentives to manufacturers. End-users can receive rebates for desktop virtualization software and remote PC power management. Specifically, rebates of $60 per thin or zero client installed are available for desktop virtualization and rebates of $5 per controlled workstation are offered. These rebate offers are managed by Xcel staff.

For the upstream component, the program contributes incentives to Ecova, who implements a program called 80 Plus. The 80 Plus program is funded by Xcel and Efficiency Vermont. The 80 Plus program works with electronics manufacturers to provide more efficient technologies. The computers component that Xcel funds, encourages computer power supply manufacturers to develop more efficient power supplies and to encourage PC manufacturers to incorporate the efficient power supplies in their products and to make them available to consumers. Savings for this program component are based on sales of PCs with qualifying power supplies in the Xcel service territory.

The equipment incentives for the program are segmented into three components: cooling efficiency, lighting efficiency, and motor and drive efficiency.

Cooling

The cooling efficiency component offers prescriptive rebates for a variety of HVAC and refrigeration equipment including chillers, direct evaporative cooling units, direct

[18] "Business Comprehensive" is an aggregation of Business Lighting, Business Cooling, Business Custom, and Business Motors & Drives programs.

expansion units, electrically commutated motors for use on refrigerated display cases, freezer display cases, and walk-in refrigerators, and walk-in-freezers, and hotel room controllers.

Lighting

The lighting efficiency component includes prescriptive and custom lighting incentives. Incentives are available for retrofit and new construction projects. Additionally, the programs provide prescriptive incentives for the replacement of incandescent signals with LED signals. This channel was expanded in 2015 to encompass direct installation of low flow devices such as aerators, showerheads, and pre-rinse spray valves.

Motors & Drives

The motors and drives component of the program offers incentives for NEMA and enhanced NEMA premium motors, prescriptive incentives for VFDs on 200 hp motors or smaller and custom incentives on motors greater than 200hp, electronically commutated motors (ECM) installed on refrigeration equipment for constant speed motor controllers, air compressor equipment, and oil pump off controllers.

Custom

The measures covered by this program fall outside of the scope of other Xcel business programs; Business Lighting Efficiency, Business Cooling Efficiency, and Business Motor & Drive Efficiency each have custom components in addition to prescriptive measures, and cover a large amount of custom measures.

Businesses can receive rebates of up to $400 per kW saved. Participants must receive pre-approval for a measure before installation.

Technical Assistance

In addition to incentives, the Xcel also provides other services to help customers identify energy saving opportunities. These services include a new building tune-up program and funding assessments of large commercial and industrial study sites, and free lighting assessments through the Lighting Efficiency component. Additionally, the program website contains a variety of information energy saving technologies.

6.4.2 Overall Program Success

The Xcel business portfolio shows a trend of decreasing in participants in the business motors and drives program and increase in the custom program. In 2016, three customers filed large custom projects that makes up 69% of the total program savings.

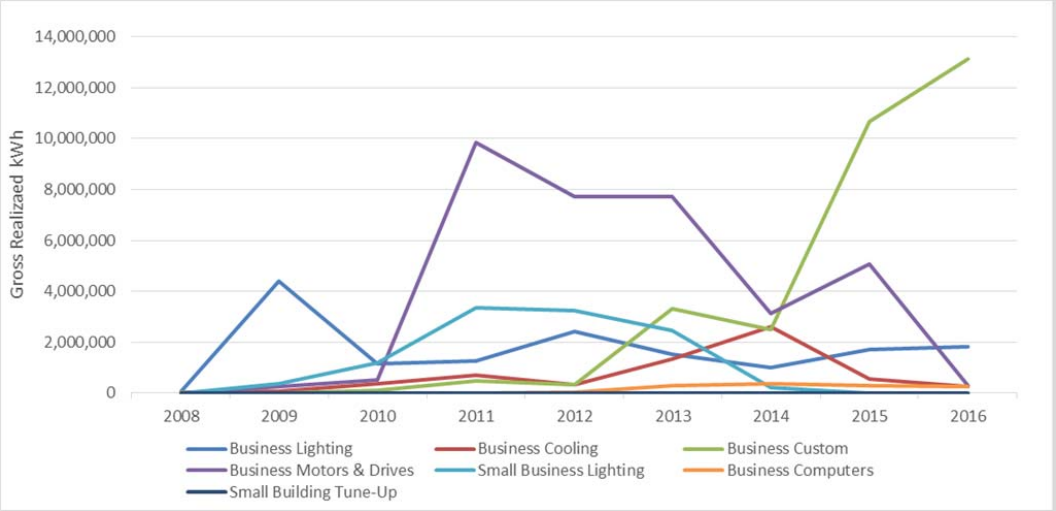


Figure 6-1 Business Comprehensive Historical Savings by Program Component

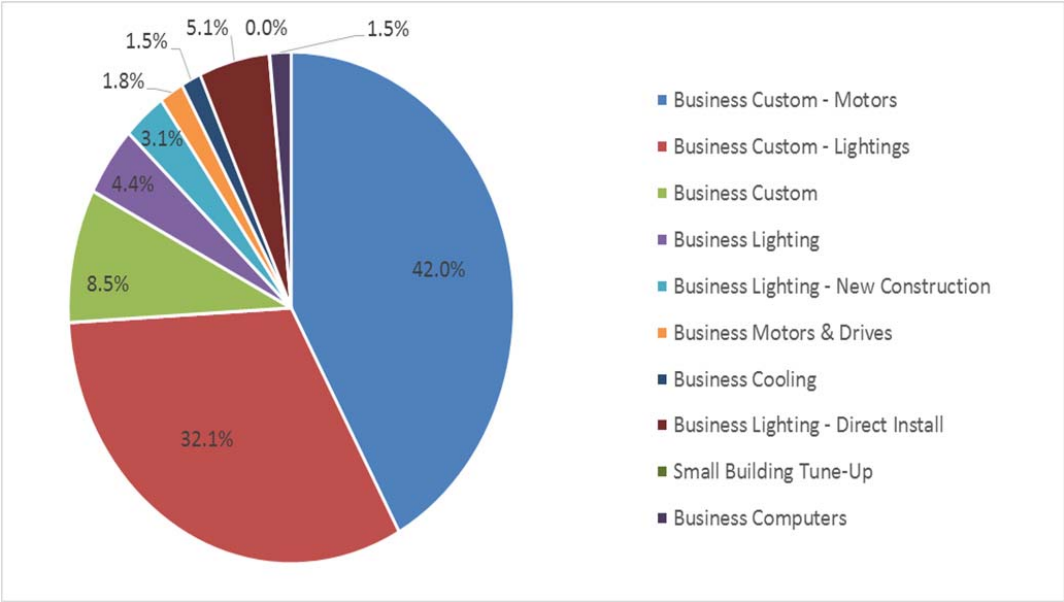


Figure 6-2 Business Comprehensive kWh by Program Measure Type

The Business Comprehensive Program had 304 participating facilities in 2016.[19] Figure 6-3 presents the distribution of participants by facility type.

[19] Based on the number of unique premise IDs in the program tracking data.

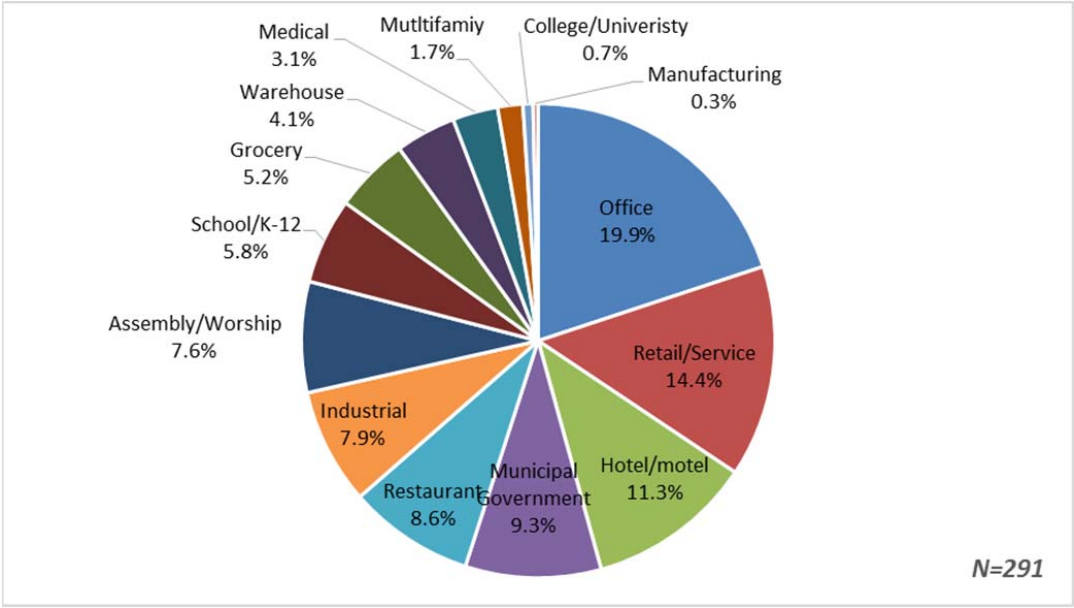


Figure 6-3 Business Comprehensive Distribution of Projects by Facility Type

The distribution of savings did not match the distribution of facilities, in that industrial facilities displayed exceedingly high savings per-project. Figure 6-4 summarizes the distribution of expected savings by facility type.

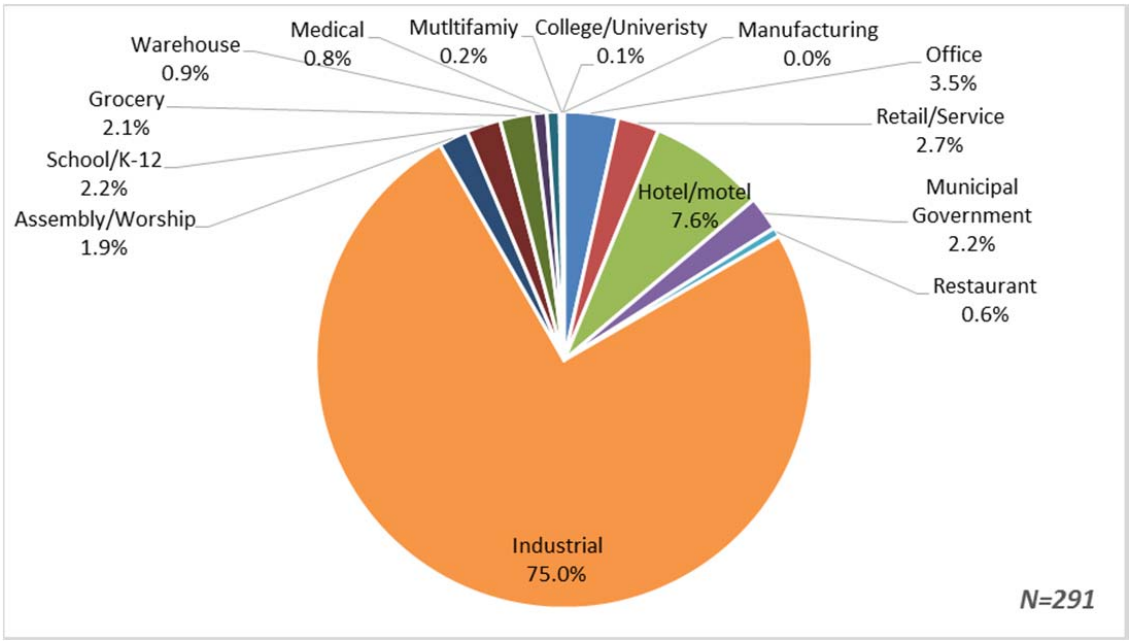


Figure 6-4 Business Comprehensive Distribution of Expected Savings by Facility Type

kWh savings are shown by measure type in Table 6-21. Custom motors accounted for the largest share of program savings followed by custom lightings and general custom projects. The sum of all custom projects account for 83% of program kWh.

Table 6-21 kWh Savings by Measure Type

Measure Type	kWh Savings	Percent of kWh Savings
Business Custom - Motors	6,733,710	42.0%
Business Custom - Lighting	5,155,624	32.1%
Business Custom	1,358,312	8.5%
Business Lighting	710,551	4.4%
Business Lighting - New Construction	498,790	3.1%
Business Motors & Drives	281,935	1.8%
Business Cooling	232,713	1.5%
Business Lighting - Direct Install	821,561	5.1%
Small Building Tune-Up	8,009	0.0%
Business Computers	246,736	1.5%

6.4.3 Quality Assurance & Verification Procedures

Quality assurance and verification processes (QA) are split between Xcel and CLEAResult. Generally, Xcel staff defines what information is to be collected during verification visits and CLEAResult staff performs the site visits. The specific QA procedures used are:

- The first five projects associated with a new contractor receive a post-inspection. CLEAResult treated all contractors as “new” during the program year regardless of prior activity in the program.
- All projects coming from managed accounts (electric load of more than 400kW) receive pre- and post-inspections for custom projects and post-inspection for standard projects.
- Problem contractors identified in the prior year’s evaluation are banned from the program. CLEAResult performs checks on the limited liability corporation name and the person’s name.

CLEAResult utilized staff that work on other utility programs to complete the verification visits during the program year to complete the verifications.

The contract with CLEAResult is structured such that the performance dollars are based on verified savings as opposed to program estimated savings.

6.4.4 Program Marketing

The Business Comprehensive Program is marketed through multiple channels. A key component of the strategy is for trade partners to promote the programs. To assist and encourage trade partners to promote the incentives, Xcel provides materials to promote the program, a phone number for trade partners to receive assistance, and trade partner incentives. Table 6-22 displays the trade partner incentives offered.

Table 6-22 Trade Partner Incentives

Program Component	*Trade Partner Incentives*
Cooling Efficiency	25% of customer rebate for all qualifying equipment
Custom Efficiency	$100 for submitting Custom Efficiency pre approval applications
Lighting Efficiency	$25 per kW of approved customer rebate
Motors Efficiency	$5 to $2,500 depending on motor size

Additionally, part of CLEAResult's role is to promote the program face-to-face with customers. During staff interviews, CLEAResult staff noted that this type of contact and the process of building relationships with Xcel customers are particularly important for engaging small businesses. Additionally, CLEAResult has been building relationships with Chambers of Commerce to promote the programs among their membership.

Xcel program staff also promotes the program through a variety of channels targeted direct mailings, email campaigns, and newsletters. Mass-market media, including radio and newspaper placements, is another strategy that Xcel has used promote its efficiency programs. Another component of program outreach that Xcel staff engaged in was "neighborhood sweeps" to promote lighting technologies.

Overall the program marketing strategy is robust with trade partners and CLEAResult, and Xcel staff each playing a role in promoting the incentives available.

6.4.5 Customer Outcomes

A survey was conducted in 2016 to collect data about customer decision-making, preferences, and perspective of the Business Comprehensive Program. In total, 37 participants responded to the survey questionnaire.

6.4.5.1 Program Awareness

Xcel uses varied channels to promote the Business Comprehensive Program equipment incentives including trade partners (vendors and contractors), direct outreach, email communications, targeted mailings, and the utility website. As shown in Figure 6-6, the most common ways respondents first learned about the program was through Xcel staff (22%), a program webinar (22%), a trade ally or contractor (14%), or from past experience with the program (11%).

Overall these findings suggest that direct personal contact methods seem to be driving awareness of the program.

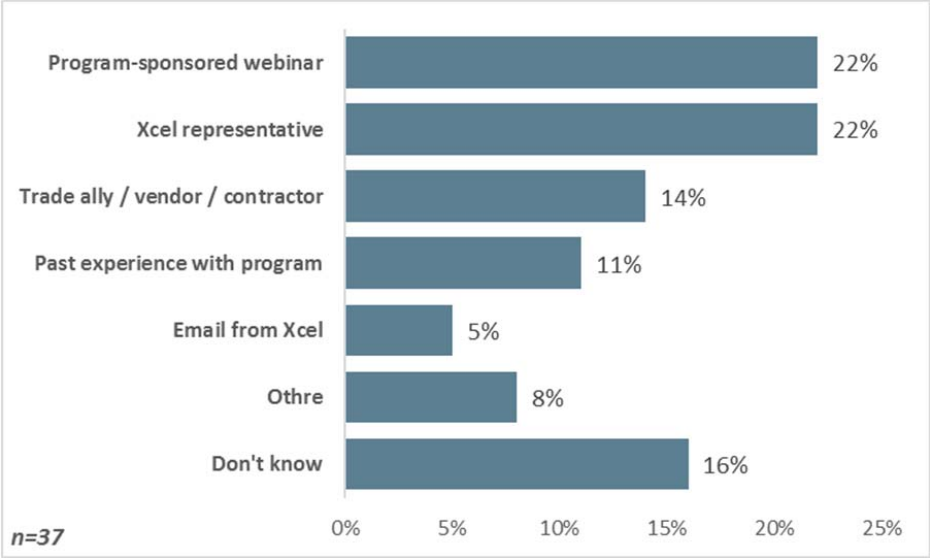


Figure 6-5 BCP Participant Sources of Program Awareness

As shown in Table 6-23, survey respondents participated in all of the Business Comprehensive Program components.

Table 6-23 Program Components for Respondents

Program Component	***Percent of Survey Respondents***
Cooling Efficiency	29%
Custom Efficiency	23%
Motors Efficiency	17%
Lighting Efficiency	25%
Custom Efficiency and Lighting Efficiency	3%
Cooling Efficiency and Custom Efficiency	3%

6.4.5.2 Program Awareness

Xcel uses varied channels to promote the Business Comprehensive Program equipment incentives including trade partners (vendors and contractors), direct outreach, email communications, targeted mailings, and the utility website. As is typical for a business program, contractors and vendors are key drivers of program activity. As shown in Figure 6-6, the most common ways respondents first learned about the program was through Xcel staff (33%), friends or colleagues (i.e. word of mouth) (25%), an equipment vendor or building contractor (17%), an information brochure (13%), and the Xcel website (13%). Fifty percent of respondents reported visiting the Xcel website for information on energy efficiency programs, while 50% never had.

Overall these findings suggest that direct personal contact methods seem to be driving awareness of the program.

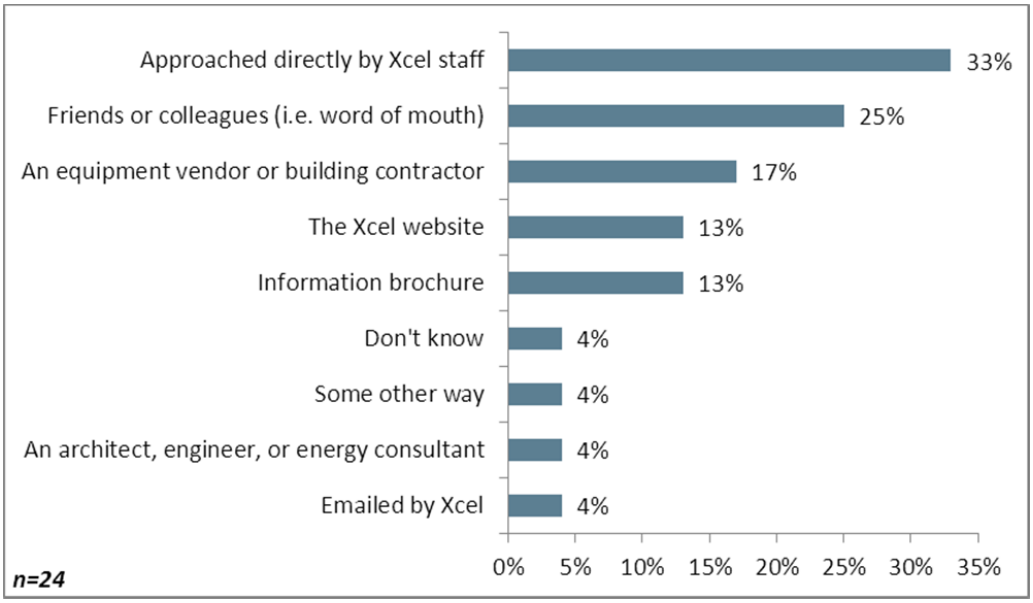


Figure 6-6 BCP Participant Sources of Program Awareness

6.4.5.3 Decisions to Participate

Participants were asked who initiated the discussion that led to the decision to participate in the program. The majority of respondents (57%) said their organization initiated the discussion. Other common responses to the question were, an Xcel representative (19%), or a vendor/contractor (14%).

Table 6-24 Organization's Decision-Making

Regarding your organization's decision to participate in the incentive program, who initiated the discussion about the incentive opportunity? Would you say…	***Percent of Respondents (n = 37)***
Your organization initiated it	57%
Your vendor or contractor initiated it	14%
The idea arose in discussion between your organization and your vendor or contractor	5%
An Xcel representative initiated it	19%
Some other way	3%
Don't know	3%

Seventy-eight percent of respondents said they had not previously installed a similar measure, while 22% said they had. About half of respondents (52%) said they had plans to install the equipment before participating in the program.

Nineteen percent of respondents had prior experience with Xcel's energy efficiency programs prior to participating in the program. Of these respondents, 85% thought this experience was an important factor in their decision to install the measure.

Table 6-25 Importance of Prior Experience with Xcel Programs

How important was previous experience with the Xcel energy efficiency programs in making your decision to install the measure? Was it…	***Percent of Respondents (n = 7)***
Very important	71%
Somewhat important	14%
Only slightly important	0%
Not important at all	0%
Don't know	14%
Refused	0%

Respondents were also asked how likely they would have been to install the equipment without the financial incentive. Fifty-seven percent of respondents probably or definitely would have installed, while 32% probably would not have installed, and 5% definitely would not have installed.

Table 6-26 Likelihood of Installation without Financial Incentive

If the financial incentive had not been available, how likely is it that you would have installed the measure anyway? Would you…	***Percent of Respondents (n = 37)***
Definitely have installed	16%
Probably have installed	41%
Probably not have installed	32%
Definitely not have installed	5%
Don't know	5%
Refused	0%

Forty-nine percent of respondents said they purchased the equipment earlier as a result of the program. These participants were then asked when they would have installed the equipment. As shown in Table 4-9, the majority of respondents would have installed within six months to two years later.

Table 6-27 Timeframe for Installation without the Program

When would you otherwise have installed the equipment?	***Percent of Respondents (n = 18)***
Less than 6 months later	0%
6-12 months later	28%
1-2 years later	50%
3-5 years later	6%
More than 5 years later	0%
Don't know	17%

Next, respondents were asked whether the program affected the quantity of measures they purchased and installed. Forty-nine percent said the program did affect their decision-making on measures, while 40% said the program did not have this effect. Lastly, 65% of respondents said they purchased and installed equipment that was more energy efficient as a result of the program.

6.4.5.4 Participation Process

As Table 6-28 shows, the respondent was involved in completing the application for program incentives 70% of the time. Other common responses were, other members of the respondent's company, an equipment vendor, or a contractor.

Table 6-28 Person/s Involved in Application Process

Which of the following people worked on completing your application for program incentives (including gathering required documentation)?[20]	***Percent of Respondents (n = 37)***
Yourself	70%
Another member of the company	30%
A contractor	11%
An equipment vendor	22%
A designer or architect	0%
Someone else	14%
Don't know	5%

Seventy-three percent of respondents said they had a clear sense of who to go for assistance with the application process, while 19% did not. In addition, 65% of respondents thought the information on how to complete the application was clear, while 8% thought it was not clear.

Table 6-29 Clarity of Application Information

Thinking back on the application process, please rate the clarity of information on how to complete the application…	***Percent of Respondents (n = 37)***
1 - Not at all clear	3%
2	5%
3	14%
4	24%
5 - Completely clear	41%
Don't know	14%

[20] Respondents were able to select more than one response, so the total percentage may add up to over 100%.

Finally, respondents were asked to rate on a scale of 1 to 5 different aspects of the application process, as shown in the figure below. Fourteen percent of respondents thought the effort required to provide documentation was unacceptable, though the majority (77%) found it acceptable. Other aspects of the application process scored even higher.

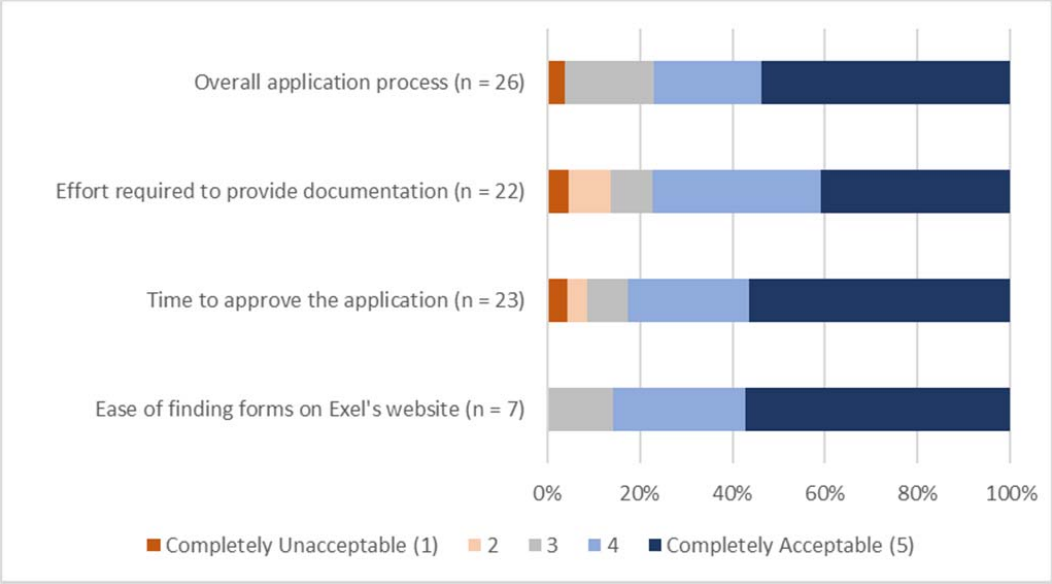


Figure 6-7 Feedback on Program Application Process

6.4.5.5 Participant Satisfaction

Respondents who had interactions with program staff, were asked to rank the knowledgeability of staff on a scale of 1 to 5. The average ranking for respondents was 4.7, which indicates respondents found staff to be very knowledgeable.

Respondents were also asked to rank various aspects of the program on a scale of 1 to 5, with 1 being very dissatisfied and 5 being very satisfied. Overall program satisfaction was very high, with 86% of respondents being satisfied or very satisfied. Respondents were least satisfied with the range of equipment that qualifies for incentives and the amount of time to receive the rebate/incentive.

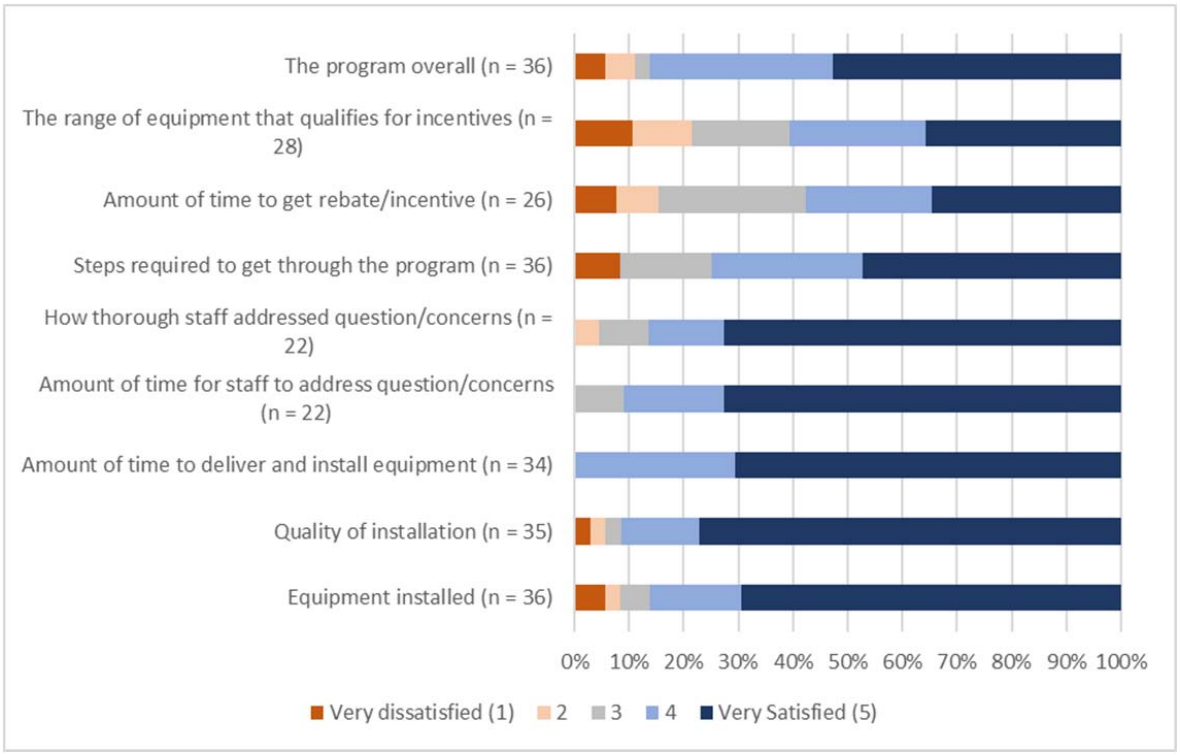


Figure 6-8 Participant Program Satisfaction

6.5 Conclusions & Recommendations

6.5.1 Conclusions

The Evaluators' conclusions for the Business Comprehensive Program are as follows:

- **Program savings were increasingly driven by a small number of custom projects.** The top five projects accounted for 63% of gross kWh in 2016.
- **The program has continued to move more projects into the Custom channel.** The 2016 program year saw a continuation of the practice of moving more projects into the custom channel. This first began when CLEAResult assumed the role of implementation contractor in 2014, and is most notable in its effects on savings for Business Lighting and Business Motors & Drives.
- **Large industrials on JEEP plans reported high satisfaction with Xcel staff.** JEEP project representatives noted particular satisfaction with Xcel staff, often calling out program staff by name in open-ended survey responses.

6.5.2 Recommendations

The Evaluators' recommendations are as follows:

- **Continue the pre-project M&V with the new EM&V Contractor.** With the program savings becoming increasingly concentrated in a small number of large projects, it is crucial that the BCP maintain the pre-M&V process.

7. Smart Thermostat Pilot

The Smart Thermostat Pilot provides WiFi-enabled thermostats to residential customers. The purpose of this pilot is to assess the energy savings potential for smart thermostats as a mechanism for direct load control (DLC) events. The pilot includes one thermostat model, the ecobee 3. Participation in the Pilot is free-of-charge to the end-use customer.

The ecobee 3 Smart Thermostat supports fixed-cycling and temperature setback strategies. The DLC pilot tested both strategies in the late summer of 2016.

7.1 Data Sources

The following data was used for the impact evaluation:

- **ecobee trend data.** The ecobee provided trended data for compressor duty cycle. This evaluation required this data for a census of program participants. The data ranged from installation date of the thermostat to the close of the DLC season (October 1st).
- **One-time power readings**: ADM took one-time power readings of the compressor for a sample of Pilot participants. This data was combined with the trended data from the ecobee to develop load profiles of air conditioning usage.
- **Xcel Billing Data**. Xcel provided ADM with billing data for all residential customers. This was mapped to the participants based on a unique premise ID, allowing for regression analysis of billed use for kWh savings estimates.

7.2 Impact Evaluation Methodology – Direct Load Control (DLC)

This section details how the estimates of kW savings for smart thermostats were developed for usage of the technology as a DLC measure. This approach combines the duty cycle data from the ecobee with the one-time power readings taken by ADM.

This analysis produced two sets of estimates:

- **Program Population:** estimated reduction in equipment duty cycle[21]
- **M&V Sample:**
    - Estimated reduction in duty cycle
    - Estimated reduction in kW/ton

[21] Duty cycle reduction is the reduction in average hourly runtime for the compressor in the time period analyzed. This is denominated in a percent; for example, a 30% duty cycle = .30 * 60 = 18 minutes of runtime for the hour.

7.3 Baseline Estimation

The baseline kW and duty cycle for each DLC event were calculated in the same manner as performed for Saver's Switch programs. Baselines are calculated as:

$$Baseline\ kW = Mean\ kW(Baseline\ Days) * Offset\ Factor$$

Where,

- Baseline Days = Three of the previous 5 non-weekend, non-holiday, non-event days displaying the highest average event-time load, and
- Offset Factor = kW for the hour preceding curtailment / Average kW for this hour during baseline days

7.4 Calculation & Extrapolation

For each event, separate calculations for reduction in duty cycles for the population and reduction in kW per ton for the M&V sample were calculated. Results from the M&V sample were extrapolated to the population as follows:

1) The one-time kW readings taken during field visits were divided by unit tonnage to provide kW/ton estimates.
2) The duty cycle reduction for the M&V sample was calculated as a discrete value, separate from the whole-population duty cycle reduction
3) This was converted into a kW multiple for the whole population as follows:

$$kW_{Population} = \frac{kW/Ton_{Sample} \times \%Duty_{Population} \times Tons_{Population}}{\%Duty_{Sample}}$$

Where,

- kW/Ton_{Sample} = the average per-ton kW reduction for the M&V sample for the event
- $\%Duty_{Sample}$ = the average per-unit reduction in duty cycle for the M&V sample for the event[22]. Duty cycle is defined as the percent of a given hour in which the compressor is running.
- $\%Duty_{Population}$ = The average reduction in duty cycle for the Pilot population for the event
- $Tons_{Population}$ = the average AC tonnage per participant in the Pilot population

This provides a kW factor for each participant household. This value was multiplied by total Pilot participants to provide total system kW reduction for each event.

[22] This is the group for which ADM took one-time power readings on-site

7.5 Impact Analysis Results

As Table 7-1 shows, there were a total of 5 events called during the DLC season. The method detailed above was performed separately for each group (Duty-Cycling vs. Temperature Offset) to allow for comparison of kW reduction achieved.

Table 7-1 Direct Load Control Events

Group	Cycling/Setback	Duration	Start Time	End Time	Date	Average Temperature
Duty-Cycling	50%	4	3:00 PM - MDT	7:00 PM - MDT	8/19/2016	89.25
Duty-Cycling	50%	4	3:00 PM - MDT	7:00 PM - MDT	9/8/2016	85.75
Duty-Cycling	50%	4	3:00 PM - MDT	7:00 PM - MDT	9/9/2016	88.00
Duty-Cycling	50%	3	4:00 PM - MDT	7:00 PM - MDT	9/12/2016	77.97
Duty-Cycling	50%	4	3:00 PM - MDT	7:00 PM - MDT	9/20/2016	86.83
Temperature Offset	4 degrees	4	3:00 PM - MDT	7:00 PM - MDT	8/19/2016	89.25
Temperature Offset	3 degrees	4	3:00 PM - MDT	7:00 PM - MDT	9/8/2016	85.75
Temperature Offset	3 degrees	4	3:00 PM - MDT	7:00 PM - MDT	9/9/2016	88.00
Temperature Offset	3 degrees	3	4:00 PM - MDT	7:00 PM - MDT	9/12/2016	77.97
Temperature Offset	3 degrees	4	3:00 PM - MDT	7:00 PM - MDT	9/20/2016	86.83

There was a total of 358 customers with connected Smart Thermostats at some point from July 1st, 2016 and Sept. 30th, 2016. Customers with active devices on the day of an event were considered part of the population for that event. Table 7-2 shows the average duty-cycle reduction and the number of connected devices for each DLC event, group, and M&V status. The able also displays is the average compressor kW measurement, average AC size (Tons), and kW/Ton reduction for the M&V sample.

Table 7-2 Smart Thermostat Event Summary

Event Date	Group	M&V Sample	Avg. Duty Cycle Reduction	# of Customers w/ Active Devices	Avg. Compressor kW (Sample)	Average Tonnage (Sample)	kW/Ton Reduction (Sample)
8/19/2016	Duty-cycling	No	0.226	124.0	NA	NA	
8/19/2016	Duty-cycling	Yes	0.312	15.0	2.938	3.714	0.247
8/19/2016	Temp offset	No	0.426	125.0	NA	NA	
8/19/2016	Temp offset	Yes	0.463	11.0	2.757	3.636	0.351
9/8/2016	Duty-cycling	No	0.153	149.0	NA	NA	
9/8/2016	Duty-cycling	Yes	0.114	15.0	2.938	3.714	0.091
9/8/2016	Temp offset	No	0.180	166.0	NA	NA	
9/8/2016	Temp offset	Yes	0.458	11.0	2.757	3.636	0.347
9/9/2016	Duty-cycling	No	0.208	151.0	NA	NA	
9/9/2016	Duty-cycling	Yes	0.098	15.0	2.938	3.714	0.078
9/9/2016	Temp offset	No	0.136	167.0	NA	NA	
9/9/2016	Temp offset	Yes	0.516	11.0	2.757	3.636	0.391
9/12/2016	Duty-cycling	No	0.125	151.0	NA	NA	
9/12/2016	Duty-cycling	Yes	0.004	15.0	2.938	3.714	0.003
9/12/2016	Temp offset	No	0.193	170.0	NA	NA	
9/12/2016	Temp offset	Yes	0.337	11.0	2.757	3.636	0.256
9/20/2016	Duty-cycling	No	0.155	153.0	NA	NA	
9/20/2016	Duty-cycling	Yes	0.131	15.0	2.938	3.714	0.104
9/20/2016	Temp offset	No	0.294	173.0	NA	NA	
9/20/2016	Temp offset	Yes	0.340	11.0	2.757	3.636	0.258

Table 7-3 breaks out the expected kW savings from this program for each group and overall. The average duty cycle reduction is slightly higher for the temperature offset group in comparison to the duty cycle group (0.25 vs. 0.17).

The larger variation in duty cycle reduction for the M&V sample is due to increased volatility associated with a small sample in comparison to the larger population. The total savings across all events is 198.3 kW, which represents average per-event kW savings of 0.609 across all devices in the pilot.

Table 7-3 Event Performance Summary

Group	Avg. Duty Cycle Reduction (M&V)	Avg. Duty Cycle Reduction (Non-M&V Pop)	Avg. kW Savings per Customer	kW Savings Total
Duty cycle	0.132	0.174	0.495	78.5
Temp offset	0.423	0.246	0.722	119.8
All	**0.277**	**0.210**	**0.609**	**198.3**

Figure 7-1 and Figure 7-2 summarize the average hourly reduction occurring by event based on average event-hour temperature. The temperature offset strategy outperforms duty cycling in all temperature ranges observed. The difference was most acute in the low-temperature event called on 9/12/2016. However, at the highest-temperature event (8/9/2016), the offset strategy still outperformed the duty cycling strategy by .154

kW/ton. The reduction was near-zero for duty cycling at the low-temperature event, from which the Evaluators infer that the baseline duty cycle was near 50% at that temperature.

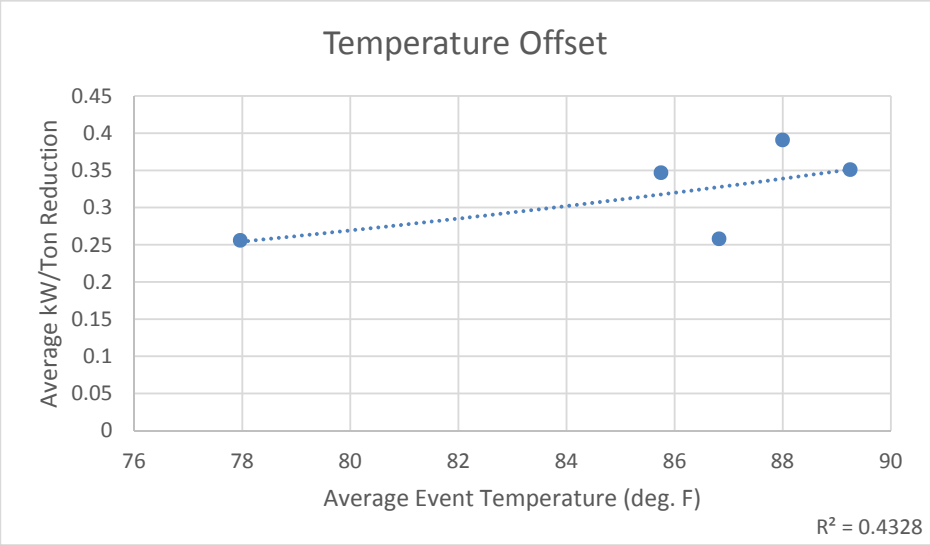


Figure 7-1 Average kW/Ton Reduction by Event Temperature – Offset Strategy

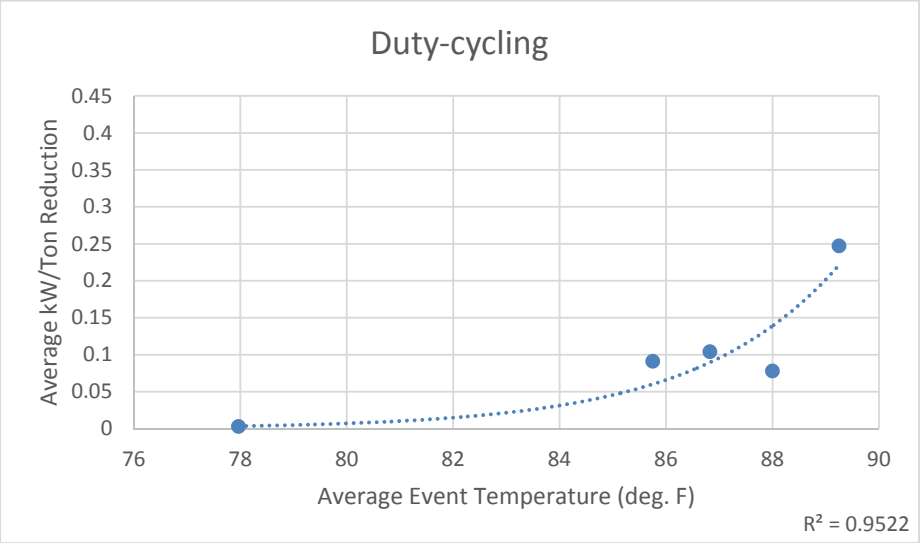


Figure 7-2 Average kW/Ton Reduction by Event Temperature – Cycling Strategy

The Pilot did not begin calling events until late in the cooling season. As a result, the events largely had moderate temperatures. Historically, June is the hottest month for Roswell, NM (with an average daytime high of 95.2 degrees). The hottest event hour in 2016 for the Pilot was 92 degrees on August 19th. Program staff should anticipate that

reductions called in the height of their cooling season (June and July) would perform more similarly to the August 19th or September 9th events called during this pilot phase.

The offset strategy resulted in .35 kW/ton reduction in the hottest event in the pilot phase across all devices in the pilot.

7.6 Net Savings Estimation

NTGR is assumed to be 100% for this program.

7.7 Comparison of Curtailment Strategies

The Evaluators compared the reductions that occurred as a result of each of the curtailment strategies. This was examined both in terms of kW per ton (for the M&V sample) and duty cycle reduction (for the entire population). In Figure 7-3 and Figure 7-4 “Hour 5” represents the first hour subsequent to the event finishing. Hour 5 is a negative value due to snapback (this is a post-event hour, and the data shows increased use as a result of heat load buildup during the event).

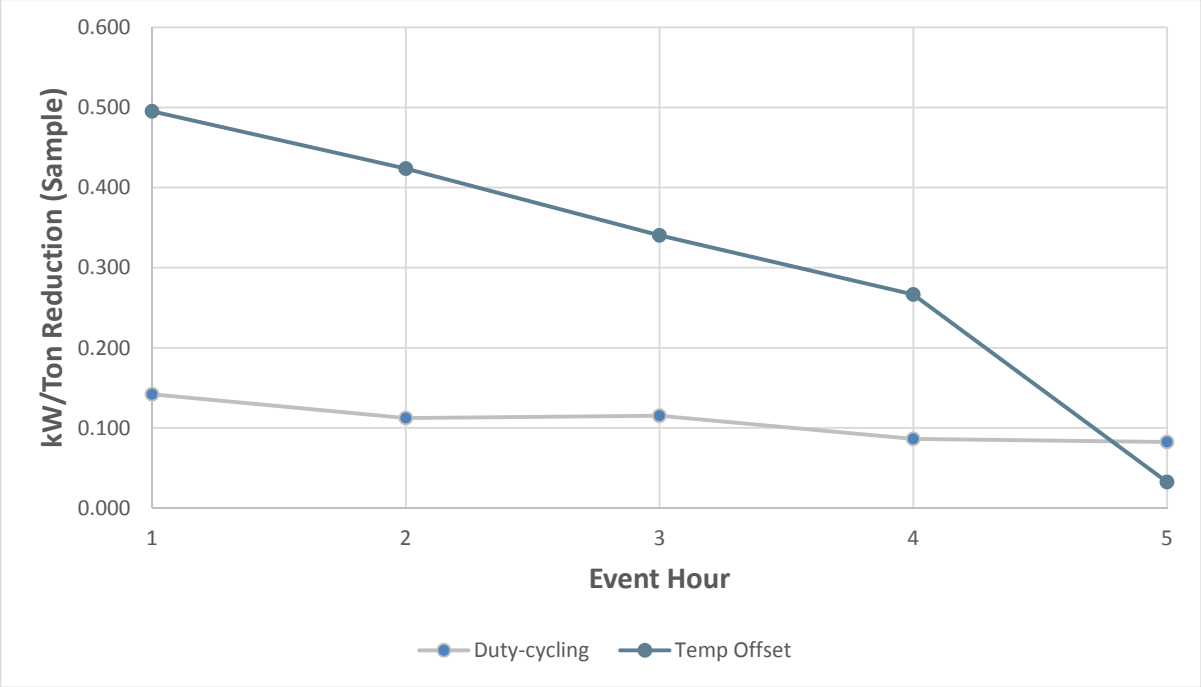


Figure 7-3 kW/Ton Reduction by-Curtailment Strategy by-Hour

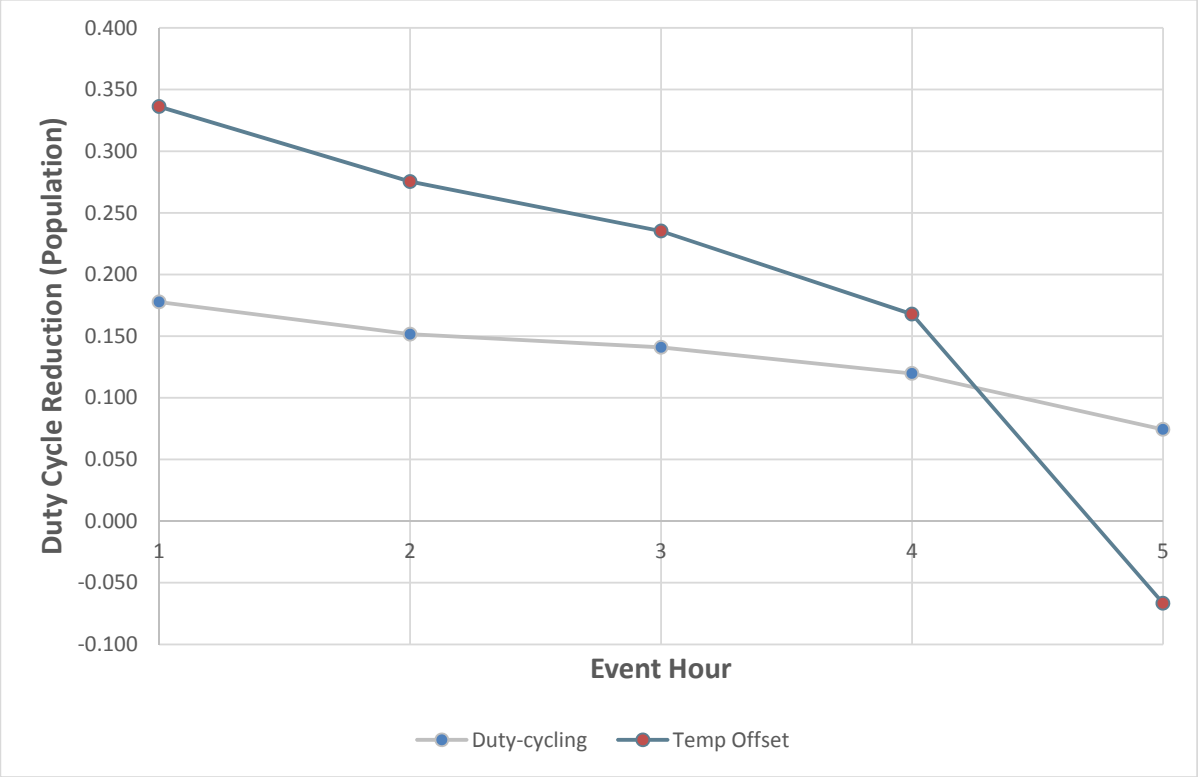


Figure 7-4 Duty Cycle Reduction for Program Population by-Curtailment Strategy by-Hour

The thermostat setback strategy yielded significantly higher reductions across all event hours. The cycling strategy provided a smaller kW reduction across all event hours. It is more typical of these strategies to see a higher first- and second-hour reduction for thermostat setback, with cycling performing better in the latter hours of a long event; the Evaluators conclude from this comparison that the setback and cycling strategies were not aligned to provide the same impact on the AC system; this may be due to systems being oversized for their residence. This would result in lower baseline duty cycling and therefore a lower demand reduction from a fixed-cycling event.

The Evaluators also compared the results of this event to those found in the 2015 evaluation of the Saver's Switch Program[23]. The findings in that evaluation took the highest kW reduction during an event. The Evaluators conducted a similar analysis for the Smart Thermostat Pilot in order to provide a consistent comparison of per-unit kW reductions achieved by the two programs.

The findings are presented in Figure 7-5 below.

[23] This program was not evaluated in 2016.

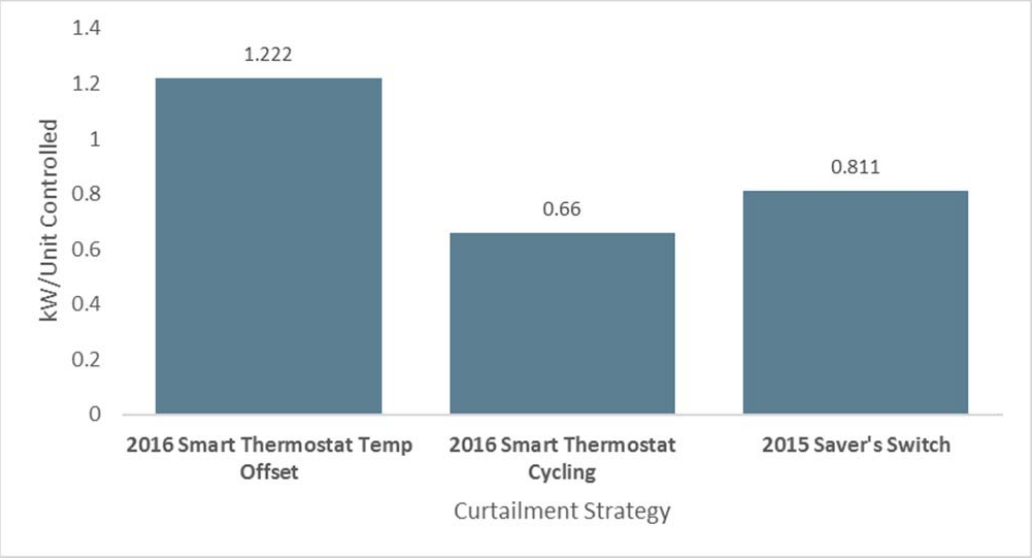


Figure 7-5 Comparison of Curtailment Strategy kW/Unit

7.8 Impact Analysis – Energy Savings

Smart thermostats produce energy savings through optimizing HVAC system use. This includes:

- Usage control via a mobile app;
- Reminders and alerts to change filters and/or have the system serviced;
- Smart Home/Away and the Follow Me features which use remote sensors that will override a manual setpoint if the ecobee senses that the home is unoccupied;
- Setting minimum fan runtime, which may reduce use through increased airflow in the home, distributing cooler air to warmer areas of the home; and
- Lockout systems limiting use of the thermostat by other household members (such as children).

The Evaluators assessed the savings impact of the thermostats based on the billing data provided by Xcel. Due to the timing of the pilot (with installation happening in July and August), the Evaluators unfortunately found that there was insufficient data to support a cooling season savings estimate. Due to this timing issue, the model developed was constrained to heating season impacts.

7.8.1 Identification of Electric-Heated Homes

Electric heated homes were identified based on comparison of usage in December of 2016 to October of 2016. This compares a heating season month (851.25 HDD) to a shoulder-season month (69.19 CDD, 132.48 HDD). This month was the lowest-use month (October) for customers in the pilot. The Evaluators concluded a that a residence

had electric heating if December use exceeded October use by a minimum of 20%. 263 households (77% of the pilot population) were identified as having electric heating.

The load profiles based on ADM's specification are presented below.

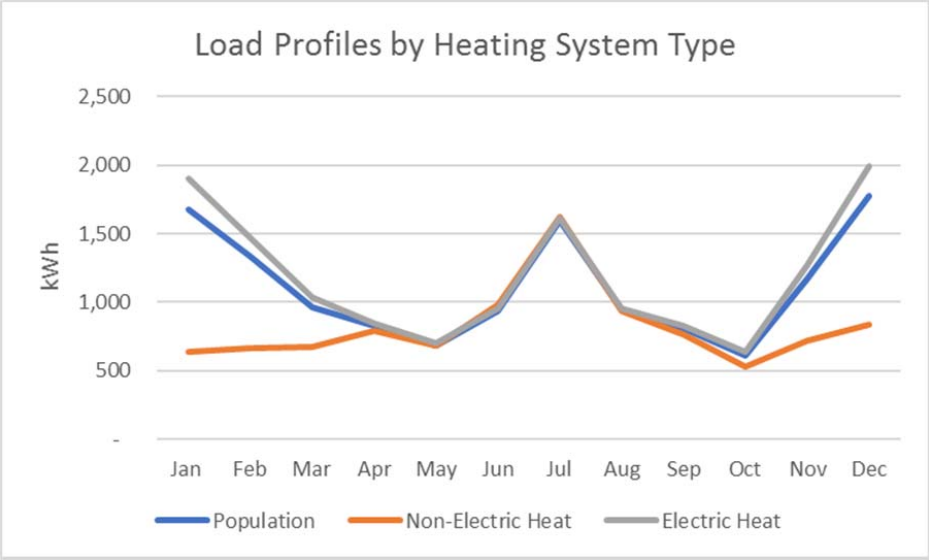


Figure 7-6 Load Profiles for Smart Thermostat Pilot Participants

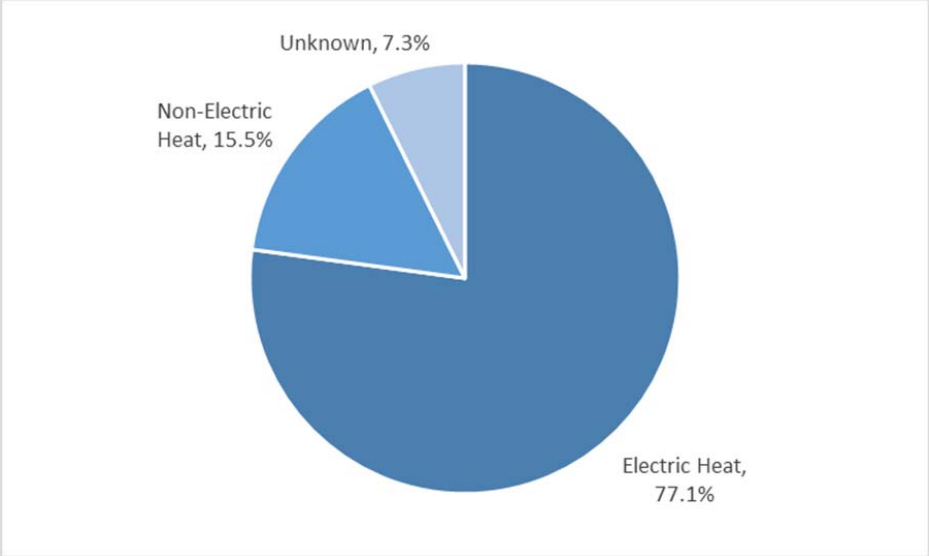


Figure 7-7 Heating System Types Identified by ADM

7.9 Model Specification

The model specification is as follows:

$$Usage_{it} = \alpha_0 + \beta 1 * HDD + \beta 1 * \beta 1 * HDD_{Post} + + + \varepsilon_{it}$$

Where

- *i* denotes the *i*th customer
- *t* denotes the first, second, third, etc. month of the analysis period
- *Usage*$_{it}$ is the average daily use for read *t* for household *i* during the analysis period
- *HDD* is the heating degree days for the observation period
- *Post* is the period after installation of the smart thermostat
- *HDDpost* is an interaction term of HDD and post.
- ε_{it} is an error term.

The model run was constrained to the months of November – May, due to a particularly cold May in the observation period. The extrapolation is constrained to November-April, based on TMY3 values for HDD.

Savings are calculated as follows:

$$kWh\ Savings(Heating) = Post * Heating\ Days + HDD_{Post} * HDD$$

7.10 Model Output

Table 7-4 Smart Thermostat Heating Season Regression Output

Variable Description	*Regression Coefficient*	*Standard Error*	*T-Stat*	*PR > |T|*
INTERCEPT	24.40	.91088	26.79	<.0001
HDD_DAY	1.32	.05353	24.76	0.7747
POST	2.26	2.1797	1.04	.2984
POST_HDD_DAY	-.3211	.15800	-2.03	.0422

Savings are calculated based on a 181-day season where heating is possible (November-April) and TMY3 HDD for Roswell, NM (2,735.79). Based on these parameters, the savings is:

- kWh Savings (Participant) = 2.26 * 181 + .32113 * 2,735.79 = 468 kWh.

The Evaluators identified 263 households as having electric heating. Based on this, total pilot kWh savings are:

- kWh Savings (Pilot) = 263 * 468 = 123,084.

The Evaluators then applied an 11 year EUL based on CA DEER 2014.

The Evaluators found that the average space heating load for electrically heated homes in the Pilot group was 4,736 kWh. Based on this, there is heating season savings of 9.9%.

The heating season reduction was benchmarked against two existing studies that reported separate reductions for heating as a percent of annual use. The studies compared were:

- The Cadmus Group, 2015, *"Evaluation of the 2013–2014 Programmable and Smart Thermostat Program."* Vectren Corporation. January 29.
- Nest Labs, 2015, *"Nest White Paper: Energy Savings from the Nest Learning Thermostat: Energy Bill Analysis Results"* February. https://nest.com/downloads/press/documents/energy-savings-white-paper.pdf.

The comparison is summarized in Figure 7-8.

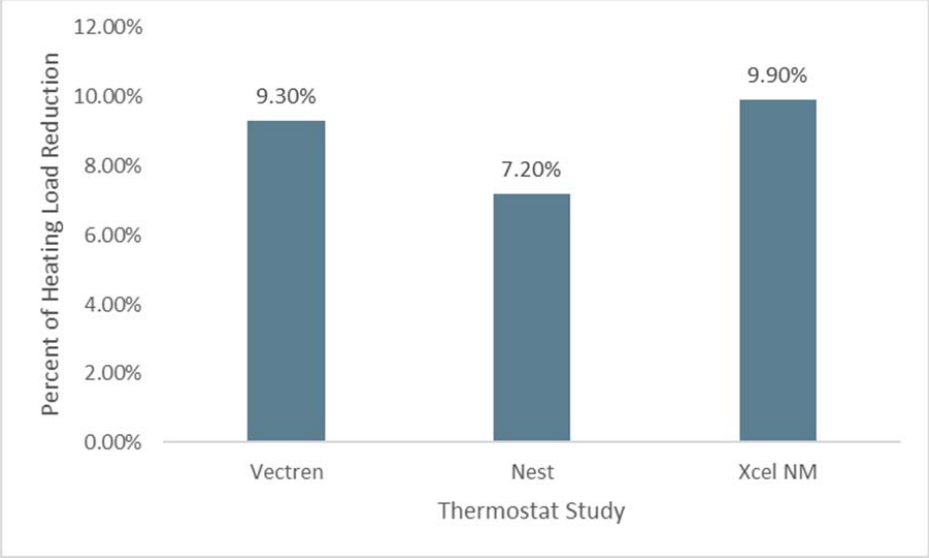


Figure 7-8 Heating Load Reduction Comparison Across Studies

7.11 Overall Program Savings Summary

Table 7-5 summarizes the savings for the Smart Thermostat Pilot. The Evaluators emphasize that the following should be noted:

- kW estimates are based on DLC findings, and do not reflect demand savings from installing smart thermostats without running DLC events;
- kWh savings estimates are constrained to heating-season estimates for homes with electric heating (a mix of heat pump and electric resistance heating).

Table 7-5 Smart Thermostat Savings Summary

kW	*kWh (Heating)*	*Lifetime kWh (Heating)*
198.30	123,084	1,230,840

7.12 Recommendations

The Evaluators recommendations are as follows:

- **Reconduct analysis with a longer post-period to develop summer-season kWh savings.** Due to the constrained period of the Pilot, the Evaluators could not produce reliable savings estimates for the summer cooling season. The savings calculated in this pilot are based on heating season savings for electric heated homes.
- **Continue to develop this load management resource.** The pilot findings showed this to be a successful DLC mechanism with lower M&V costs than the load control switches used in Residential Saver's Switch.
- **Test more aggressive cycling strategies.** The pilot data showed that the cycling events had much lower reductions in duty cycling than thermostat setback; program staff should consider testing 30% cycling events in 2017.
- **If feasible, test adaptive cycling events.** Adaptive cycling events (in which the thermostat "learns" if the AC is over- or under-sized and normalizes the cycling to comfort level) would account for sizing issues that mar the effectiveness of fixed cycling events. If the ecobee thermostat can support this, Xcel should consider testing this type of cycling strategy.
- **Use best-case values from this pilot in future planning.** The events were called during lower temperature days than typical due to the timing of the pilot. The hottest average event temperature was 89 degrees, and during this time the pilot provided a reduction of .35 kW/ton controlled.

8. Residential Cooling

The Residential Cooling Program provides rebates of up to $700 for central units with a media saturation efficiency of 85% or higher.

The program was scheduled for EM&V in 2016. However, there were only two participants in 2016 and in response to this the Evaluators suspended EM&V efforts. It is recommended that this program be scheduled for 2017 evaluation.

The savings estimates from Xcel were in compliance with the New Mexico TRM. Gross savings are:

- 3,332 kWh;
- 2.38 kW; and
- 49,980 lifetime kWh.

The program uses a NTGR of 66%. Net savings are:

- 2,199 kWh;
- 1.57 kW;
- 32,988 lifetime kWh.

9. Appendix A: Tables for Xcel Annual Report

This section contains tables formatted for Xcel' annual report submission.

Program	*Participants or Units*	*Annual Savings (kWh)*	*Annual Savings (kW)*	*Lifetime Savings (kWh)*	*Total Program Costs*
Home Energy Services (Regular & LI)	1,559	4,789,829	514.09	80,465,748	$1,585,343.52
Home Lighting	270,230	11,535,659	1,573.01	89,285,998	$2,143,976.52
Business Comprehensive	1,692	14,445,592	1529.77	180,637,241	$3,286,049.73
Energy Feedback Program	15,464	2,418,997	651.15	2,418,997	$152,699.19
Residential Cooling	1	3,332	2.38	49,980	$61,812.28
Refrigerator Recycling	364	263,776	16.58	1,318,880	$73,986.66
School Education Kits	16,188	766,423	16.85	7,296,347	$138,353.04
Residential Saver's Switch	4140	34,593	3550	34,593	$256,832.81
Business Saver's Switch	170	3373	434	3373	$69,786.64
Smart Thermostat Pilot	350	123,084	198.3	1,230,840	$314,253.10
Interruptible Credit Option	0	0	0	0	$101.23
Consumer Education	0	0	0	0	$104,739.21
Market Research	0	0	0	0	$40,467.54
Measurement & Verification	0	0	0	0	$5,135.54
Planning & Administration	0	0	0	0	$253,361.98
Product Development	0	0	0	0	$83,639.46
Total	310,158	34,384,658	8,486.13	362,741,997	$8,570,538.45

Program	*Verified NTGR*
Home Energy Services (Regular & LI)	94.1%
Home Lighting	90.1%
Business Comprehensive	91.7%
Energy Feedback Program	100.0%
Residential Cooling	100.0%
Refrigerator Recycling	67.3%
School Education Kits	100.0%
Residential Saver's Switch	100.0%
Business Saver's Switch	100.0%
Smart Thermostat Pilot	100.0%

Program	*Participants or Units*	*Cost per kWh Saved (lifetime)*	*2016 Economic Benefits*	*Total Economic Benefits*
Home Energy Services (Regular & LI)	1,559	$0.020	$221,781.09	$5,351,417.64
Home Lighting	270,230	$0.024	$584,925.71	$5,765,021.05
Business Comprehensive	1,692	$0.018	$631,447.66	$10,856,419.20
Energy Feedback Program	15,464	$0.063	$171,390.07	$171,390.07
Residential Cooling	1	$1.237	$461.03	$8,373.61
Refrigerator Recycling	364	$0.056	$10,434.19	$62,818.53
School Education Kits	16,188	$0.019	$25,566.21	$348,306.20
Residential Saver's Switch	4140	$7.424	$18,745.37	$18,745.37
Business Saver's Switch	170	$20.690	$539,489.72	$539,489.72
Smart Thermostat Pilot	350	$0.260	$61,663.16	$61,663.16
Interruptible Credit Option	0	NA	$0	$0
Consumer Education	0	NA	$0	$0
Market Research	0	NA	$0	$0
Measurement & Verification	0	NA	$0	$0
Planning & Administration	0	NA	$0	$0
Product Development	0	NA	$0	$0
Total	310,158	$0.024	$2,265,904.21	$23,183,644.55

Program	*Avoided Production Costs*	*Avoided Capacity Expansion Costs*	*Administration Costs*	*Incentives*
Home Energy Services (Regular & LI)	$2,115,090.66	$825,474.18	$1,113,222.95	$472,120.57
Home Lighting	$2,781,175.93	$1,446,243.90	$1,124,037.02	$1,019,939.50
Business Comprehensive	$4,935,152.36	$1,890,856.08	$2,221,208.35	$1,064,841.38
Energy Feedback Program	$67,805.49	$92,208.65	$152,699.19	$0
Residential Cooling	$1,363.33	$3,557.99	$60,612.28	$1,200.00
Refrigerator Recycling	$40,169.99	$10,565.55	$55,111.66	$18,875.00
School Education Kits	$221,294.01	$18,227.97	$81,212.07	$57,140.97
Residential Saver's Switch	$969.66	$502,711.69	$89,371.36	$167,461.45
Business Saver's Switch	$90.35	$57,479.95	$20,636.64	$49,150.00
Smart Thermostat Pilot	$36,990.41	$28,081.05	$133,445.10	$180,808.00
Interruptible Credit Option	$0	$0	$101.23	$0
Consumer Education	$0	$0	$104,739.21	$0
Market Research	$0	$0	$40,467.54	$0
Measurement & Verification	$0	$0	$5,135.54	$0
Planning & Administration	$0	$0	$253,361.98	$0
Product Development	$0	$0	$83,639.46	$0
Total	$10,200,102.19	$4,875,407.01	$5,539,001.58	$3,031,536.87

10. Appendix B: Site Reports

This appendix contains the site reports for evaluation of the Xcel 2016 Business Portfolio.

Project Number OID1980910
Program Business Custom Efficiency

EXECUTIVE SUMMARY

The participant is a natural gas processing facility that received incentives from Xcel for the installation of VFDs and high efficiency motors on (2) 2,500 HP Acid Gas Injection (AGI) compressors. The facility only runs one compressor at any given time and rotates their use. The baseline for this project is a compressor running at constant speed with bypass and throttling valves. On site the evaluator verified installation of the VFDs on compressors and verified operation strategies through the facility trending data. The gross kWh realization rate for this project is 100%.

M&V METHODOLOGY

During the site visit, the evaluator verified the installation of (2) 2,500 HP AGI compressors. The evaluators used IPMVP option A to calculate the savings from this project. The evaluators used the facility trend data of AGI compressors.

SAVINGS CALCULATIONS

The evaluators calculated the savings based on the facility trend data of measure equipment and spot measurement of its operating condition from May 13th, 2016 through May 19th, 2016. The facility operates at steady production rate therefore the trended data can represent rest of the year.

Average Acid Gas Injection Flow Rate and Operating Hours

Flow Rate (MCF/day)	4,078
Annual Operating Hours (hrs/yr)	8,760

Based on the average flow rate, the evaluators estimated baseline and as-built equipment operating conditions to meet that demand.

Estimated Compressor Operating Conditions

	Baseline (Bypass)	***As-Built (VFD)***
Compressor Power (HP)	2,114	1,435
Compressor Load	100.0%	67.4%
Motor Efficiency	93.4%	96.1%
VFD Efficiency	N/A	93.7%
Motor Power (kW)	1,687.26	1,188.59

The evaluators used performance tests of the compressor done by Ariel Corporation, extrapolated to calculated motor efficiency and estimated compressor brake horsepower.

Two compressors operate alternatively so compressors run only a half a year on each compressor. The total annual savings from installing VFDs on AGI compressors is shown following table.

Savings from VFDs on AGI compressors

	Baseline	As Built	Savings
Quantity	2	2	-
Average kW	1,687.26	1,188.59	498.67
Operating Hours	4,380	4,380	-
Annual kWh	14,790,386	10,412,015	4,368,371

RESULTS

It was calculated that the installation of VFDs on compressors, decreases annual energy consumption by 4,368,371 kWh and a demand reduction of 498.67 kW resulting in a realization rate of 100%.

Verified Gross Savings & Realization Rates

Type	Claimed		Verified			
	kWh Savings	kW Savings	kWh Savings	kW Savings	Realization Rate kWh	Realization Rate kW
VFD Compressor	4,368,371	498.67	4,368,371	498.67	100%	100%
Total	**4,368,371**	**498.67**	**4,368,371**	**498.67**	**100%**	**100%**

This project has 100% gross realization rate because the evaluator and the implementer were collaboratively worked on ex ante savings calculation. The implementer created the initial savings calculation and the evaluator independently reviewed the methodology and calculation and commented where additional supports were needed. After exchanging comments, both the implementer and the evaluator came to an agreement on savings value then the project was approved by the utility. The ex post savings methodology matches to ex ante therefore, the gross realization rate is 100%.

Project Number OID2314956
Program Business Comprehensive
Component Custom Efficiency - Lighting

Project Background

The participant is an industrial facility that received incentives from Xcel for implementing energy efficient lighting. On-site, the evaluators verified the participant had installed:

- (898) 2-lamp linear tube LED, replacing 4' 4-Lamp T8 fixtures.
- (271) 2-lamp linear tube LED, replacing 4' 2-Lamp T8 fixtures.
- (366) Various LED fixtures replacing 400W Metal Halide fixtures.
- (215) 17W LED fixtures replacing 100W Metal Halide fixtures.
- (29) 390W LED fixtures replacing 1000W Metal Halide fixtures.
- (14) LED bulbs in various wattage, replacing 100W Incandescent bulbs.
- (7) 100W Metal Halide fixtures delamped
- (3) 100W Incandescent lamps delamped
- (1) 400W Metal Halide fixtures delamped

M&V Methodology

The evaluators confirmed installation of all fixtures listed in the project application. Savings for the lighting measures were calculated using the methodology explained on NM TRM. A stipulated Heating Cooling Energy Factor (HCEF) and Heating Cooling Demand Factor (HCDF) are used and ADM created Peak Coincident Factor (PCF) and annual hours of operation based on facility staff interviews in which it was verified that all lighting operated 8,760. Each parameter used in calculating savings are presented in the table below.

Deemed Savings Parameters

Building Type	*Space Type*	*Annual Hours – Non-CFLs*	*Annual Hours – CFLs*	*HCEF*	*HCDF*	*PCF*
Light Industrial	Whole Building (Conditioned)	8,760	8,760	1.028	1.338	1.00

Savings Calculations

Using parameters from the table above, the evaluators calculated lighting savings as follows:

$$Annual\ kWh\ Savings = \left(kW_{base} * Hours_{base} - kW_{post} * Hours_{post}\right) * HCEF$$

Parameters for kWh Savings Calculation of Lighting Retrofit Measures

kW_{base}	Total Baseline fixtures x $W/Fixture_{base}$ / 1000 W/kW
kWpost	Total Installed fixtures x $W/Fixture_{post}$ / 1000 W/kW
$Hours_{base}$	Annual Hours of Operation of Baseline Fixtures
$Hours_{post}$	Annual Hours of Operation of Installed Fixtures
HCEF	Heating/Cooling Energy Interactive Factor

Following this, the evaluators calculated peak kW savings. This is based upon a Xcel-defined peak of 3:00 – 6:00 PM during summer weekdays. Peak kW savings are calculated as:

$$Peak\ kW\ Savings = (kW_{base} - kW_{post}) * HCDF * PCF$$

Parameters for Peak Demand (kW) Savings Calculation of Lighting Retrofit Measures

kW_{base}	Total Baseline fixtures x $W/Fixture_{base}$ / 1000 W/kW
kW_{post}	Total Installed fixtures x $W/Fixture_{post}$ / 1000 W/kW
PCF	Peak Coincident Factor, % Time During the Peak Period in Which Lighting is Operating
HCDF	Heating Cooling Demand Interactive Factor

Lighting Retrofit kWh Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours		Expected kWh Savings	Realized kWh Savings	HCEF	Realization Rate
	Base	Post	Base	Post	Base	Post				
4' 2L T8 to 4' 2L 18W LED	271	271	60	36	8,760	8,760		10,008	1.437	
4' 4L T8 to 4' 2L 18W LED	271	271	60	36	8,760	8,760		670,542	1.025	
4' 4L T8 to 4' 2L 15W LED	889	889	120	36	8,760	8,760		7,294	1.028	
100W Incandescent to 17W LED	9	9	120	30	8,760	8,760		5,890	1.019	
100W Incandescent Removal	12	12	72	17	8,760	8,760		1,892	1.000	
100W Incandescent to 200W LED	3	0	72	0	8,760	8,760		1,191	1.000	
100W Metal Halide to 17W LED	8	2	72	220	8,760	8,760		219,771	1.000	
100W Metal Halide to 9.5W LED	227	180	124	17	8,760	8,760		35,106	1.000	
100W Metal Halide Removal	35	35	124	9.5	8,760	8,760		7,604	1.000	
1000W Metal Halide to 315W LED	7	0	124	0	8,760	8,760		193,833	1.000	
400W Metal Halide to 85W LED	29	29	1078	315	8,760	8,760		275,818	1.007	
400W Metal Halide to 200W LED	85	85	453	85	8,760	8,760		249,012	1.000	
400W Metal Halide to 17W LED	122	122	453	220	8,760	8,760		221,129	1.000	
400W Metal Halide to 129W LED	57	34	453	17	8,760	8,760		208,900	1.000	
400W Metal Halide to 70W LED	74	75	453	129	8,760	8,760		49,012	1.000	
400W Metal Halide to 90W LED	15	15	453	80	8,760	8,760		46,817	1.009	
400W Metal Halide to 146W LED	15	15	453	100	8,760	8,760		26,893	1.000	
400W Metal Halide to 150W LED	10	10	453	146	8,760	8,760		25,229	1.000	
400W Metal Halide Removal	10	10	453	165	8,760	8,760		3,968	1.000	
						Total	**2,272,709**	**2,307,746**		**101.5%**

Lighting Retrofit kW Savings Calculations

Measure	Quantity (Fixtures)		Wattage		PCF		Expected kW Savings	Realized kW Savings	HCDF	Realization Rate
	Base	Post	Base	Post	Base	Post				
4' 2L T8 to 4' 2L 18W LED	271	271	60	36	1.00	1.00		7.70	1.185	
4' 4L T8 to 4' 2L 18W LED	889	889	120	36	1.00	1.00		97.25	1.302	
4' 4L T8 to 4' 2L 15W LED	9	9	120	30	1.00	1.00		1.08	1.338	
100W Incandescent to 17W LED	12	12	72	17	1.00	1.00		0.81	1.225	
100W Incandescent Removal	3	0	72	0	1.00	1.00		0.22	1.000	
100W Incandescent to 200W LED	8	2	72	220	1.00	1.00		0.14	1.000	
100W Metal Halide to 17W LED	227	180	124	17	1.00	1.00		25.09	1.000	
100W Metal Halide to 9.5W LED	35	35	124	9.5	1.00	1.00		4.01	1.000	
100W Metal Halide Removal	7	0	124	0	1.00	1.00		0.87	1.000	
1000W Metal Halide to 315W LED	29	29	1078	315	1.00	1.00		22.13	1.000	
400W Metal Halide to 85W LED	85	85	453	85	1.00	1.00		33.77	1.080	
400W Metal Halide to 200W LED	122	122	453	220	1.00	1.00		28.43	1.000	
400W Metal Halide to 17W LED	57	34	453	17	1.00	1.00		25.24	1.000	
400W Metal Halide to 129W LED	74	75	453	129	1.00	1.00		23.85	1.000	
400W Metal Halide to 70W LED	15	15	453	80	1.00	1.00		5.60	1.000	
400W Metal Halide to 90W LED	15	15	453	100	1.00	1.00		5.89	1.113	
400W Metal Halide to 146W LED	10	10	453	146	1.00	1.00		3.07	1.000	
400W Metal Halide to 150W LED	10	10	453	165	1.00	1.00		2.88	1.000	
400W Metal Halide Removal	1	0	453	0	1.00	1.00		0.45	1.000	
						Total	**279.25**	**288.46**		**103.3%**

Results

The kWh realization rate for OID2314956 is 101.5% and the kW realization rate is 103.3%. The evaluators made minor modification to some fixture wattages. All fixtures

operate 8,760 hours annually and fixture wattages are based on manufacturer's specifications.

Verified Gross Savings & Realization Rates

Measure	***Verified***			
	kWh Savings	***kW Savings***	***kWh Realization Rate***	***kW Realization Rate***
Lighting Retrofit	2,307,746	288.46	101.5%	103.3%
Total	**2,307,746**	**288.46**	**101.5%**	**103.3%**

Project Number OID1980906
Program Business Custom Efficiency

EXECUTIVE SUMMARY

The participant is a natural gas processing facility that received incentives from Xcel for the installation of VFDs on (6) 600 HP Amine pumps. The facility has a symmetrical configuration and three pumps are installed on each side. It was designed to operate 2 out of 3 pumps at all time to reduce load on pumps to maximize the savings from VFDs but the facility only runs one pump and rotates them to reduce its annual runtime on a single pump. The baseline for this project is pumps running at constant speed with bypass and throttling valves. On site the evaluator verified installation of the VFDs on Amine pumps and verified operation strategies through the facility trending data. The gross kWh realization rate for this project is 100%.

M&V METHODOLOGY

During the site visit, the evaluator verified the installation of (6) 600 HP Amine pumps. The evaluator used IPMVP option A to calculate the savings from this project. The evaluator used the facility trend data of Amine pumps.

SAVINGS CALCULATIONS

The evaluator calculated the savings based on the facility trend data of measure equipment and spot measurement of its operating condition from July 22th, 2016 through August 8th, 2016. The facility operates at steady production rate therefore the trended data can represent rest of the year.

Average Amine Pump Operation

	Average GPM	***Average Pressure***	***Average Drive Frequency***	***% Operating hours during monitoring period***	***Annual Operating hours***
A-Train	397.15	852.93	52.99	99.92%	8,753
B-Train	410.25	850.69	53.41	99.93%	8,754
Average	403.70	851.81	53.20	99.93%	8,753

Based on the average flow rate, the evaluator estimated baseline and as-built equipment operating conditions to meet that demand.

Estimated Amine Pump Operating Conditions

	Baseline (Bypass)	***As-Built (VFD)***
Pump Flow (GPM)	403.70	403.70
Head (ft)	1,191.69	851.81
Pump Efficiency	71.0%	74.7%
Brake Horsepower (BHP)	395.29	268..58
Motor Efficiency	95.2%	91.5%
VFD Efficiency	N/A	96%
Motor Power (kW)	306.64	228.04

The evaluator used performance tests of Amine pumps from Baker Hughes Incorporated, extrapolated to calculated pump efficiency and estimated pump motor brake horsepower.

Each train operates one pump at a time and rotates to other pumps so pump only runs one-third of a year for each and it is equivalent to running 2 pumps for all year. The total annual savings from installing VFDs on Amine pumps is shown following table.

Savings from VFDs on Amine Pumps

	Baseline	***As Built***	***Savings***
Quantity	2	2	-
Average kW	306.64	228.04	157.21
Operating Hours	8,753	8,753	-
Annual kWh	5,368,355	3,992,251	1,376,104

RESULTS

It was calculated that the installation of VFDs on compressors, decreases annual energy consumption by 1,376,104 kWh and a demand reduction of 157.21 kW resulting in a realization rate of 100%.

Verified Gross Savings & Realization Rates

Type	***Claimed***		***Verified***			
	kWh Savings	***kW Savings***	***kWh Savings***	***kW Savings***	***Realization Rate kWh***	***Realization Rate kW***
VFD Amine Pumps	1,376,104	157.21	1,376,104	157.21	100%	100%
Total	**1,376,104**	**157.21**	**1,376,104**	**157.21**	**100%**	**100%**

This project has 100% gross realization rate because the evaluator and the implementer were collaboratively worked on ex ante savings calculation. The implementer created the initial savings calculation and the evaluator independently reviewed the methodology and calculation and commented where additional supports were needed. After exchanging comments, both the implementer and the evaluator came to an agreement on savings value then the project was approved by the utility. The ex post savings methodology matches to ex ante therefore, the gross realization rate is 100%.

Project Number OID153611
Program Business Custom Efficiency

EXECUTIVE SUMMARY

The participant is a dairy produce that received incentives from Xcel for the installation of (4) air compressors and (6) heated-blow desiccant air dryers. The baseline air compressors are larger in size because the baseline heatless desiccant air dryers require additional compressed air used to recharge. The main savings are coming from reduction in compressed air demand. The evaluator reviewed the ex ante analysis and requested additional information from the facility to calculate the savings from this project. The gross kWh realization rate for this project is 100%

M&V METHODOLOGY

The facility installed (4) 200 HP air compressors, (5) 1,800 CFM heated-blow desiccant air dryers, and (1) 1,300 CFM heated-blow desiccant air dryers. Among those new air compressors, one air compressor is a back-up. The baseline equipment are (3) 250 HP air compressors, (2) 2,100 CFM heatless desiccant air dryers, (2) 1,550 CFM heatless desiccant air dryers, and (1) 1,130 CFM desiccant air dryers. The evaluator used IPMVP option A to calculate the savings from this project. As for key parameters, monitored data of measure equipment and the facility trend data of production were used.

SAVINGS CALCULATIONS

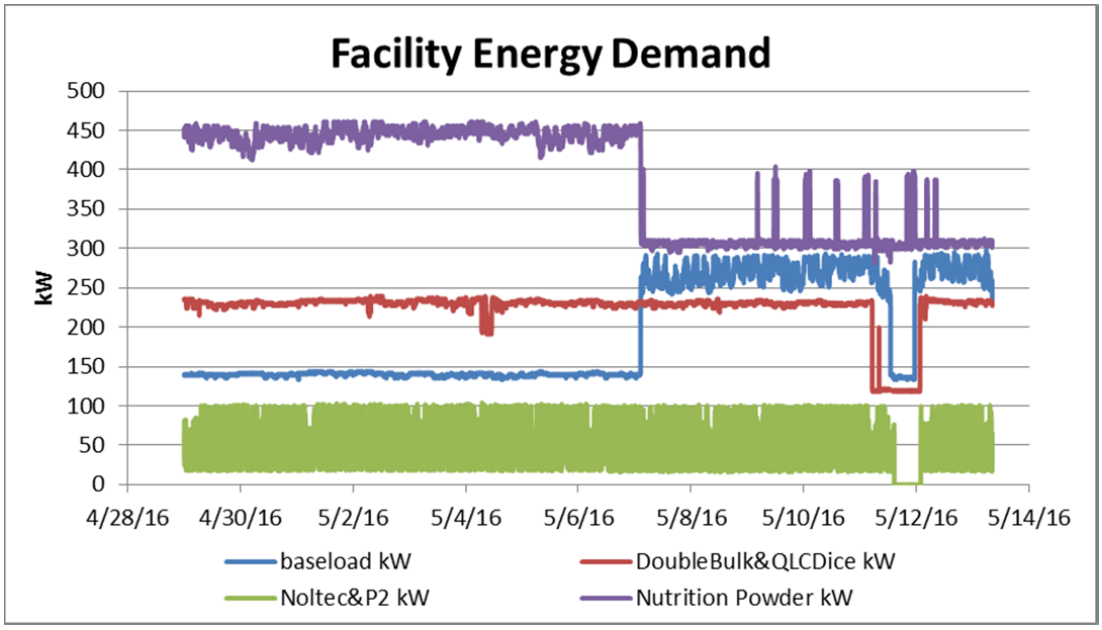
The evaluator calculated the savings based on the facility monitoring data of new equipment from April 26, 2016 to May 13, 2016 then confirmed the monitoring period can represent the annual production by obtaining the total production data from May 1, 2016 through July 30, 2016. The average production rate during monitoring period was 1,798,746 lbs/day and the average production rate of three months period was 1,819,611 lbs/day with a standard error of 58,620 lbs/day. The production rate during monitoring period was within the error boundary of three month average production rate. The demand for compressed air was directly related to the production rate.

Production Rate During Monitoring Period Versus Three-Month Data

Production Rate During 2-week Monitoring Period (Lbs/day)	1,798,746
Production Rate during 3-month record (Lbs/day)	1,819,611 ± 58,620

During the 2-week monitoring period the air compressors had following operating profile.

Facility Energy Demand



The energy demand shows significant change in profile on May 7th for baseload and nutrition powder production. This is a typical operation proven by 2-month production data.

Using this profile, the evaluator calculated following as-built energy consumption

As Built Energy Consumption

Production Type	*Supply Flow (SCFM)*	*Compressor kW*	*Heated Dryer Penalty kW*	*Hours*	*kWh*
Baseload in Low Demand	624	139.74	10.06	4,869	729,299
Baseload in High Demand	939	237.34	15.13	3,651	921,897
Double Bulk & QLC Dice Demand	1,017	224.84	32.77	8,520	2,194,876
Noltec & P2 Demand	151	54.78	57.15	7,891	450,986
Nutrition Powder in High Demand	1,993	468.06	500.17	4,807	2,404,566
Nutrition Powder in Low Demand	1,354	338.24	360.06	3,713	1,336,714
TOTAL					**8,038,337**

The baseline air dryers are heatless desiccant air dryer which requires additional compressed air to go through a purge process to recharge desiccants, therefore the baseline air dryers must be larger in capacity. By adding additional compressor required for recharging process to the as built profile and using the larger baseline air compressors' manufacturer's specification, the evaluator derived following baseline energy consumption.

Baseline Energy Consumption

Production Type	Supply Flow (SCFM)	Compressor kW	Hours	kWh
Baseload in Low Demand	926	214.70	4,869	1,045,278
Baseload in High Demand	1,241	256.68	3,651	937,236
Double Bulk & QLC Dice Demand	1,319	299.68	8,520	2,553,263
Noltec & P2 Demand	314	91.65	7,891	723,252
Nutrition Powder in High Demand	2,439	554.68	4,807	2,666,616
Nutrition Powder in Low Demand	1,800	391.19	3,713	1,452,305
TOTAL				**9,377,950**

The operating hours for baseline is the same as the as built but both supply flow and compressor energy demand are increased due to increased demand for compressed air and air compressors of larger capacity.

The peak savings is calculated using the peak energy consumption during monitoring period.

Peak Energy Consumption

Production Type	Baseline kW	As Built kW	kW Reduction
Baseload in Peak Demand	363.51	311.29	52.22
Double Bulk & QLC Dice in Peak Demand	312.79	278.74	34.05
Noltec & P2 Demand	91.65	57.15	34.50
Nutrition Powder in Low Demand	391.19	360.06	31.14
TOTAL	**1,159.14**	**1,007.23**	**151.91**

When the baseload is operating in high demand, the nutrition powder production is in low demand and when baseload is operating in low demand, the nutrition powder production is in high demand. The peak demand for the facility occurs when the baseload is in peak demand and the nutrition powder production is in low demand.

The total savings for this project is shown below.

Savings from Compressed Air System Retrofit

	Baseline	As Built	Savings
kW Reduction	1,159.14	1,007.23	151.91
Annual kWh	9,377,950	8,038,337	1,339,613

RESULTS

Total savings were 1,339,613 kWh and a demand reduction of 151.91 kW resulting in a realization rate of 100%.

Verified Gross Savings & Realization Rates

Type	Claimed		Verified			
	kWh Savings	kW Savings	kWh Savings	kW Savings	Realization Rate kWh	Realization Rate kW
Compressed Air System Retrofit	1,339,613	157.23	1,339,613	151.91	100%	97%
Total	**1,339,613**	**157.23**	**1,339,613**	**151.91**	**100%**	**97%**

This project has 100% gross realization rate because the evaluator and the implementer were collaboratively worked on ex ante savings calculation. The implementer created the initial savings calculation and the evaluator independently reviewed the methodology and calculation and commented where additional supports were needed. After exchanging comments, both the implementer and the evaluator came to an agreement on savings value then the project was approved by the utility. The ex post savings methodology matches to ex ante therefore, the gross realization rate is 100%.

Project Number OID2646754
Program Business Comprehensive
Component Custom Efficiency- Lighting

Project Background

The participant is an industrial facility that received incentives from Xcel for implementing energy efficient lighting. On-site, the evaluators verified the participant had installed:

- (8) 315W LED fixtures replacing 1,000W metal halide fixture,
- (186) 17W LED fixtures replacing 100W metal halide fixture,
- (9) 17W LED fixtures replacing 32W CFL fixtures,
- (141) Various LED fixtures replacing 400W Metal Halide fixtures, and
- (273) LED linear fixtures replacing T12 linear fluorescent fixtures.

M&V Methodology

The evaluators confirmed installation of all fixtures listed in the project application. Savings for the lighting measures were calculated using the methodology explained on NM TRM. A stipulated Heating Cooling Energy Factor (HCEF) and Heating Cooling Demand Factor (HCDF) are used and ADM created Peak Coincident Factor (PCF) and annual hours of operation based on facility staff interviews in which it was verified that all lighting operated 8,760. Each parameter used in calculating savings are presented in the table below.

Deemed Savings Parameters

Building Type	***Space Type***	***Annual Hours – Non-CFLs***	***Annual Hours – CFLs***	***HCEF***	***HCDF***	***PCF***
Light Industrial	Whole Building (Conditioned)	8,760	8,760	1.110	1.330	1.00
Light Industrial	Whole Building (Unconditioned)	8,760	8,760	1.000	1.000	1.00
Light Industrial	Exterior Light (Dusk-to-Dawn)	4,380	4,380	1.000	1.000	0.00

Savings Calculations

Using parameters from the table above, the evaluators calculated lighting savings as follows:

$$Annual\ kWh\ Savings = \left(kW_{base} * Hours_{base} - kW_{post} * Hours_{post}\right) * HCEF$$

Parameters for kWh Savings Calculation of Lighting Retrofit Measures

kW_{base}	Total Baseline fixtures x $W/Fixture_{base}$ / 1000 W/kW
kWpost	Total Installed fixtures x $W/Fixture_{post}$ / 1000 W/kW
$Hours_{base}$	Annual Hours of Operation of Baseline Fixtures
$Hours_{post}$	Annual Hours of Operation of Installed Fixtures
HCEF	Heating/Cooling Energy Interactive Factor

Following this, the evaluators calculated peak kW savings. This is based upon a Xcel-defined peak of 3:00 – 6:00 PM during summer weekdays. Peak kW savings are calculated as:

$$Peak\ kW\ Savings = (kW_{base} - kW_{post}) * HCDF * PCF$$

Parameters for Peak Demand (kW) Savings Calculation of Lighting Retrofit Measures

kW_{base}	Total Baseline fixtures x $W/Fixture_{base}$ / 1000 W/kW
kW_{post}	Total Installed fixtures x $W/Fixture_{post}$ / 1000 W/kW
PCF	Peak Coincident Factor, % Time During the Peak Period in Which Lighting is Operating
HCDF	Heating Cooling Demand Interactive Factor

Lighting Retrofit kWh Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours		Expected kWh Savings	Realized kWh Savings	HCEF	Realization Rate
	Base	Post	Base	Post	Base	Post				
1000W MH to 315W LED	8	8	1,078	315	8,760	8,760	59,508	59,353	1.110	99.7%
100W MH to 17W LED	186	186	124	17	8,760	8,760	195,328	193,519	1.110	99.1%
32W CFL to 17W LED	9	9	34	17	8,760	8,760	1,488	1,488	1.110	100.0%
400W MH to 129W LED	64	64	453	129	8,760	8,760	202,251	201,629	1.110	99.7%
400W MH to 200W LED	12	12	454	200	8,760	8,760	26,700	26,700	1.000	100.0%
4L F20T12 to 2L 17.5W LED	1	1	59	35	8,760	8,760	214	233	1.110	109.1%
2L F40T12 to 2L 15W LED	157	157	58	30	8,760	8,760	42,745	42,745	1.110	100.0%
4L F40T12 to 2L 17.5W LED	93	93	112	35	8,760	8,760	67,822	69,631	1.110	102.7%
2L F40T12 to 2L 18W LED	4	4	58	36	8,760	8,760	771	771	1.000	100.0%
4L F40T12 to 2L 18W LED	7	7	112	36	8,760	8,760	4,538	4,660	1.000	102.7%
4L F40T12 to 2L 18W LED	11	11	112	36	8,760	8,760	7,131	7,323	1.000	102.7%
400W MH to 200W LED	35	35	453	200	8,760	8,760	86,443	86,102	1.110	99.6%
400W MH to 81W LED	5	5	453	81	4,380	4,380	8,169	8,147	1.000	99.7%
400W MH to 81W LED	15	15	453	81	8,760	8,760	54,404	54,258	1.110	99.7%
400W MH to 81W LED	10	10	453	81	8,760	8,760	32,675	32,587	1.000	99.7%
						Total	**790,185**	**789,146**		**99.9%**

Lighting Retrofit kW Savings Calculations

Measure	Quantity (Fixtures)		Wattage		PCF		Expected kW Savings	Realized kW Savings	HCDF	Realization Rate
	Base	Post	Base	Post	Base	Post				
1000W MH to 315W LED	8	8	1,078	315	1.00	1.00	8.14	8.12	1.330	99.7%
100W MH to 17W LED	186	186	124	17	1.00	1.00	26.72	26.47	1.330	99.1%
32W CFL to 17W LED	9	9	34	17	1.00	1.00	0.20	0.20	1.330	100.0%
400W MH to 129W LED	64	64	453	129	1.00	1.00	27.66	27.58	1.330	99.7%
400W MH to 200W LED	12	12	454	200	1.00	1.00	3.05	3.05	1.000	100.0%
4L F20T12 to 2L 17.5W LED	1	1	59	35	1.00	1.00	0.03	0.03	1.330	109.1%
2L F40T12 to 2L 15W LED	157	157	58	30	1.00	1.00	5.85	5.85	1.330	100.0%
4L F40T12 to 2L 17.5W LED	93	93	112	35	1.00	1.00	9.28	9.52	1.330	102.7%
2L F40T12 to 2L 18W LED	4	4	58	36	1.00	1.00	0.09	0.09	1.000	100.0%
4L F40T12 to 2L 18W LED	7	7	112	36	1.00	1.00	0.52	0.53	1.000	102.7%
4L F40T12 to 2L 18W LED	11	11	112	36	1.00	1.00	0.81	0.84	1.000	102.7%
400W MH to 200W LED	35	35	453	200	1.00	1.00	11.82	11.78	1.330	99.6%
400W MH to 81W LED	5	5	453	81	0.00	0.00	0.00	0.00	1.000	N/A
400W MH to 81W LED	15	15	453	81	1.00	1.00	7.44	7.42	1.330	99.7%
400W MH to 81W LED	10	10	453	81	1.00	1.00	3.73	3.72	1.000	99.7%
						Total	**107.20**	**105.20**		**99.9%**

Results

The kWh realization rate for OID2646754 is 99.9% and the kW realization rate is 99.9%. The evaluators made minor modification to some baseline fixture wattages. Most fixtures operate 8,760 hours annually and fixture wattages are based on manufacturer's specifications.

Verified Gross Savings & Realization Rates

Measure	*Verified*			
	kWh Savings	*kW Savings*	*kWh Realization Rate*	*kW Realization Rate*
Lighting Retrofit	789,146	105.20	99.9%	99.9%
Total	**789,146**	**105.20**	**99.9%**	**99.9%**

Project Number OID1980914
Program Business Custom Efficiency

EXECUTIVE SUMMARY

The participant is a natural gas processing facility that received incentives from Xcel for the installation of VFDs on (3) 450 HP Natural Gas Liquid (NGL) pipeline pumps. The facility only runs one pipeline pump at any given time and rotates them to even out their annual operating hours, also the other two pumps serve as backups. The baseline equipment is (3) 600 HP pump motor because throttle pump require higher brake horse power to match the facility desired flow and pressure. On site the evaluator verified installation of the VFDs on pumps and verified operation strategies through the facility trending data. The gross kWh realization rate for this project is 100%

M&V METHODOLOGY

During the site visit, the evaluator verified the installation of (3) 450 HP NGL pipeline pumps. The evaluator used IPMVP option A to calculate the savings from this project. The evaluator used the facility trend data of NGL pipeline pumps.

SAVINGS CALCULATIONS

The evaluator calculated the savings based on the facility trend data of measure equipment and spot measurement of its operating condition from February 27th, 2016 through June 27th, 2016. The facility operates at steady production rate therefore the trended data can represent rest of the year.

NGL Pipeline Pump Flow Rate, Pressure, and Operating Hours

	Pressure Increase	***Flow***	***Hours***	***% of Hours***
Pump 1 [P-1700]	517.31	783.33	1,782	61.4%
Pump 2 [P-1725]	561.28	786.84	305	10.5%
Pump 3 [P-1750]	468.52	782.34	763	26.3%
OFF	0.00	0.00	54	1.9%

Weighted Average Flow Rate, Pressure, and Operating Hours

Flow Rate (GPM)	783.44
Pipeline Pressure increase (psig)	508.95
Annual Operating Hours (hrs/yr)	8,597

Based on the average flow rate, the evaluator estimated baseline and as-built equipment operating conditions to meet that demand.

Estimated Compressor Operating Conditions

	Baseline (Bypass)	***As-Built (VFD)***
Flow (GPM)	783.44	783.44
Pressure Increase (pisg)	847.54	508.95
Pressure Increase (ft H_2O)	3,263	1,959
Pump Efficiency	59.6%	47.6%
Pump Motor Brake Horse Power (BHP)	649.47	488.18
Pump Motor Efficiency	95.8%	96.1%
VFD Efficiency	N/A	97%
Pump Motor Power (kW)	505.75	390.68

The evaluator used performance tests of measure pumps, extrapolated to operating condition. The total annual savings from installing VFDs on AGI compressors is shown following table.

Savings from VFDs on NGL pumps

	Baseline	***As Built***	***Savings***
Quantity	3	3	-
Average kW	505.75	390.68	115.07
Operating Hours	2,866	2,866	-
Annual kWh	4,347,956	3,358,721	989,235

RESULTS

The initial estimated ex ante savings for this project was 590,035 kWh then the final ex ante savings were upward revised based on facility trend data to 989,235 kWh. The initial savings amount were claimed from OID1980914 rebate which is this project then additional 399,200 kWh were claimed through OID2803122 rebate application.

Verified Gross Savings & Realization Rates

Type	***Claimed***		***Verified***			
	kWh Savings	***kW Savings***	***kWh Savings***	***kW Savings***	***Realization Rate kWh***	***Realization Rate kW***
Pipeline Pump VFD – OID1980914	590,035	67.36	590,035	68.64	100%	102%
Pipeline Pump VFD – OID2803122	399,200	45.57	399,200	46.43	100%	102%
Total	**989,235**	**112.93**	**989,235**	**115.07**	**100%**	**102%**

This project has 100% gross realization rate because the evaluator and the implementer were collaboratively worked on ex ante savings calculation based on facility trend data. The implementer created the initial savings calculation and the evaluator independently reviewed the methodology and calculation and commented where additional supports were needed. After exchanging comments, both the implementer and the evaluator

came to an agreement on savings value then the project was approved by the utility. The ex post savings methodology matches to ex ante therefore, the gross realization rate is 100%.

Project Number OID 2587707
Program Business Lighting Efficiency

Project Background

The participant is a hospitality facility that received incentives from Xcel for implementing energy efficient lighting. On-site, the evaluators verified the participant had installed:

- (54) 9W LED fixtures, replacing (54) 50W Incandescent fixtures;
- (1,104) 7W LED fixtures, replacing (1,104) 40W Incandescent fixtures;
- (234) 10W LED fixtures, replacing (234) 60W Incandescent fixtures;
- (40) 9W LED fixtures, replacing (40) 50W Incandescent fixtures; and
- (24) 9W LED fixtures, replacing (24) 50W Incandescent fixtures.

M&V Methodology

The evaluators found some lighting fixture counts deviated from those listed in the project application. Specifically, the (12) 6W LED lamps and (70) 4.5W LED lamps described in the project documentation were not found on-site. Verified fixture counts were used in ex post savings calculations. Savings for the lighting measures were calculated using New Mexico TRM deemed values by space type for hours of use, along with a stipulated Peak Coincident Factor (PCF), Heating Cooling Energy Factor (HCEF) and Heating Cooling Demand Factor (HCDF) determined using local weather data and Xcel peak parameters. The deemed values used in calculating savings are presented in the table below.

Deemed Savings Parameters

Building Type	*Space Type*	*Annual Hours – Non-CFLs*	*Annual Hours – CFLs*	*HCEF*	*HCDF*	*PCF*
Hotel	Guest Room	799	799	1.437	1.566	0.11
Hotel	Common Area	8,760	8,760	1.437	1.566	1.00

Savings Calculations

Using deemed values from the table above, the evaluators calculated lighting savings as follows:

$$Annual\ kWh\ Savings = \left(kW_{base} * Hours_{base} - kW_{post} * Hours_{post}\right) * HCEF$$

Parameters for kWh Savings Calculation of Lighting Retrofit Measures

kW_{base}	Total Baseline fixtures x $W/Fixture_{base}$ / 1000 W/kW
kWpost	Total Installed fixtures x $W/Fixture_{post}$ / 1000 W/kW
$Hours_{base}$	Annual Hours of Operation of Baseline Fixtures
$Hours_{post}$	Annual Hours of Operation of Installed Fixtures

HCEF	Heating/Cooling Energy Interactive Factor

Following this, the evaluators calculated peak kW savings. This is based upon a Xcel-defined peak of 3:00 – 6:00 PM during summer weekdays. Peak kW savings are calculated as:

$$Peak\ kW\ Savings = (kW_{base} - kW_{post}) * HCDF * PCF$$

Parameters for Peak Demand (kW) Savings Calculation of Lighting Retrofit Measures

kW_{base}	Total Baseline fixtures x $W/Fixture_{base}$ / 1000 W/kW
kW_{post}	Total Installed fixtures x $W/Fixture_{post}$ / 1000 W/kW
PCF	Peak Coincident Factor, % Time During the Peak Period in Which Lighting is Operating
HCDF	Heating Cooling Demand Interactive Factor

Lighting Retrofit kWh Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours		Expected kWh Savings	Realized kWh Savings	HCEF	Realization Rate
	Base	Post	Base	Post	Base	Post				
50W incandescent to 9W LED	54	54	50	9	8,760	8,760	13,291	27,870	1.437	209.7%
40W incandescent to 7W LED	1104	1104	29	7	799	799	222,025	28,520	1.437	12.8%
60W incandescent to 10W LED	135	135	43	10	8,760	8,760	40,927	56,930	1.437	139.1%
60W incandescent to 10W LED	99	99	43	10	799	799	30,013	3,808	1.437	12.7%
35W incandescent to 6W LED	0	0	35	6	799	799	2,089	0	1.437	0.0%
30W incandescent to 5W LED	0	0	30	5	799	799	10,716	0	1.437	0.0%
50W incandescent to 9W LED	40	40	50	9	8,760	8,760	58,437	20,594	1.437	35.2%
50W incandescent to 9W LED	24	24	50	9	799	799	34,866	1,127	1.437	3.2%
						Total	**412,364**	**138,849**		**33.7%**

Lighting Retrofit kW Savings Calculations

Measure	Quantity (Fixtures)		Wattage		PCF		Expected kW Savings	Realized kW Savings	HCDF	Realization Rate
	Base	Post	Base	Post	Base	Post				
50W incandescent to 9W LED	54	54	50	9	1.00	1.00	1.57	3.47	1.566	220.8%
40W incandescent to 7W LED	1104	1104	29	7	0.11	0.11	26.25	4.28	1.566	16.3%
60W incandescent to 10W LED	135	135	43	10	1.00	1.00	4.84	7.08	1.566	146.3%
60W incandescent to 10W LED	99	99	43	10	0.11	0.11	3.55	0.57	1.566	16.1%
35W incandescent to 6W LED	0	0	35	6	0.11	0.11	0.25	0.00	1.566	0.0%
30W incandescent to 5W LED	0	0	30	5	0.11	0.11	1.27	0.00	1.566	0.0%
50W incandescent to 9W LED	40	40	50	9	1.00	1.00	6.91	2.56	1.566	37.1%
50W incandescent to 9W LED	24	24	50	9	0.11	0.11	4.12	0.17	1.566	4.1%
						Total	**48.75**	**18.13**		**37.2%**

Results

The kWh realization rate for project OID 2587707 is 33.7% and the kW realization rate is 37.2%.

The low realization for kWh and kW savings is due primarily to the fact that (12) 6W LED lamps and (70) 4.5W LED lamps identified in the project application could not be located on site. In addition, the project application claimed that all fixtures operated 24 hours a day. On site, it was found that (1,104) 6.5W LED lamps, (99) 9.5W LED lamps, and (24) 9.1 W LED lamps were installed in guest rooms, corresponding to 799 annual hours of operation. Additional discrepancies between expected and realized savings cannot be verified because evaluators were unable to re-create Ex Ante calculations.

Verified Gross Savings & Realization Rates

Measure	***Verified***			
	kWh Savings	***kW Savings***	***kWh Realization Rate***	***kW Realization Rate***
50W incandescent to 9W LED	27,870	3.47	209.7%	220.8%
40W incandescent to 7W LED	28,520	4.28	12.8%	16.3%
60W incandescent to 10W LED	56,930	7.08	139.1%	146.3%
60W incandescent to 10W LED	3,808	0.57	12.7%	16.1%
35W incandescent to 6W LED	0	0.00	0.0%	0.0%
30W incandescent to 5W LED	0	0.00	0.0%	0.0%
50W incandescent to 9W LED	20,594	2.56	35.2%	37.1%
50W incandescent to 9W LED	1,127	0.17	3.2%	4.1%
Total	**138,849**	**18.13**	**33.7%**	**37.2%**

Project Number OID2803122
Program Business Custom Efficiency

EXECUTIVE SUMMARY

The participant is a natural gas processing facility that received incentives from Xcel for the installation of VFDs on (3) 450 HP Natural Gas Liquid (NGL) pipeline pumps. The facility only runs one pipeline pump at any given time and rotates them to even out their annual operating hours, also the other two pumps serve as backups. The baseline equipment is (3) 600 HP pump motor because throttle pumps require higher brake horse power to match the facility desired flow and pressure. On site the evaluator verified installation of the VFDs on pumps and verified operation strategies through the facility trending data. The gross kWh realization rate for this project is 100%

M&V METHODOLOGY

During the site visit, the evaluator verified the installation of (3) 450 HP NGL pipeline pumps. The evaluator used IPMVP option A, retrofit isolation was used to calculate the savings from this project. The evaluator used the facility trend data of NGL pipeline pumps.

SAVINGS CALCULATIONS

The evaluator calculated the savings based on the facility trend data of measure equipment and spot measurement of its operating condition from February 27th, 2016 through June 27th, 2016. The facility operates at steady production rate therefore the trended data can represent rest of the year.

NGL Pipeline Pump Flow Rate, Pressure, and Operating Hours

	Pressure Increase	***Flow***	***Hours***	***% of Hours***
Pump 1 [P-1700]	517.31	783.33	1,782	61.4%
Pump 2 [P-1725]	561.28	786.84	305	10.5%
Pump 3 [P-1750]	468.52	782.34	763	26.3%
OFF	0.00	0.00	54	1.9%

Weighted Average Flow Rate, Pressure, and Operating Hours

Flow Rate (GPM)	783.44
Pipeline Pressure increase (psig)	508.95
Annual Operating Hours (hrs/yr)	8,597

Based on the average flow rate, the evaluator estimated baseline and as-built equipment operating conditions to meet that demand.

Estimated Compressor Operating Conditions

	Baseline (Bypass)	***As-Built (VFD)***
Flow (GPM)	783.44	783.44
Pressure Increase (pisg)	847.54	508.95
Pressure Increase (ft H_2O)	3,263	1,959
Pump Efficiency	59.6%	47.6%
Pump Motor Brake Horse Power (BHP)	649.47	488.18
Pump Motor Efficiency	95.8%	96.1%
VFD Efficiency	N/A	97%
Pump Motor Power (kW)	505.75	390.68

The evaluator used performance tests of measure pumps, extrapolated to operating condition. The total annual savings from installing VFDs on AGI compressors is shown following table.

Savings from VFDs on NGL pumps

	Baseline	***As Built***	***Savings***
Quantity	3	3	-
Average kW	505.75	390.68	115.07
Operating Hours	2,866	2,866	-
Annual kWh	4,347,956	3,358,721	989,235

RESULTS

The initial estimated ex ante savings for this project was 590,035 kWh then the final ex ante savings were upward revised based on facility trend data to 989,235 kWh. The initial savings amount were claimed from OID1980914 rebate and remainder of 399,200 kWh are claimed on this rebate application (OID2803122).

Verified Gross Savings & Realization Rates

Type	***Claimed***		***Verified***			
	kWh Savings	***kW Savings***	***kWh Savings***	***kW Savings***	***Realization Rate kWh***	***Realization Rate kW***
Pipeline Pump VFD – OID1980914	590,035	67.36	590,035	68.64	100%	102%
Pipeline Pump VFD – OID2803122	399,200	45.57	399,200	46.43	100%	102%
Total	**989,235**	**112.93**	**989,235**	**115.07**	**100%**	**102%**

This project has 100% gross realization rate because the evaluator and the implementer were collaboratively worked on ex ante savings calculation based on facility trend data. The implementer created the initial savings calculation and the evaluator independently reviewed the methodology and calculation and commented where additional supports were needed. After exchanging comments, both the implementer and the evaluator

came to an agreement on savings value then the project was approved by the utility. The ex post savings methodology matches to ex ante therefore, the gross realization rate is 100%.

Project Number OID 2528734
Program Business Custom Efficiency

Project Background

The participant is a hospitality facility that received incentives from Xcel for implementing energy efficient lighting in interior and exterior areas. On-site, the evaluators verified the participant had installed:

- (28) 65W LED fixtures, replacing (28) 250W Metal Halide fixtures;
- (39) 240W LED fixtures, replacing (39) 1000W Metal Halide fixtures;
- (48) 20W LED fixtures, replacing (48) 50W Metal Halide fixtures;
- (19) 100W LED fixtures, replacing (19) 400W Metal Halide fixtures;
- (120) 16W LED fixtures, replacing (60) 32W 4' 1-lamp Linear Fluorescent fixtures;
- (150) 36W LED fixtures, replacing (150) 85W 4' 3-lamp Linear Fluorescent fixtures;
- (130) 24W LED fixtures, replacing (90) 58W 4' 2-lamp Linear Fluorescent fixtures;
- (128) 17W LED fixtures, replacing (109) 2' 2-lamp Linear Fluorescent fixtures; and
- A delamping of (4) 400W Metal Halide fixtures.

M&V Methodology

The evaluators found some lighting fixture counts deviated from those listed in the project application. Specifically, (70) 4.5W LED lamps described in project documentation were not found on-site. Verified fixture counts were used in ex post savings calculations. Savings for the lighting measures were calculated using New Mexico TRM deemed values by space type for hours of use, along with a stipulated Peak Coincident Factor (PCF), Heating Cooling Energy Factor (HCEF) and Heating Cooling Demand Factor (HCDF) determined using local weather data and Xcel peak parameters. The deemed values used in calculating savings are presented in the table below.

Deemed Savings Parameters

Building Type	*Space Type*	*Annual Hours – Non-CFLs*	*Annual Hours – CFLs*	*HCEF*	*HCDF*	*PCF*
Hotel	Exterior	4,313	4,313	1.00	1.00	0.00
Hotel	Corridor	8,760	8,760	1.437	1.566	1.00

Savings Calculations

Using deemed values from the table above, the evaluators calculated lighting savings as follows:

$$Annual\ kWh\ Savings = \left(kW_{base} * Hours_{base} - kW_{post} * Hours_{post}\right) * HCEF$$

Parameters for kWh Savings Calculation of Lighting Retrofit Measures

kW_{base}	Total Baseline fixtures x $W/Fixture_{base}$ / 1000 W/kW
kWpost	Total Installed fixtures x $W/Fixture_{post}$ / 1000 W/kW
$Hours_{base}$	Annual Hours of Operation of Baseline Fixtures
$Hours_{post}$	Annual Hours of Operation of Installed Fixtures
HCEF	Heating/Cooling Energy Interactive Factor

Following this, the evaluators calculated peak kW savings. This is based upon a Xcel-defined peak of 3:00 – 6:00 PM during summer weekdays. Peak kW savings are calculated as:

$$Peak\ kW\ Savings = (kW_{base} - kW_{post}) * HCDF * PCF$$

Parameters for Peak Demand (kW) Savings Calculation of Lighting Retrofit Measures

kW_{base}	Total Baseline fixtures x $W/Fixture_{base}$ / 1000 W/kW
kW_{post}	Total Installed fixtures x $W/Fixture_{post}$ / 1000 W/kW
PCF	Peak Coincident Factor, % Time During the Peak Period in Which Lighting is Operating
HCDF	Heating Cooling Demand Interactive Factor

Lighting Retrofit kWh Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours		Expected kWh Savings	Realized kWh Savings	HCEF	Realization Rate
	Base	Post	Base	Post	Base	Post				
250W metal halide to 65W LED	28	28	275	65	4,313	4,313	30,463	25,359	1.000	83.2%
1000W metal halide to 240W LED	39	39	1,078	240	4,313	4,313	169,720	140,948	1.000	83.0%
50W metal halide to 20W LED	48	48	56	20	4,313	4,313	8,082	7,521	1.000	93.1%
400W metal halide to 100W LED	19	19	429	100	4,313	4,313	33,467	26,959	1.000	80.6%
50W metal halide to Delamp	4	0	56	-	4,313	0	1,140	972	1.000	85.3%
4' 1-lamp T8 to 16W LED	60	120	32	16	4,313	4,313	0	0	1.000	N/A
4' 3-lamp T8 to 36W LED	150	150	85	36	8,760	8,760	38,855	92,523	1.437	238.1%
4' 2-lamp T8 to 24W LED	90	130	58	24	8,760	8,760	10,879	26,435	1.437	243.0%
2' 2-lamp T8 to 17W LED	109	128	33	17	8,760	8,760	7,362	17,888	1.437	243.0%
40W incandescent to 5W LED	0	0	29	5	8,760	8,760	12,874	0	1.437	0.0%

Total	**312,842**	**338,605**		**108.2%**

Lighting Retrofit kW Savings Calculations

Measure	Quantity (Fixtures)		Wattage		PCF		Expected kW Savings	Realized kW Savings	HCDF	Realization Rate
	Base	Post	Base	Post	Base	Post				
250W metal halide to 65W LED	28	28	275	65	0.00	0.00	1.41	0.00	1.000	0.0%
1000W metal halide to 240W LED	39	39	1,078	240	0.00	0.00	7.83	0.00	1.000	0.0%
50W metal halide to 20W LED	48	48	56	20	0.00	0.00	0.37	0.00	1.000	0.0%
400W metal halide to 100W LED	19	19	429	100	0.00	0.00	1.54	0.00	1.000	0.0%
50W metal halide to Delamp	4	0	56	-	0.00	0.00	0.05	0.00	1.000	0.0%
4' 1-lamp T8 to 16W LED	60	120	32	16	0.00	0.00	0.00	0.00	1.000	N/A
4' 3-lamp T8 to 36W LED	150	150	85	36	1.00	1.00	1.79	11.51	1.566	642.2%
4' 2-lamp T8 to 24W LED	90	130	58	24	1.00	1.00	0.50	3.29	1.566	655.6%
2' 2-lamp T8 to 17W LED	109	128	33	17	1.00	1.00	0.34	2.23	1.566	656.7%
40W incandescent to 5W LED	0	0	29	5	1.00	1.00	0.59	0.00	1.566	0.0%
						Total	**14.43**	**17.03**		**118.0%**

Results

The kWh realization rate for project OID 2528734 is 108.2% and the kW realization rate is 118.0%.

There are several contributing factors that help account for the discrepancies between expected and realized savings. On-site verification revealed that installed fixture counts did not match claimed fixture counts in several instances. Most notably, (70) 4.5W LED lamps that were listed on the project application could not be found on-site. In addition, the annual hours of operation for exterior fixtures did not match those reported in the project application. The project application claimed that outdoor fixtures operate 4,380 hours per year, this was changed to 4,313 in Ex Post calculations. Further discrepancies between expected and realized savings cannot be explained as evaluators were unable to recreate Ex Ante calculations.

Verified Gross Savings & Realization Rates

Measure	***Verified***			
	kWh Savings	***kW Savings***	***kWh Realization Rate***	***kW Realization Rate***
250W metal halide to 65W LED	25,359	0.00	83.2%	0.0%
1000W metal halide to 240W LED	140,948	0.00	83.0%	0.0%
50W metal halide to 20W LED	7,521	0.00	93.1%	0.0%
400W metal halide to 100W LED	26,959	0.00	80.6%	0.0%
50W metal halide to Delamp	972	0.00	85.3%	0.0%
4' 1-lamp T8 to 16W LED	0	0.00	N/A	N/A
4' 3-lamp T8 to 36W LED	92,523	11.51	238.1%	642.2%
4' 2-lamp T8 to 24W LED	26,435	3.29	243.0%	655.6%
2' 2-lamp T8 to 17W LED	17,888	2.23	243.0%	656.7%
40W incandescent to 5W LED	0	0.00	0.0%	0.0%
Total	**338,605**	**17.03**	**108.2%**	**118.0%**

Project Number OID 2384763
Program Business Custom Efficiency

Project Background

The participant is a retail facility that received incentives from Xcel for implementing energy efficient lighting. On-site, the evaluators verified the participant had installed:

- (47) 140W LED fixtures, replacing (47) 368W Metal Halide fixtures;
- (4) 27.5W LED fixtures, replacing (4) 213W Metal Halide fixtures;
- (3) 42.5W LED fixtures, replacing (3) 213W Metal Halide fixtures;
- (32) 568W LED fixtures, replacing (32) 1085W Metal Halide fixtures; and
- (13) 44W LED fixtures, replacing (13) 100W Metal Halide fixtures.

M&V Methodology

The evaluators found some lighting fixture counts deviated from those listed in the project application. Verified fixture counts were used in ex post savings calculations. Savings for the lighting measures were calculated using New Mexico TRM deemed values by space type for hours of use, along with a stipulated Peak Coincident Factor (PCF), Heating Cooling Energy Factor (HCEF) and Heating Cooling Demand Factor (HCDF) determined using local weather data and Xcel peak parameters. The deemed values used in calculating savings are presented in the table below.

Deemed Savings Parameters

Building Type	*Space Type*	*Annual Hours – Non-CFLs*	*Annual Hours – CFLs*	*HCEF*	*HCDF*	*PCF*
Retail	Exterior	4,313	4,313	1.00	1.00	0.0

Savings Calculations

Using deemed values from the table above, the evaluators calculated lighting savings as follows:

$$Annual\ kWh\ Savings = \left(kW_{base} * Hours_{base} - kW_{post} * Hours_{post}\right) * HCEF$$

Parameters for kWh Savings Calculation of Lighting Retrofit Measures

kW_{base}	Total Baseline fixtures x $W/Fixture_{base}$ / 1000 W/kW
kWpost	Total Installed fixtures x $W/Fixture_{post}$ / 1000 W/kW
$Hours_{base}$	Annual Hours of Operation of Baseline Fixtures
$Hours_{post}$	Annual Hours of Operation of Installed Fixtures
HCEF	Heating/Cooling Energy Interactive Factor

Following this, the evaluators calculated peak kW savings. This is based upon a Xcel-defined peak of 3:00 – 6:00 PM during summer weekdays. Peak kW savings are calculated as:

$$Peak\ kW\ Savings = (kW_{base} - kW_{post}) * HCDF * PCF$$

Parameters for Peak Demand (kW) Savings Calculation of Lighting Retrofit Measures

kW_{base}	Total Baseline fixtures x $W/Fixture_{base}$ / 1000 W/kW
kW_{post}	Total Installed fixtures x $W/Fixture_{post}$ / 1000 W/kW
PCF	Peak Coincident Factor, % Time During the Peak Period in Which Lighting is Operating
HCDF	Heating Cooling Demand Interactive Factor

Lighting Retrofit kWh Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours		Expected kWh Savings	Realized kWh Savings	HCEF	Realization Rate
	Base	Post	Base	Post	Base	Post				
320W metal halide to 140W LED	32	32	368	140	4,313	4,313	26,407	31,465	1.000	119.2%
320W metal halide to 140W LED	15	15	368	140	4,313	4,313	29,708	14,749	1.000	49.6%
175W metal halide to 28W LED	4	4	213	28	4,313	4,313	3,581	3,200	1.000	89.4%
175W metal halide to 28W LED	3	3	213	43	4,313	4,313	2,468	2,206	1.000	89.4%
1000W metal halide to 568W LED	32	32	1,085	568	4,313	4,313	79,838	71,349	1.000	89.4%
100W metal halide to 44W LED	13	13	100	44	4,313	4,313	3,513	3,140	1.000	89.4%
						Total	**145,515**	**126,109**		**86.7%**

Lighting Retrofit kW Savings Calculations

Measure	Quantity (Fixtures)		Wattage		PCF		Expected kW Savings	Realized kW Savings	HCDF	Realization Rate
	Base	Post	Base	Post	Base	Post				
320W metal halide to 140W LED	32	32	368	140	0.00	0.00	6.03	0.00	1.000	0.0%
320W metal halide to 140W LED	15	15	368	140	0.00	0.00	6.78	0.00	1.000	0.0%
175W metal halide to 28W LED	4	4	213	28	0.00	0.00	0.82	0.00	1.000	0.0%
175W metal halide to 28W LED	3	3	213	43	0.00	0.00	0.56	0.00	1.000	0.0%
1000W metal halide to 568W LED	32	32	1,085	568	0.00	0.00	18.23	0.00	1.000	0.0%
100W metal halide to 44W LED	13	13	100	44	0.00	0.00	0.80	0.00	1.000	0.0%
						Total	**33.22**	**0.00**		**0.0%**

Results

The kWh realization rate for project OID 2384763 is 86.7% and the kW realization rate is 0%. There are several contributors to the kWh realization rate. The number of 140W LED fixtures observed on-site was 15 less than that which was listed in the project application. In addition, the project application claimed 4,380 annual hours of fixture operation. This was changed to 4,313 hours in Ex Post calculations.

The kW realization is 0% because Ex Ante calculations used a coincidence factor of 1. This was changed to 0 in Ex Post calculations to reflect the fact that the fixtures are located outside and operate from dusk to dawn.

Verified Gross Savings & Realization Rates

Measure	***Verified***			
	kWh Savings	***kW Savings***	***kWh Realization Rate***	***kW Realization Rate***
320W metal halide to 140W LED	31,465	0.00	119.2%	0.0%
320W metal halide to 140W LED	14,749	0.00	49.6%	0.0%
175W metal halide to 28W LED	3,200	0.00	89.4%	0.0%
175W metal halide to 28W LED	2,206	0.00	89.4%	0.0%
1000W metal halide to 568W LED	71,349	0.00	89.4%	0.0%
100W metal halide to 44W LED	3,140	0.00	89.4%	0.0%
Total	**126,109**	**0.00**	**86.7%**	**0.0%**

Project Number OID 2580661
Program Business Custom Efficiency

Project Background

The participant is the City of Carlsbad, which received incentives from Xcel for implementing energy efficient lighting in exterior recreational spaces. On-site, the evaluators verified the participant had installed:

- (30) 84W LED fixtures, replacing (30) 400W metal halide fixtures;
- (159) 24W LED fixtures, replacing (159) 100W metal halide fixtures;

M&V Methodology

The evaluators confirmed installation of all fixtures listed in the project application. Savings for the lighting measures were calculated using New Mexico TRM deemed values by space type for hours of use, along with a stipulated Peak Coincident Factor (PCF), Heating Cooling Energy Factor (HCEF) and Heating Cooling Demand Factor (HCDF) determined using local weather data and NM peak parameters. The deemed values used in calculating savings are presented in the table below.

Deemed Savings Parameters

Building Type	*Space Type*	*Annual Hours – Non-CFLs*	*Annual Hours – CFLs*	*HCEF*	*HCDF*	*PCF*
Office Building	Exterior	4,313	4,313	1.00	1.00	0

Savings Calculations

Using deemed values from the table above, the evaluators calculated lighting savings as follows:

$$Annual\ kWh\ Savings = \left(kW_{base} * Hours_{base} - kW_{post} * Hours_{post}\right) * HCEF$$

Parameters for kWh Savings Calculation of Lighting Retrofit Measures

kW_{base}	Total Baseline fixtures x $W/Fixture_{base}$ / 1000 W/kW
kWpost	Total Installed fixtures x $W/Fixture_{post}$ / 1000 W/kW
$Hours_{base}$	Annual Hours of Operation of Baseline Fixtures
$Hours_{post}$	Annual Hours of Operation of Installed Fixtures
HCEF	Heating/Cooling Energy Interactive Factor

Following this, the evaluators calculated peak kW savings. This is based upon a Xcel-defined peak of 3:00 – 6:00 PM during summer weekdays. Peak kW savings are calculated as:

$$Peak\ kW\ Savings = (kW_{base} - kW_{post}) * HCDF * PCF$$

Parameters for Peak Demand (kW) Savings Calculation of Lighting Retrofit Measures

kW_{base}	Total Baseline fixtures x $W/Fixture_{base}$ / 1000 W/kW
kW_{post}	Total Installed fixtures x $W/Fixture_{post}$ / 1000 W/kW
PCF	Peak Coincident Factor, % Time During the Peak Period in Which Lighting is Operating
HCDF	Heating Cooling Demand Interactive Factor

Lighting Retrofit kWh Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours		Expected kWh Savings	Realized kWh Savings	CEF	kWh Realization Rate
	Base	Post	Base	Post	Base	Post				
400W metal halide to 84W LED	30	30	453	84	4,313	4,313	48,100	47,742	1.000	99.3%
100W metal halide to 24W LED	159	159	124	24	4,313	4,313	69,087	68,572	1.000	99.3%
	Total						**117,187**	**116,314**		**99.3%**

Lighting Retrofit kW Savings Calculations

Measure	Quantity (Fixtures)		Wattage		PCF		Expected kW Savings	Realized kW Savings	CDF	kW Realization Rate
	Base	Post	Base	Post	Base	Post				
400W metal halide to 84W LED	30	30	453	84	0.00	0.00	0.00	0.00	1.000	100.0%
100W metal halide to 24W LED	159	159	124	24	0.00	0.00	0.00	0.00	1.000	100.0%
	Total						**0.00**	**0.00**		**100.0%**

Results

The kWh realization rate for project #OID 2580661 is 99.3% and the kW realization rate is 100.0%.

The kW realization is 0% because Ex Ante calculations used a value of 1.0 for the Coincidence factor. This was changed to 0 in Ex Post calculation to take into account the fact that the fixtures are located outside and operate from dusk to dawn.

Verified Gross Savings & Realization Rates

Measure	Verified			
	kWh Savings	kW Savings	kWh Realization Rate	kW Realization Rate
400W metal halide to 84W LED	47,742	0.00	99.3%	100.0%
100W metal halide to 24W LED	68,572	0.00	99.3%	100.0%
Total	**116,314**	**0.00**	**99.3%**	**100.0%**

Project Number OID 2431426
Program Business Custom Efficiency

Project Background

The participant is an educational facility that received incentives from Xcel for implementing energy efficient lighting. On-site, the evaluators verified the participant had installed:

- (540) 18W LED fixtures, replacing (540) 4' 1-lamp T8 fixtures;
- (56) 76W LED fixtures, replacing (56) 100W Metal Halide fixtures;
- (12) 15W LED fixtures, replacing (12) 1-lamp T8 6" Spacing U-Tube HLO fixtures;
- (17) 9.5W LED fixtures, replacing (17) 19W Incandescent fixtures;
- (4) 1-lamp 3W LED Exit fixtures, replacing (4) 2-lamp 34W Incandescent Exit fixtures;
- (4) 60W LED fixtures, replacing (4) 175W MV fixtures;
- (4) 80W LED fixtures, replacing (4) 150W Metal Halide fixtures;
- (24) 240W LED fixtures, replacing (24) 4' 6-lamp T5HO fixtures; and
- (42) 18W LED fixtures, replacing (42) 4' 1-lamp T8 fixtures.

M&V Methodology

The evaluators found some lighting fixture counts deviated from those listed in the project application. Verified fixture counts were used in ex post savings calculations. Savings for the lighting measures were calculated using New Mexico TRM deemed values by space type for hours of use, along with a stipulated Peak Coincident Factor (PCF), Heating Cooling Energy Factor (HCEF) and Heating Cooling Demand Factor (HCDF) determined using local weather data and Xcel peak parameters. The deemed values used in calculating savings are presented in the table below.

Deemed Savings Parameters

Building Type	*Space Type*	*Annual Hours – Non-CFLs*	*Annual Hours – CFLs*	*HCEF*	*HCDF*	*PCF*
Secondary School	Classroom	2,445	2,445	1.346	1.344	0.42
Secondary School	Exterior	4,313	4,313	1.000	1.000	0.00
Secondary School	Exit Signs	8,760	8,760	1.346	1.344	0.42

Savings Calculations

Using deemed values from the table above, the evaluators calculated lighting savings as follows:

$$Annual\ kWh\ Savings = \left(kW_{base} * Hours_{base} - kW_{post} * Hours_{post}\right) * HCEF$$

Parameters for kWh Savings Calculation of Lighting Retrofit Measures

kW_{base}	Total Baseline fixtures x $W/Fixture_{base}$ / 1000 W/kW
kWpost	Total Installed fixtures x $W/Fixture_{post}$ / 1000 W/kW
$Hours_{base}$	Annual Hours of Operation of Baseline Fixtures
$Hours_{post}$	Annual Hours of Operation of Installed Fixtures
HCEF	Heating/Cooling Energy Interactive Factor

Following this, the evaluators calculated peak kW savings. This is based upon a Xcel-defined peak of 3:00 – 6:00 PM during summer weekdays. Peak kW savings are calculated as:

$$Peak\ kW\ Savings = (kW_{base} - kW_{post}) * HCDF * PCF$$

Parameters for Peak Demand (kW) Savings Calculation of Lighting Retrofit Measures

kW_{base}	Total Baseline fixtures x $W/Fixture_{base}$ / 1000 W/kW
kW_{post}	Total Installed fixtures x $W/Fixture_{post}$ / 1000 W/kW
PCF	Peak Coincident Factor, % Time During the Peak Period in Which Lighting is Operating
HCDF	Heating Cooling Demand Interactive Factor

Lighting Retrofit kWh Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours		Expected kWh Savings	Realized kWh Savings	HCEF	Realization Rate
	Base	Post	Base	Post	Base	Post				
4' 1-lamp T8 to 18W LED	540	540	35	18	2,445	2,445	31,159	30,211	1.346	97.0%
100W metal halide to 76W LED	56	56	124	76	4,313	4,313	3,770	11,593	1.000	307.5%
1-lamp T8 6" Spacing U-Tube HLO to 15W LED	12	12	34	15	2,445	2,445	561	750	1.346	133.8%
19W incandescent to 9.5W LED	17	17	19	10	2,445	2,445	1,880	531	1.346	28.2%
2-lamp 34W incandescent Exit to 1-lamp 3W LED Exit	4	4	68	3	8,760	8,760	308	3,066	1.346	996.3%
175W MV to 60W LED	4	4	205	60	4,313	4,313	769	2,501	1.000	325.1%
150W metal halide to 80W LED	4	4	163	80	4,313	4,313	522	1,432	1.000	274.3%
4' 6-lamp T5HO to 240W LED	24	24	362	240	2,445	2,445	4,372	9,636	1.346	220.4%
4' 1-lamp T8 to 18W LED	42	42	35	18	2,445	2,445	5,309	2,350	1.346	44.3%
						Total	**48,649**	**62,070**		**127.6%**

Lighting Retrofit kW Savings Calculations

Measure	Quantity (Fixtures)		Wattage		PCF		Expected kW Savings	Realized kW Savings	HCDF	Realization Rate
	Base	Post	Base	Post	Base	Post				
4' 1-lamp T8 to 18W LED	540	540	35	18	0.42	0.42	25.73	5.18	1.344	20.1%
100W metal halide to 76W LED	56	56	124	76	0.00	0.00	3.11	0.00	1.000	0.0%
1-lamp T8 6" Spacing U-Tube HLO to 15W LED	12	12	34	15	0.42	0.42	0.46	0.13	1.344	28.1%
19W incandescent to 9.5W LED	17	17	19	10	0.42	0.42	1.55	0.09	1.344	5.8%
2-lamp 34W incandescent Exit to 1-lamp 3W LED Exit	4	4	68	3	1.00	1.00	0.25	0.35	1.344	137.7%
175W MV to 60W LED	4	4	205	60	0.00	0.00	0.64	0.00	1.000	0.0%
150W metal halide to 80W LED	4	4	163	80	0.00	0.00	0.43	0.00	1.000	0.0%
4' 6-lamp T5HO to 240W LED	24	24	362	240	0.42	0.42	3.61	1.65	1.344	45.7%
4' 1-lamp T8 to 18W LED	42	42	35	18	0.42	0.42	4.38	0.40	1.344	9.1%
						Total	**40.18**	**7.80**		**19.4%**

Results

The kWh realization rate for project OID 2431426 is 127.6% and the kW realization rate is 19.4%. Some of the discrepancy between expected and realized kWh savings is due to the fact that estimates for this site's annual hours of operation were changed compared to those that there were used in Ex Ante calculations. Ex Ante hours of operation ranged between 4,032 and 8,760 hours per year. On-site evaluation revealed that the annual hours of operation for the site range from 2,445 and 8,760 hours per year. In addition, some changes to the wattages of baseline fixtures were made in Ex Post calculations; these adjustments also influenced kW realization rates. Additional discrepancy is due to the fact that evaluators could not recreate Ex Ante savings.

Verified Gross Savings & Realization Rates

Measure	***Verified***			
	kWh Savings	***kW Savings***	***kWh Realization Rate***	***kW Realization Rate***
4' 1-lamp T8 to 18W LED	30,211	5.18	97.0%	20.1%
100W metal halide to 76W LED	11,593	0.00	307.5%	0.0%
1-lamp T8 6" Spacing U-Tube HLO to 15W LED	750	0.13	133.8%	28.1%
19W incandescent to 9.5W LED	531	0.09	28.2%	5.8%
2-lamp 34W incandescent Exit to 1-lamp 3W LED Exit	3,066	0.35	996.3%	137.7%
175W MV to 60W LED	2,501	0.00	325.1%	0.0%
150W metal halide to 80W LED	1,432	0.00	274.3%	0.0%
4' 6-lamp T5HO to 240W LED	9,636	1.65	220.4%	45.7%
4' 1-lamp T8 to 18W LED	2,350	0.40	44.3%	9.1%
Total	**62,070**	**7.80**	**127.6%**	**19.4%**

Project Number OID 2538582
Program Business Custom Efficiency

Project Background

The participant is a gym that received incentives from Xcel for implementing energy efficient lighting. On-site, the evaluators verified the participant had installed:

- (54) 2-lamp 22W LED T8 fixtures, replacing (50) 4-lamp 4' 32W Fluorescent T8 fixtures.

M&V Methodology

The evaluators found some lighting fixture counts deviated from those listed in the project application. Verified fixture counts were used in ex post savings calculations. Savings for the lighting measures were calculated using New Mexico TRM deemed values by space type for hours of use, along with a stipulated Peak Coincident Factor (PCF), Heating Cooling Energy Factor (HCEF) and Heating Cooling Demand Factor (HCDF) determined using local weather data and Xcel peak parameters. The deemed values used in calculating savings are presented in the table below.

Deemed Savings Parameters

Building Type	*Space Type*	*Annual Hours – Non-CFLs*	*Annual Hours – CFLs*	*HCEF*	*HCDF*	*PCF*
Small Retail	Gym	8,760	8,760	1.346	1.344	1.00

Savings Calculations

Using deemed values from the table above, the evaluators calculated lighting savings as follows:

$$Annual\ kWh\ Savings = \left(kW_{base} * Hours_{base} - kW_{post} * Hours_{post}\right) * HCEF$$

Parameters for kWh Savings Calculation of Lighting Retrofit Measures

kW_{base}	Total Baseline fixtures x $W/Fixture_{base}$ / 1000 W/kW
kWpost	Total Installed fixtures x $W/Fixture_{post}$ / 1000 W/kW
$Hours_{base}$	Annual Hours of Operation of Baseline Fixtures
$Hours_{post}$	Annual Hours of Operation of Installed Fixtures
HCEF	Heating/Cooling Energy Interactive Factor

Following this, the evaluators calculated peak kW savings. This is based upon a Xcel-defined peak of 3:00 – 6:00 PM during summer weekdays. Peak kW savings are calculated as:

$$Peak\ kW\ Savings = (kW_{base} - kW_{post}) * HCDF * PCF$$

Parameters for Peak Demand (kW) Savings Calculation of Lighting Retrofit Measures

kW_{base}	Total Baseline fixtures x $W/Fixture_{base}$ / 1000 W/kW
kW_{post}	Total Installed fixtures x $W/Fixture_{post}$ / 1000 W/kW
PCF	Peak Coincident Factor, % Time During the Peak Period in Which Lighting is Operating
HCDF	Heating Cooling Demand Interactive Factor

Lighting Retrofit kWh Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours		Expected kWh Savings	Realized kWh Savings	HCEF	Realization Rate
	Base	Post	Base	Post	Base	Post				
4' 4-lamp T8 to 22W LED	50	100	112	22	8,760	8,760	35,491	40,089	1.346	113.0%
						Total	**35,491**	**40,089**		**113.0%**

Lighting Retrofit kW Savings Calculations

Measure	Quantity (Fixtures)		Wattage		PCF		Expected kW Savings	Realized kW Savings	HCDF	Realization Rate
	Base	Post	Base	Post	Base	Post				
4' 4-lamp T8 to 22W LED	50	100	112	22	1.00	1.00	4.86	4.57	1.344	94.0%
						Total	**4.86**	**4.57**		**94.0%**

Results

The kWh realization rate for project OID 2538582 is 113.0% and the kW realization rate is 94.0%.

The primary reason for the high kWh and kW realization rates is the adjustment HCEF and HCDF values compared to those used in Ex Ante calculations. Ex Ante calculations used a HCEF of 1.230 and HCDF of 1.335. These were changed to 1.346 and 1.334, respectively. In addition, the wattage of the baseline fixtures was changed from 110W to 112W. This change resulted in a 1,048 kWh increase in savings and a 0.11 increase in kW savings. In addition, the facility's annual hours of operation were changed from 8,736 to 8,760; this change was accompanied by a change in coincidence factor from 0.88 to 1.00. This change is responsible for a 98 kWh increase in savings.

Verified Gross Savings & Realization Rates

Measure	*Verified*			
	kWh Savings	*kW Savings*	*kWh Realization Rate*	*kW Realization Rate*
4' 4-lamp T8 to 22W LED	40,089	4.57	113.0%	94.0%
Total	**40,089**	**4.57**	**113.0%**	**94.0%**

Project Number OID 2472350
Program Business Custom Efficiency

Project Background

The participant is hospital which received incentives from Xcel for implementing energy efficient lighting in exterior parking spaces. On-site, the evaluators verified the participant had installed:

- (18) 139W LED fixtures, replacing (18) 400W metal halide fixtures;

M&V Methodology

The evaluators confirmed installation of all fixtures listed in the project application. Savings for the lighting measures were calculated using New Mexico TRM deemed values by space type for hours of use, along with a stipulated Peak Coincident Factor (PCF), Heating Cooling Energy Factor (HCEF) and Heating Cooling Demand Factor (HCDF) determined using local weather data and NM peak parameters. The deemed values used in calculating savings are presented in the table below.

Deemed Savings Parameters

Building Type	***Space Type***	***Annual Hours – Non-CFLs***	***Annual Hours – CFLs***	***HCEF***	***HCDF***	***PCF***
Office Building	Exterior	4,313	4,313	1.00	1.00	0

Savings Calculations

Using deemed values from the table above, the evaluators calculated lighting savings as follows:

$$Annual\ kWh\ Savings = \left(kW_{base} * Hours_{base} - kW_{post} * Hours_{post}\right) * HCEF$$

Parameters for kWh Savings Calculation of Lighting Retrofit Measures

kW_{base}	Total Baseline fixtures x $W/Fixture_{base}$ / 1000 W/kW
kWpost	Total Installed fixtures x $W/Fixture_{post}$ / 1000 W/kW
$Hours_{base}$	Annual Hours of Operation of Baseline Fixtures
$Hours_{post}$	Annual Hours of Operation of Installed Fixtures
HCEF	Heating/Cooling Energy Interactive Factor

Following this, the evaluators calculated peak kW savings. This is based upon a Xcel-defined peak of 3:00 – 6:00 PM during summer weekdays. Peak kW savings are calculated as:

$$Peak\ kW\ Savings = (kW_{base} - kW_{post}) * HCDF * PCF$$

Parameters for Peak Demand (kW) Savings Calculation of Lighting Retrofit Measures

kW_{base}	Total Baseline fixtures x $W/Fixture_{base}$ / 1000 W/kW
kW_{post}	Total Installed fixtures x $W/Fixture_{post}$ / 1000 W/kW
PCF	Peak Coincident Factor, % Time During the Peak Period in Which Lighting is Operating
HCDF	Heating Cooling Demand Interactive Factor

Lighting Retrofit kWh Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours		Expected kWh Savings	Realized kWh Savings	CEF	kWh Realization Rate
	Base	Post	Base	Post	Base	Post				
400W metal halide to 139W LED	18	18	453	139	4,313	4,313	28,934	24,375	1.000	84.2%
	Total						**28,934**	**24,375**		**84.2%**

Lighting Retrofit kW Savings Calculations

Measure	Quantity (Fixtures)		Wattage		PCF		Expected kW Savings	Realized kW Savings	CDF	kW Realization Rate
	Base	Post	Base	Post	Base	Post				
400W metal halide to 139W LED	18	18	453	139	0.00	0.00	6.61	0.00	1.000	0.0%
	Total						**6.61**	**0.00**		**0.0%**

Results

The kWh realization rate for project #OID 2472350 is 84.2% and the kW realization rate is 0.0%. The reported ex ante savings was 28,934 kWh but ADM calculated 23,690 kWh, this might have been a data entry error. If the project was reported correctly, the realization rate would have been 103% due to longer operating hours used by ADM.

The kW realization is 0% because Ex Ante calculations used a value of 1.0 for the Coincidence factor. This was changed to 0 in Ex Post calculation to take into account the fact that the fixtures are located outside and operate from dusk to dawn.

Verified Gross Savings & Realization Rates

Measure	Verified			
	kWh Savings	kW Savings	kWh Realization Rate	kW Realization Rate
400W metal halide to 139W LED	24,375	0.00	84.2%	0.0%
Total	**24,375**	**0.00**	**84.2%**	**0.0%**

Project Number OID 2528760
Program Business Lighting Efficiency

Project Background

The participant is a gas station that received incentives from Xcel for implementing energy efficient lighting on the exterior of the facility. On-site, the evaluators verified the participant had installed:

- (14) 122W LED fixtures, replacing (12) 400W Metal Halide fixtures.

M&V Methodology

The evaluators confirmed installation of all fixtures listed in the project application. Savings for the lighting measures were calculated using New Mexico TRM deemed values by space type for hours of use, along with a stipulated Peak Coincident Factor (PCF), Heating Cooling Energy Factor (HCEF) and Heating Cooling Demand Factor (HCDF) determined using local weather data and Xcel peak parameters. The deemed values used in calculating savings are presented in the table below.

Deemed Savings Parameters

Building Type	*Space Type*	*Annual Hours – Non-CFLs*	*Annual Hours – CFLs*	*HCEF*	*HCDF*	*PCF*
Gas Station	Exterior	4,313	4,313	1.00	1.00	0.0

Savings Calculations

Using deemed values from the table above, the evaluators calculated lighting savings as follows:

$$Annual\ kWh\ Savings = \left(kW_{base} * Hours_{base} - kW_{post} * Hours_{post}\right) * HCEF$$

Parameters for kWh Savings Calculation of Lighting Retrofit Measures

kW_{base}	Total Baseline fixtures x $W/Fixture_{base}$ / 1000 W/kW
kWpost	Total Installed fixtures x $W/Fixture_{post}$ / 1000 W/kW
$Hours_{base}$	Annual Hours of Operation of Baseline Fixtures
$Hours_{post}$	Annual Hours of Operation of Installed Fixtures
HCEF	Heating/Cooling Energy Interactive Factor

Following this, the evaluators calculated peak kW savings. This is based upon a Xcel-defined peak of 3:00 – 6:00 PM during summer weekdays. Peak kW savings are calculated as:

$$Peak\ kW\ Savings = (kW_{base} - kW_{post}) * HCDF * PCF$$

Parameters for Peak Demand (kW) Savings Calculation of Lighting Retrofit Measures

kW_{base}	Total Baseline fixtures x $W/Fixture_{base}$ / 1000 W/kW
kW_{post}	Total Installed fixtures x $W/Fixture_{post}$ / 1000 W/kW
PCF	Peak Coincident Factor, % Time During the Peak Period in Which Lighting is Operating
HCDF	Heating Cooling Demand Interactive Factor

Lighting Retrofit kWh Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours		Expected kWh Savings	Realized kWh Savings	HCEF	Realization Rate
	Base	Post	Base	Post	Base	Post				
400W metal halide to 122W LED	14	14	453	122	4,313	4,313	20,358	19,985	1.000	98.2%
						Total	**20,358**	**19,985**		**98.2%**

Lighting Retrofit kW Savings Calculations

Measure	Quantity (Fixtures)		Wattage		PCF		Expected kW Savings	Realized kW Savings	HCDF	Realization Rate
	Base	Post	Base	Post	Base	Post				
400W metal halide to 122W LED	14	14	453	122	0.00	0.00	4.65	0.00	1.000	0.0%
						Total	**4.65**	**0.00**		**0.0%**

Results

The kWh realization rate for project OID 2528760 is 98.2% and the kW realization rate is 0%. The kWh realization rate is low because of a change in the annual operating hours of the lighting fixtures compared to that which was used in Ex Ante calculations. Ex Ante calculations used 4,380 as the annual hours of operation for outdoor fixtures; this was changed to 4,313 in Ex Post calculations.

The kW realization rate is 0% because a coincidence factor of 0.0 was used for Ex Post calculations. This coincidence factor was used because the lights are outdoors and operate from dusk to dawn. Ex Ante calculations used a coincidence factor of 1.

Verified Gross Savings & Realization Rates

Measure	Verified			
	kWh Savings	kW Savings	kWh Realization Rate	kW Realization Rate
400W metal halide to 122W LED	19,985	0.00	98.2%	0.0%
Total	**19,985**	**0.00**	**98.2%**	**0.0%**

Project Number OID 2537846
Program Business Custom Efficiency

Project Background

The participant is an office building that received incentives from Xcel for implementing energy efficient lighting on the exterior of the facility. On-site, the evaluators verified the participant had installed:

- (9) 81.45 LED Flood Lights, replacing (9) 400W Metal Halide lamps.

M&V Methodology

The evaluators confirmed installation of all fixtures listed in the project application. Savings for the lighting measures were calculated using New Mexico TRM deemed values by space type for hours of use, along with a stipulated Peak Coincident Factor (PCF), Heating Cooling Energy Factor (HCEF) and Heating Cooling Demand Factor (HCDF) determined using local weather data and Xcel peak parameters. The deemed values used in calculating savings are presented in the table below.

Deemed Savings Parameters

Building Type	*Space Type*	*Annual Hours – Non-CFLs*	*Annual Hours – CFLs*	*HCEF*	*HCDF*	*PCF*
Office Building	Exterior	4,313	4,313	1.00	1.00	0

Savings Calculations

Using deemed values from the table above, the evaluators calculated lighting savings as follows:

$$Annual\ kWh\ Savings = \left(kW_{base} * Hours_{base} - kW_{post} * Hours_{post}\right) * HCEF$$

Parameters for kWh Savings Calculation of Lighting Retrofit Measures

kW_{base}	Total Baseline fixtures x $W/Fixture_{base}$ / 1000 W/kW
kWpost	Total Installed fixtures x $W/Fixture_{post}$ / 1000 W/kW
$Hours_{base}$	Annual Hours of Operation of Baseline Fixtures
$Hours_{post}$	Annual Hours of Operation of Installed Fixtures
HCEF	Heating/Cooling Energy Interactive Factor

Following this, the evaluators calculated peak kW savings. This is based upon a Xcel-defined peak of 3:00 – 6:00 PM during summer weekdays. Peak kW savings are calculated as:

$$Peak\ kW\ Savings = (kW_{base} - kW_{post}) * HCDF * PCF$$

Parameters for Peak Demand (kW) Savings Calculation of Lighting Retrofit Measures

kW_{base}	Total Baseline fixtures x $W/Fixture_{base}$ / 1000 W/kW
kW_{post}	Total Installed fixtures x $W/Fixture_{post}$ / 1000 W/kW
PCF	Peak Coincident Factor, % Time During the Peak Period in Which Lighting is Operating
HCDF	Heating Cooling Demand Interactive Factor

Lighting Retrofit kWh Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours		Expected kWh Savings	Realized kWh Savings	HCEF	Realization Rate
	Base	Post	Base	Post	Base	Post				
400W metal halide to 84W LED	9	9	453	81	4,313	4,313	14,686	14,421	1.000	98.2%
						Total	**14,686**	**14,421**		**98.2%**

Lighting Retrofit kW Savings Calculations

Measure	Quantity (Fixtures)		Wattage		PCF		Expected kW Savings	Realized kW Savings	HCDF	Realization Rate
	Base	Post	Base	Post	Base	Post				
400W metal halide to 84W LED	9	9	453	81	0.00	0.00	3.35	0.00	1.000	0.0%
						Total	**3.35**	**0.00**		**0.0%**

Results

The kWh realization rate for project OID 2537849 is 98.2% and the kW realization rate is 0.0%. The kWh savings are different than expected because of a change in the facility's annual hours of operation and a change in the wattage of the baseline fixture used to calculate savings. Ex Ante calculations listed the fixture's annual hours of operation as 3,432. This was changed to 4,313 in Ex Post calculations. The wattage of the baseline fixture used to calculate Ex Ante savings was 400W. This was changed to 453W Ex Post.

The kW realization rate is 0% because Ex Ante calculations used a value of 1.0 for the coincidence factor. This was changed to 0 in Ex Post calculations to take into account the fact that the fixtures are located outside and operate from dusk to dawn.

Verified Gross Savings & Realization Rates

Measure	Verified			
	kWh Savings	kW Savings	kWh Realization Rate	kW Realization Rate
400W metal halide to 84W LED	14,421	0.00	98.2%	0.0%
Total	**14,421**	**0.00**	**98.2%**	**0.0%**

Project Number OID 2588812
Program Business Lighting Efficiency

Project Background

The participant is a motel which received incentives from Xcel for implementing energy efficient lighting in guest rooms. On-site, the evaluators verified the participant had installed:

- (117) 9W LED fixtures, replacing (117) 13W CFL fixtures;
- (71) 9W LED fixtures, replacing (71) 13W CFL fixtures.

M&V Methodology

The evaluators confirmed installation of all fixtures listed in the project application. Savings for the lighting measures were calculated using New Mexico TRM deemed values by space type for hours of use, along with a stipulated Peak Coincident Factor (PCF), Heating Cooling Energy Factor (HCEF) and Heating Cooling Demand Factor (HCDF) determined using local weather data and NM peak parameters. The deemed values used in calculating savings are presented in the table below.

Deemed Savings Parameters

Building Type	*Space Type*	*Annual Hours – Non-CFLs*	*Annual Hours – CFLs*	*HCEF*	*HCDF*	*PCF*
Office Building	Exterior	4,313	4,313	1.00	1.00	0

Savings Calculations

Using deemed values from the table above, the evaluators calculated lighting savings as follows:

$$Annual\ kWh\ Savings = \left(kW_{base} * Hours_{base} - kW_{post} * Hours_{post}\right) * HCEF$$

Parameters for kWh Savings Calculation of Lighting Retrofit Measures

kW_{base}	Total Baseline fixtures x $W/Fixture_{base}$ / 1000 W/kW
kWpost	Total Installed fixtures x $W/Fixture_{post}$ / 1000 W/kW
$Hours_{base}$	Annual Hours of Operation of Baseline Fixtures
$Hours_{post}$	Annual Hours of Operation of Installed Fixtures
HCEF	Heating/Cooling Energy Interactive Factor

Following this, the evaluators calculated peak kW savings. This is based upon a Xcel-defined peak of 3:00 – 6:00 PM during summer weekdays. Peak kW savings are calculated as:

$$Peak\ kW\ Savings = (kW_{base} - kW_{post}) * HCDF * PCF$$

Parameters for Peak Demand (kW) Savings Calculation of Lighting Retrofit Measures

kW_{base}	Total Baseline fixtures x $W/Fixture_{base}$ / 1000 W/kW
kW_{post}	Total Installed fixtures x $W/Fixture_{post}$ / 1000 W/kW
PCF	Peak Coincident Factor, % Time During the Peak Period in Which Lighting is Operating
HCDF	Heating Cooling Demand Interactive Factor

Lighting Retrofit kWh Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours		Expected kWh Savings	Realized kWh Savings	CEF	kWh Realization Rate
	Base	Post	Base	Post	Base	Post				
13W CFL to 9W LED	117	117	13	9	755	755	8,047	485	1.372	6.0%
13W CFL to 9W LED	71	71	13	9	755	755	4,884	294	1.372	6.0%
	Total						**12,931**	**779**		**6.0%**

Lighting Retrofit kW Savings Calculations

Measure	Quantity (Fixtures)		Wattage		PCF		Expected kW Savings	Realized kW Savings	CDF	kW Realization Rate
	Base	Post	Base	Post	Base	Post				
13W CFL to 9W LED	117	117	13	9	0.08	0.08	1.62	0.05	1.295	3.1%
13W CFL to 9W LED	71	71	13	9	0.08	0.08	0.98	0.03	1.295	3.1%
	Total						**2.60**	**0.08**		**3.1%**

Results

The kWh realization rate for project #OID 2588812 is 6% and the kW realization rate is 3.1%. This project has lower realization rate because the bulbs are installed in guestrooms rather than common space. Hotel and motel common space would have 8,760 hours of operation but guestroom on average operates 755 hours annually.

Verified Gross Savings & Realization Rates

Measure	Verified			
	kWh Savings	kW Savings	kWh Realization Rate	kW Realization Rate
13W CFL to 9W LED	485	0.05	6.0%	3.1%
13W CFL to 9W LED	294	0.03	6.0%	3.1%
Total	**779**	**0.08**	**6.0%**	**3.1%**

Project Number OID 2469017
Program Business Lighting Efficiency

Project Background

The participant is a farm which received incentives from Xcel for implementing energy efficient lighting in exterior spaces. On-site, the evaluators verified the participant had installed:

- (8) 17W LED fixtures, replacing (8) 120W incandescent fixtures.

M&V Methodology

The evaluators confirmed installation of all fixtures listed in the project application. Savings for the lighting measures were calculated using New Mexico TRM deemed values by space type for hours of use, along with a stipulated Peak Coincident Factor (PCF), Heating Cooling Energy Factor (HCEF) and Heating Cooling Demand Factor (HCDF) determined using local weather data and NM peak parameters. The deemed values used in calculating savings are presented in the table below.

Deemed Savings Parameters

Building Type	*Space Type*	*Annual Hours – Non-CFLs*	*HCEF*	*HCDF*	*PCF*
Storage	Unconditioned	3,441	1.00	1.00	0.70

Savings Calculations

Using deemed values from the table above, the evaluators calculated lighting savings as follows:

$$Annual\ kWh\ Savings = \left(kW_{base} * Hours_{base} - kW_{post} * Hours_{post}\right) * HCEF$$

Parameters for kWh Savings Calculation of Lighting Retrofit Measures

kW_{base}	Total Baseline fixtures x $W/Fixture_{base}$ / 1000 W/kW
kWpost	Total Installed fixtures x $W/Fixture_{post}$ / 1000 W/kW
$Hours_{base}$	Annual Hours of Operation of Baseline Fixtures
$Hours_{post}$	Annual Hours of Operation of Installed Fixtures
HCEF	Heating/Cooling Energy Interactive Factor

Following this, the evaluators calculated peak kW savings. This is based upon a Xcel-defined peak of 3:00 – 6:00 PM during summer weekdays. Peak kW savings are calculated as:

$$Peak\ kW\ Savings = (kW_{base} - kW_{post}) * HCDF * PCF$$

Parameters for Peak Demand (kW) Savings Calculation of Lighting Retrofit Measures

kW_{base}	Total Baseline fixtures x $W/Fixture_{base}$ / 1000 W/kW
kW_{post}	Total Installed fixtures x $W/Fixture_{post}$ / 1000 W/kW
PCF	Peak Coincident Factor, % Time During the Peak Period in Which Lighting is Operating
HCDF	Heating Cooling Demand Interactive Factor

Lighting Retrofit kWh Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours		Expected kWh Savings	Realized kWh Savings	CEF	kWh Realization Rate
	Base	Post	Base	Post	Base	Post				
120W incandescent to 17W LED	8	8	120	17	3,441	3,441	1,416	2,835	1.000	200.2%
	Total						**1,416**	**2,835**		**200.2%**

Lighting Retrofit kW Savings Calculations

Measure	Quantity (Fixtures)		Wattage		PCF		Expected kW Savings	Realized kW Savings	CDF	kW Realization Rate
	Base	Post	Base	Post	Base	Post				
120W incandescent to 17W LED	8	8	120	17	0.70	0.70	0.44	0.58	1.000	131.8%
	Total						**0.44**	**0.58**		**131.8%**

Results

The kWh realization rate for project #OID 2469017 is 200.2% and the kW realization rate is 131.8%. The kWh realization rate was higher because the annual hours of operation was increased to 3,441.

Verified Gross Savings & Realization Rates

Measure	Verified			
	kWh Savings	kW Savings	kWh Realization Rate	kW Realization Rate
120W incandescent to 17W LED	2,835	0.58	200.2%	131.8%
Total	**2,835**	**0.58**	**200.2%**	**131.8%**

Project Number OID 2588745
Program Business Lighting Efficiency

Project Background

The participant is a retail facility that received incentives from Xcel for implementing energy efficient lighting. On-site, the evaluators verified the participant had installed:

- (10) 9W LED fixtures, replacing (10) 60W Incandescent fixtures.

M&V Methodology

The evaluators found some lighting fixture counts deviated from those listed in the project application. Verified fixture counts were used in ex post savings calculations. Savings for the lighting measures were calculated using New Mexico TRM deemed values by space type for hours of use, along with a stipulated Peak Coincident Factor (PCF), Heating Cooling Energy Factor (HCEF) and Heating Cooling Demand Factor (HCDF) determined using local weather data and Xcel peak parameters. The deemed values used in calculating savings are presented in the table below.

Deemed Savings Parameters

Building Type	*Space Type*	*Annual Hours – Non-CFLs*	*Annual Hours – CFLs*	*HCEF*	*HCDF*	*PCF*
Large Single Story Retail	Office	2,714	2,714	1.230	1.348	0.88
Large Single Story Retail	Storage (Conditioned)	2,663	2,663	1.230	1.348	0.88
Large Single Story Retail	Exterior	4,313	4,313	1.00	1.00	0.0

Savings Calculations

Using deemed values from the table above, the evaluators calculated lighting savings as follows:

$$Annual\ kWh\ Savings = \left(kW_{base} * Hours_{base} - kW_{post} * Hours_{post}\right) * HCEF$$

Parameters for kWh Savings Calculation of Lighting Retrofit Measures

kW_{base}	Total Baseline fixtures x $W/Fixture_{base}$ / 1000 W/kW
kWpost	Total Installed fixtures x $W/Fixture_{post}$ / 1000 W/kW
$Hours_{base}$	Annual Hours of Operation of Baseline Fixtures
$Hours_{post}$	Annual Hours of Operation of Installed Fixtures
HCEF	Heating/Cooling Energy Interactive Factor

Following this, the evaluators calculated peak kW savings. This is based upon a Xcel-defined peak of 3:00 – 6:00 PM during summer weekdays. Peak kW savings are calculated as:

$$Peak\ kW\ Savings = (kW_{base} - kW_{post}) * HCDF * PCF$$

Parameters for Peak Demand (kW) Savings Calculation of Lighting Retrofit Measures

kW_{base}	Total Baseline fixtures x $W/Fixture_{base}$ / 1000 W/kW
kW_{post}	Total Installed fixtures x $W/Fixture_{post}$ / 1000 W/kW
PCF	Peak Coincident Factor, % Time During the Peak Period in Which Lighting is Operating
HCDF	Heating Cooling Demand Interactive Factor

Lighting Retrofit kWh Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours		Expected kWh Savings	Realized kWh Savings	HCEF	Realization Rate
	Base	Post	Base	Post	Base	Post				
60W incandescent to 9W LED	10	10	43	9	2,714	2,714	891	1,135	1.230	127.4%
14W CFL to 9W LED	0	0	14	9	2,738	2,738	52	0	1.230	0.0%
65W incandescent to 9W LED	0	0	65	9	4,313	4,313	147	0	1.000	0.0%
						Total	**1,090**	**1,135**		**104.1%**

Lighting Retrofit kW Savings Calculations

Measure	Quantity (Fixtures)		Wattage		PCF		Expected kW Savings	Realized kW Savings	HCDF	Realization Rate
	Base	Post	Base	Post	Base	Post				
60W incandescent to 9W LED	10	10	43	9	0.88	0.88	0.18	0.40	1.348	222.5%
14W CFL to 9W LED	0	0	14	9	0.88	0.88	0.01	0.00	1.348	0.0%
65W incandescent to 9W LED	0	0	65	9	0.00	0.00	0.03	0.00	1.000	0.0%
						Total	**0.22**	**0.40**		**181.8%**

Results

The kWh realization rate for project OID 2588745 is 104.1% and the kW realization rate is 181.8%.

On-site inspection revealed that several fixtures listed on the project application had not been installed. In addition, evaluators were unable to re-create Ex Ante calculations.

Verified Gross Savings & Realization Rates

Measure	***Verified***			
	kWh Savings	***kW Savings***	***kWh Realization Rate***	***kW Realization Rate***
60W incandescent to 9W LED	1,135	0.40	127.4%	222.5%
14W CFL to 9W LED	0	0.00	0.0%	0.0%
65W incandescent to 9W LED	0	0.00	0.0%	0.0%
Total	**1,135**	**0.40**	**104.1%**	**181.8%**

Project Number OID2523908
Program Business Cooling Efficiency

EXECUTIVE SUMMARY

The participant is a bank that received incentives from Xcel for the installation of three high efficiency rooftop units. On site ADM verified installation of all three rooftop units and unit specifications matched project documentation. Gross kWh realization for this project is 117%.

M&V METHODOLOGY

During the site visit, ADM verified the installation of (1) 3.96 Ton DX Rooftop unit and (2) 1.97 Ton DX rooftop units. ADM used the New Mexico technical assumptions for cooling efficiency to calculate the savings for this project.

SAVINGS CALCULATIONS

ADM verified this facility operates similar to office rather than retail in technical assumptions based on interviews.

The deemed savings calculation listed on the technical assumptions for cooling efficiency is as follows,

$$kWh_{Savings} = Ton \times EFLH \times \left(\frac{12}{SEER_{Baseline}} - \frac{12}{SEER_{New}}\right)$$

$$kW_{Reduction} = Ton \times \left[\frac{(12 \times OA_{Correction})}{EER_{Baseline}} - \frac{12}{EER_{New}}\right]$$

Where,

Ton = *Rated cooling capacity in tons*
EFLH = *Equivalent full load hours for offices, 1,900 hours*
$SEER_{Baseline}$ = *Baseline seasonal energy efficiency ratio*
$SEER_{New}$ = *New seasonal energy efficiency ratio*
$EER_{Baseline}$ = *Baseline energy efficiency ratio*
EER_{New} = *New energy efficiency ratio*
$OA_{correction}$ = *Rated outside air correction term, 1.139425*

Compute all parameters, the savings is

Savings from the high efficiency chiller

Qty	Ton	EFLH	$SEER_{Baseline}$	$SEER_{New}$	kWh Savings
1	3.96	1,900	13.00	14.00	496.09
2	1.97	1,900	13.00	14.50	714.84
				Total	**1,210.93**

Peak demand reduction from the high efficiency chiller

Qty	Ton	$EER_{Baseline}$	EER_{New}	$OA_{Correction}$	kW Reduction
2	3.96	11.10	11.90	0.646	0.88
1	1.97	11.10	12.33	0.646	1.02
				Total	**1.90**

RESULTS

It was calculated that the installation of the high efficiency chiller decreases annual energy consumption by 1,211 kWh and a demand reduction of 1.90 kW resulting in a realization rate of 117%.

Verified Gross Savings & Realization Rates

Type	***Claimed***		***Verified***			
	kWh Savings	***kW Savings***	***kWh Savings***	***kW Savings***	***Realization Rate kWh***	***Realization Rate kW***
High Efficiency RTUs	1,035	0.76	1,211	1.90	117%	250%
Total	**1,035**	**0.76**	**1,211**	**1.90**	**117%**	**250%**

ADM used the cooling efficiency technical assumption method. AHRI certification cooling efficiency and SEER values for measure units were used which were identical to ex ante. ADM was not able to recreate ex ante savings using information from the application to identify the source of difference.

Project Number OID 2573057
Program Business Lighting Efficiency

Project Background

The participant is a fast food facility that received incentives from Xcel for implementing energy efficient lighting. On-site, the evaluators verified the participant had installed:

- (16) 9W LED fixtures, replacing (13) CFL fixtures.

M&V Methodology

The evaluators found that the lighting fixture count deviated from the 13 pre-existing fixtures to be replaced listed in the project application. Verified fixture counts were used in ex post savings calculations. Savings for the lighting measures were calculated using New Mexico TRM deemed values by space type for hours of use, along with a stipulated Peak Coincident Factor (PCF), Heating Cooling Energy Factor (HCEF) and Heating Cooling Demand Factor (HCDF) determined using local weather data and Xcel peak parameters. The deemed values used in calculating savings are presented in the table below.

Deemed Savings Parameters

Building Type	*Space Type*	*Annual Hours – Non-CFLs*	*Annual Hours – CFLs*	*HCEF*	*HCDF*	*PCF*
Fast Food	Dining Area	4,850	4,850	1.243	1.277	0.81

Savings Calculations

Using deemed values from the table above, the evaluators calculated lighting savings as follows:

$$Annual\ kWh\ Savings = \left(kW_{base} * Hours_{base} - kW_{post} * Hours_{post}\right) * HCEF$$

Parameters for kWh Savings Calculation of Lighting Retrofit Measures

kW_{base}	Total Baseline fixtures x $W/Fixture_{base}$ / 1000 W/kW
kWpost	Total Installed fixtures x $W/Fixture_{post}$ / 1000 W/kW
$Hours_{base}$	Annual Hours of Operation of Baseline Fixtures
$Hours_{post}$	Annual Hours of Operation of Installed Fixtures
HCEF	Heating/Cooling Energy Interactive Factor

Following this, the evaluators calculated peak kW savings. This is based upon a Xcel-defined peak of 3:00 – 6:00 PM during summer weekdays. Peak kW savings are calculated as:

$$Peak\ kW\ Savings = (kW_{base} - kW_{post}) * HCDF * PCF$$

Parameters for Peak Demand (kW) Savings Calculation of Lighting Retrofit Measures

kW_{base}	Total Baseline fixtures x $W/Fixture_{base}$ / 1000 W/kW
kW_{post}	Total Installed fixtures x $W/Fixture_{post}$ / 1000 W/kW
PCF	Peak Coincident Factor, % Time During the Peak Period in Which Lighting is Operating
HCDF	Heating Cooling Demand Interactive Factor

Lighting Retrofit kWh Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours		Expected kWh Savings	Realized kWh Savings	HCEF	Realization Rate
	Base	Post	Base	Post	Base	Post				
CFL to 9W LED	13	16	23	9	4,850	4,850	894	934	1.243	104.5%
						Total	**894**	**934**		**104.5%**

Lighting Retrofit kW Savings Calculations

Measure	Quantity (Fixtures)		Wattage		PCF		Expected kW Savings	Realized kW Savings	HCDF	Realization Rate
	Base	Post	Base	Post	Base	Post				
CFL to 9W LED	13	16	23	9	0.81	0.81	0.18	0.16	1.277	88.9%
						Total	**0.18**	**0.16**		**88.9%**

Results

The kWh realization rate for project OID 2573057 is 104.5% and the kW realization rate is 88.9%. The kWh realization rate is high because on-site inspections revealed that one of the new lamps had burned out and not been replaced. Evaluators were unable to recreate Ex Ante kW estimates.

Verified Gross Savings & Realization Rates

Measure	Verified			
	kWh Savings	kW Savings	kWh Realization Rate	kW Realization Rate
CFL to 9W LED	934	0.16	104.5%	88.9%
Total	**934**	**0.16**	**104.5%**	**88.9%**