Evaluation of 2016 DSM Portfolio: New Mexico Gas Company

Prepared for

New Mexico Gas Company

June 2017

Final

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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 New Mexico Gas Company (NMGC). In 2016, the NMGC portfolio consisted of four residential and one non-residential programs. ADM estimated gross realization, net savings, and cost-effectiveness for tree evaluated programs.

1.1 Summary of NMGC 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 NMGC DSM portfolio contained the following programs:

- Low Flow Showerheads;
- Low Income Weatherization;
- ENERGY STAR Heating;
- ENERGY STAR Water Heating; and
- Efficient Buildings;

For 2016, ADM evaluated a subset of the portfolio. The programs evaluated for this program year include:

- ENERGY STAR Heating;
- Low Flow Showerheads; and
- Efficient Buildings;

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 Utility Cost Test (UCT); 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 selected programs. Table 1-1 and 1-2 below present the gross and net impact by program.

Table 1-1 Gross Impact Summary

Program	Annual Energy Saving (Therms)		Lifetime Energy Savings (Therms)		Gross Realization Rate
	Expected	Realized	Expected	Realized	
ENERGY STAR Space Heating	123,019	123,418	2,413,800	2,423,869	100.32%
ENERGY STAR Water Heating	53,055	53,055	1,061,100	1,061,100	100.00%
Low Flow Showerhead	170,857	114,128	1,708,560	831,314	66.80%
Low Income Weatherization	184,503	184,503	3,383,824	3,383,824	100.00%
Efficient Buildings	443,239	438,014	6,336,288	6,231,284	98.82%
Total	974,673	913,118	14,903,572	13,931,391	93.68%

Table 1-2 Net Impact Summary

Program	Annual Energy Saving (Therms)		Lifetime Energy Savings (Therms)		Net Realization Rate
	Expected	Realized	Expected	Realized	
ENERGY STAR Space Heating	97,416	88,012	1,906,055	1,731,377	90.35%
ENERGY STAR Water Heating	42,444	42,444	848,880	848,880	100.00%
Low Flow Showerhead	102,514	107,926	1,025,130	783,505	105.28%
Low Income Weatherization	184,503	184,503	3,383,824	3,383,824	100.00%
Efficient Buildings	357,178	362,837	5,094,540	5,157,223	101.58%
Total	784,055	785,722	12,258,429	11,904,809	100.21%

Additionally, the Evaluators estimated cost-effectiveness of the 2016 programs and overall portfolio using the Utility Cost (UCT) test. The results are provided in Table 1-3 below.

Table 1-3 Cost Effectiveness Testing by Program

Program	NPV of UCT Benefits	NPV of UCT Costs	UCT
ENERGY STAR Space Heating	$989,512	$800,071	1.24
ENERGY STAR Water Heating	$484,809	$466,313	1.04
Low Flow Showerhead	$474,710	$278,241	1.71
Low Income Weatherization	$2,327,993	$1,677,950	1.39
Efficient Buildings	$3,002,024	$1,016,268	2.95
Portfolio Costs	$0	$132,713	-
Total	$7,279,048	$4,371,557	1.67

1.4 Program Findings

The Evaluators' findings for the 2016 NMGC DSM portfolio are as follows:

- The portfolio as a whole performed well and passed cost-effectiveness testing. All programs passed the UCT and TRC tests.
- NMGC has successfully engaged in cross-fuel promotion and implementation with PNM. Examples of this have included:
    - Co-funding showerhead kits delivered through PNM's Low Income Easy Savings Program for homes with natural gas water heating;
    - Co-funding the direct install activities in PNM's Home Energy Checkup Program for homes with natural gas water heating;
    - Using PNM's Home Energy Check-up Program to facilitate participation in NMGC's prescriptive insulation incentives when the home has gas space heating. 5.5% of NMGC insulation participants were referrals from PNM's program (this constituted 70% of PNM's insulation participants).
- Participation in Efficient Buildings was largely driven by custom projects. One project accounted for 25% of program savings. The program produced a significant number of custom projects in the 2016 program year, with facility audits yielding an increasing volume of high-return projects.
- Approaches for boiler retrofit projects in Efficient Buildings were inconsistent. Boiler retrofit projects displayed inconsistency in approaches by implementation staff; not all projects completed appropriate weather normalization, and it was not apparent when a project was using an early retirement baseline.
- Efficient Buildings Program participant tracking information was often not populated. The Evaluators needed to submit a supplementary request to implementation staff to receive contact names and phone numbers for completed projects.
- The insulation measure has a significant share of low income participation. 9.23% of survey respondents from the insulation program channel gave answers for income and household occupants that would put the household below 200% of the federal poverty limit. These customers would potentially be eligible for higher service levels through NMGC's Low Income Weatherization Program.

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

The following glossary details the definitions of terms used in this report:

- *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 by the Evaluators following completion of the EM&V 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 14 Therms 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 verifies 12 Therms per showerhead, Gross Realization Rate = 12/14 = 86%)
- *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, (e.g., if Free-Ridership for low-flow showerheads = 50%, net savings = 12 Therms x 50% = 6 Therms
- *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 Therms* = Ex Post Gross Savings x EUL
- *UCT – Utility Cost Test, taking the ratio of net benefits to the utility divided by net costs to the utility.*

2.2 Overview of Methodology

The Evaluators methodology for this EM&V of the 2016 NMGC 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. By leveraging experience and lessons learned from impact evaluation of prior program years, we have been able to expand upon the 2015 evaluation effort, in order to use the results of this impact evaluation to better inform NMGC as to methods by which program and portfolio performance could be improved.

2.3 Sampling

Sampling is necessary to evaluate savings for the NMGC 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

2.4 Census of Participants

A census of participant data was used for select programs where such review is feasible. For example, Residential Insulation was evaluated by calculating participant-specific Therms savings based upon weather zone, baseline R-value, post R-value, and square footage.

2.4.1 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:

$$CV(x) = \frac{Standard\ Deviation\ (x)}{Mean(x)}$$

where x is the average Therms 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, as per guidelines set in the California Evaluation Framework. 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.

2.4.2 Stratified Random Sampling

For the NMGC 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 Efficient Buildings Program had 59 projects and a CV of 2.48 at year's end. Using the base simple random sample function, this would require selecting 57 of 59 projects for the M&V sample, which would be prohibitively expensive.

To address this situation, we use a sample design for selecting projects for the M&V sample that takes the skewed distribution 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 the EBP was reduced to 14.

2.4.3 Free-Ridership

In determining ex post net savings for the NMGC 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, the Evaluators 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 Therms 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

2.5 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.

2.5.1 Telephone Surveying

The Evaluators conducted telephone surveys in evaluating the 2016 NMGC DSM portfolio. 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;
- Data on decision-making to be used in determining program free-ridership; and
- Feedback from participants from their experiences with the program.

Table 2-1 below presents the total surveys conducted by program.

Table 2-1 Telephone Surveys by Program

Program	Surveys
Energy Star Space Heating	122
Efficient Buildings	0
Low Flow Showerheads	80
Total Surveys:	202

Surveys with business program participants, NMGC staff, 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.

2.5.2 Onsite Visits

On-site data collection procedures varied by program. For residential programs, site visits constituted a verification inspection of rebated equipment. For business participants, ADM conducted onsite metering at facilities where factors contributing to energy savings, including lighting schedule and motor load factors, were subject to high uncertainty. Table 2-2 below provides a summary of on-site visits by program.

Table 2-2 Summary of Site Visits by Program

Program	# Site Visits
Energy Star Space Heating	0
Efficient Buildings	14
Low Flow Showerheads	0
Total	14

2.6 Cost Effectiveness Testing

The Evaluators performed cost-effectiveness testing at the program and portfolio levels. The Evaluators performed the Utility Cost test (UCT).

The UCT value is defined as:

$$UCT = \frac{\text{Gas Cost Decrease}}{\text{Utilty Equipment Expenditures} + \text{Utility Administrative Cost}}$$

The parameters for this equation are defined in

Table *2-3* below.

Table 2-3 Parameters for UCT Testing

Parameter	***Definition***
GCD	Gas Cost Decrease: NPV of gas savings created incidentally by electric DSM programs (from measures such as weatherization, low-flow showerheads, etc.). Estimated by taking NPV of net Therms savings multiplied by $/Therm of gas production/distribution by gas utilities serving the NMGC territory.
UEE	Utility Equipment Expenditures: Incentives paid to program participants for energy efficient equipment.
UAC	Utility Administrative Costs: Costs accrued by NMGC 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. ENERGY STAR Heating

3.1 Program Description

The ENERGY STAR Heating Program (ESHP) provides incentives for high efficiency furnaces in retrofit and new construction applications. Available incentives include:

- Retrofit:
  - $275 for 90% AFUE;
  - $325 for 92% AFUE; and
  - $375 for 95% AFUE.
- New Construction:
  - $200 for 90% AFUE;
  - $250 for 92% AFUE; and
  - $300 for 95% AFUE.

3.2 M&V Methodology

The M&V approach for the ESHP is aimed at the following:

- Application of NM TRM values for furnace retrofits;
- Verifying installation of the furnaces through participant surveying; and
- Determining the program NTGR.

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

Table 3-1 Sources for Gross Impact Parameters – ESHP

Parameter	***Source***
Equipment Quantities & Specifications	Program tracking data
Unit energy savings	NM TRM
Retrofit NTGR	Participant surveys
New Construction NTGR	Builder interviews

3.2.1 Participation Summary

The 2016 ESHP had a total of 1,667 processed rebates.

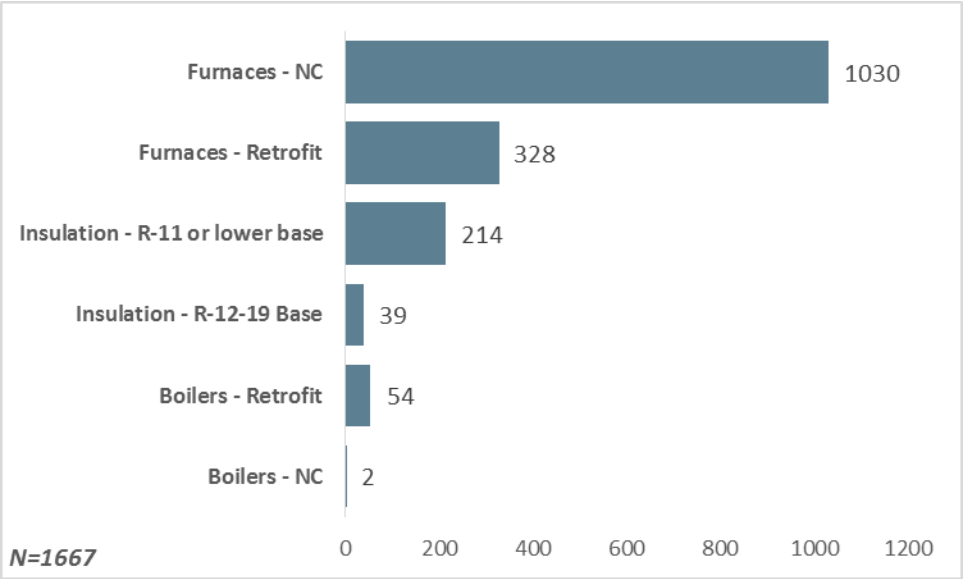


Figure 3-1 ESHP Participation Summary

3.3 ENERGY STAR Heating Impact Evaluation

3.3.1 ESHP Verification of Installation

The Evaluators conducted surveys with

- 47 furnace retrofit participants;
- 8 boiler retrofit participants;
- 65 insulation participants;
- 2 home builders

In these surveys, the Evaluators verified installation of the furnace and collected data needed for free-ridership and process evaluation activities.

3.3.2 Validated Unit Energy Savings

The Evaluators applied NM TRM values for furnaces to each line item in the program tracking data. Initially, the ability to apply these values was constrained however by the quality of tracking. ICF's tracking database lists each furnace in a qualitative manner. For example, instead of listing the actual rated AFUE of a furnace, a furnace would instead be listed as "92% AFUE or Greater". However, after subsequent data requests to NMGC and ICF, precise AFUEs were provided for the rebated units, allowing the Evaluators to fully-credit Therms savings.

Figure 3-2 summarizes the gross savings realization by measure category for the ESHP. Overall realization was 99.9%, and was consistently high across all categories (ranging from 99.6% to 101.1%).

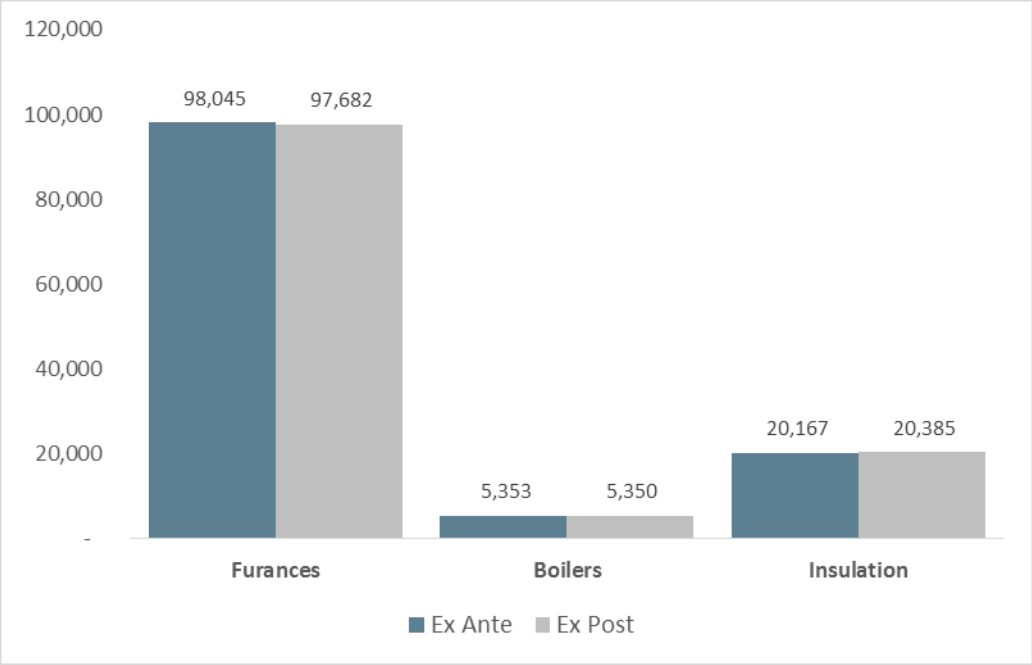


Figure 3-2 ESHP Gross Savings Summary

3.3.3 Free-Ridership

3.3.3.1 Retrofit Free-Ridership

Free-ridership estimates for residential participants in the ESHP were developed through combined scoring of the survey respondents and of participating HVAC vendors. This section will detail the questions and answers from the participant survey that contributed to the participant response portion of the program free-rider scoring.

Q-6 When did you decide to buy a high efficiency furnace? Was it…

- ❑ Before deciding to purchase a high efficiency furnace
- ❑ At the same time as deciding to purchase a high efficiency furnace
- ❑ After you decided to purchase a high efficiency furnace
- ❑ After the furnace was installed

Table 3-2 Timing of Decision to Purchase High Efficiency Relative

Timing	***%***
Before deciding to purchase a high efficiency furnace	28.2%
At the same time as deciding to purchase a high efficiency furnace	42.2%
After deciding to purchase a high efficiency furnace	12.3%
After the furnace was installed	12.3%
n=57	

Q-13 How important was the rebate from New Mexico Gas in your decision to buy the high efficiency space heating equipment?

When prompted to discuss the rebate, 29.8% of respondents indicated that the rebate was "very important" in their decision to purchase a high efficiency furnace. Thirty-five percent stated that the rebate was "somewhat important', 5.3% stated "only slightly important", and 19.3% indicated that it was "not important at all".

Q-16 Would you have been financially able to purchase the high efficiency furnace if you did not receive the rebate from New Mexico Gas?

- ❑ Yes
- ❑ No – ASK Q-11a
- ❑ Don't know

Ninety-three percent of respondents indicated that they would have been financially able to purchase the furnace without a program rebate. Those that indicated that they would have been financially able were then asked Q-17.

Q-17 When deciding about the furnace, did you purchase a more efficient furnace than you would have because of the program rebate?

Forty-four percent of respondents that were financially able indicated that the rebate motivated them to purchase a more efficient unit than they otherwise would have.

Q-18 If you had not received the New Mexico Gas rebate, how likely is it that you would have installed the same high efficiency space heating equipment anyway?

- ❑ Definitely would have installed
- ❑ Probably would have installed
- ❑ Probably would not have installed
- ❑ Definitely would not have installed
- ❑ Don't know (*don't read*)

Sixty percent stated that they "definitely would have installed", 27.3% that they "probably would have installed", 310.9% "probably would not have installed", and 1.8% stated that they "definitely would not have installed" a high efficiency furnace without a program rebate.

Q-19 If you had not installed the high efficiency space heating equipment through the program, would you have installed standard efficiency equipment instead?

- ❑ Yes
- ❑ No
- ❑ Don't know

Thirty-seven percent stated that they would have installed a standard efficiency furnace without the program.

The scoring for NTGR was completed as follows:

Table 3-3 Timing of Decision to Purchase High Efficiency Relative

Parameter Type	*NTGR Component*	*NTGR Effect*
Gate Values occur automatically and override other questions	Learned of program after having installed furnace	Automatic 0% NTGR
	Would not have been financially able to purchase high efficiency equipment without rebate	Automatic 100% NTGR
Additive Values - sum the effects of these three if neither gated value triggers	No prior plans for high efficiency equipment	33% NTGR
	Stated importance of financial incentive	33% NTGR
	Stated alternative of standard efficiency equipment	33% NTGR

Based off these combined answers, the Evaluators verified a NTGR of 83.6% for the retrofit component.

3.3.3.2 New Construction Free-Ridership

A small group of home builders are responsible for a significant share of the EHSP program savings. The Evaluators sent an email survey to participating builders. Many of the builders that had replied to surveys in the last evaluation of the EHSP did not respond to the Evaluators' survey this year. The non-responses included builders that account for over 75% of the rebated furnaces (these builders had replied in the last evaluation). Given these effects the Evaluators elected to not revise the NTGR for new construction projects. The NTGR of 67.2% that was found in the 2014 evaluation was applied to 2016.

3.3.3.3 Insulation Free-Ridership

The Evaluators surveyed 65 insulation participants. These participants were asked the same battery of questions as furnace respondents. Key data points include:

- 29.2% of respondents would not have been financially ably to purchase the insulation without the program rebate.
- 3.1% of respondents learned of the program after having already installed the insulation.
- 58.5% of respondents indicated having prior plans to install insulation before learning about the program.

- 61.5% stated that they "definitely would have installed" insulation without a program rebate; of these, 35% of these respondents stated in another question that they could not have afforded to install insulation without a rebate. Such respondents were credited with 100% NTGR.

These findings aggregated to a 68.2% NTGR.

3.3.3.4 Verified Savings

Table 3-4 ESHP Gross Savings Summary

Channel	Expected Gross Therms	Verified Gross Therms	Expected Lifetime Therms	Verified Lifetime Therms	Gross Realization Rate
Insulation	19,970	20,385	499,250	509,625	102.08%
Boiler NC	131	131	2,620	2,620	100.00%
Furnace NC	73,226	73,198	1,318,068	1,317,564	99.96%
Furnace Retrofit	101	98	2,020	1,960	97.02%
Boiler Retrofit	29592.1	29,605	591,842	592,100	100.04%
Total	123,019	123,418	2,413,800	2,423,869	100.32%

Table 3-5 ESHP Net Savings Summary

Channel	Expected Net Therms	Verified Net Therms	Expected Net Lifetime Therms	Verified Net Lifetime Therms	Net Realization Rate
Insulation	14,977	13,903	374,425	347,575	92.83%
Boiler NC	105	88	2,100	1,760	84.00%
Furnace NC	58,580	49,189	1,054,440	885,402	83.97%
Boiler Retrofit	80.48	82	1,610	1,640	101.38%
Furnace Retrofit	23,674	24,750	473,480	495,000	104.55%
Total	97,416	88,012	1,906,055	1,731,377	90.35%

3.4 ENERGY STAR Heating Process Evaluation

The process evaluation of the ESHP was targeted at addressing:

- Has the program re-launch successfully built momentum?
- Is the new program design optimizing potential savings?
- Will the program remain cost-effective with increasing federal standards for furnaces?

3.4.1 Data Collection Activities

Data collection activities conducted in association with the process evaluation of the ESHP included:

- Surveys with 52 retrofit participants;
- Surveys with 65 insulation participants

- Interviews with three participating builders; and
- Comparison of program design and incentive levels in similar programs implemented by other utilities.

3.4.1.1 Furnace Survey Response

The Evaluators completed 52 surveys with residential retrofit program participants in the ESHP. These surveys captured information pertaining to the customer decision-making process regarding the replacement of their furnace with a high efficiency unit.

3.4.1.2 Program Awareness

As shown in Figure 3-3, the most common ways respondents first learned about the program was through a contractor or equipment manufacturer (49%), retailer (18%), and word of mouth from friends, relatives or others (9%).

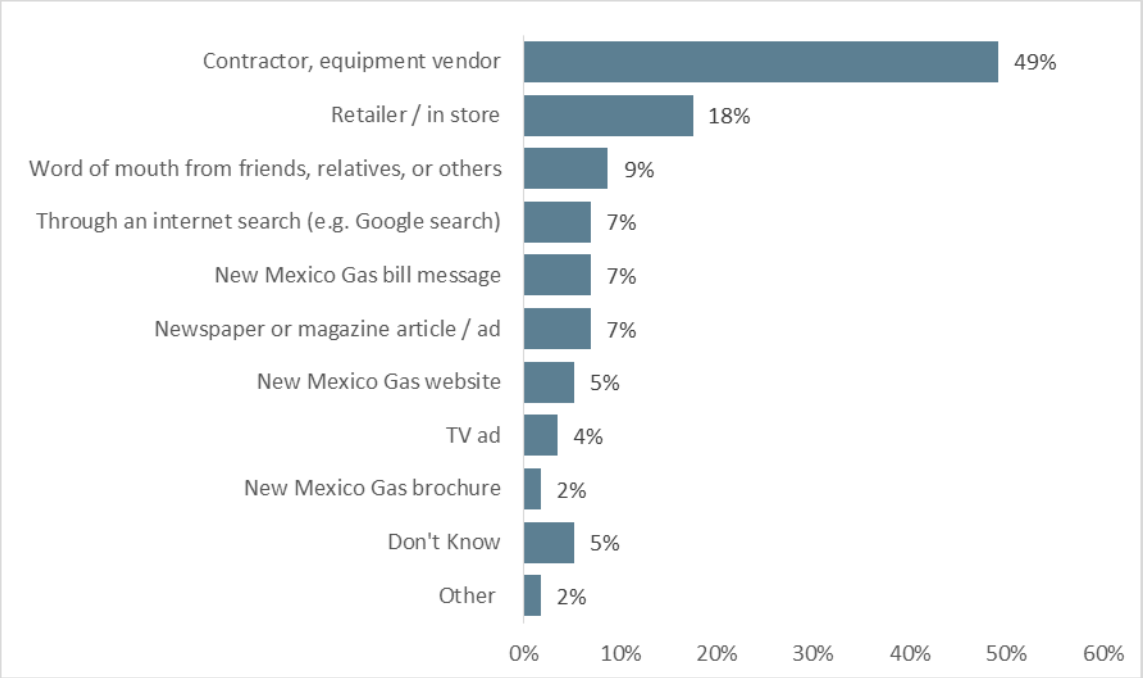


Figure 3-3 ESHP Sources of Program Awareness

3.4.1.3 Reasons for Participation

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 (44%), while 14% said they did it because it is the right thing to do. Table 3-6 summarizes reasons for participation; the total is over 100% as respondents were allowed to give multiple responses.

Table 3-6 Reason for Participation

What is the main reason you decided to participate in the program?	***Percent of Respondents (n = 57)***
To reduce my monthly gas bill	44%
It is the right thing to do	14%
Home remodel	12%
Help save the environment	11%
Got high efficiency because you were getting a high efficiency CAC	11%
Contractor recommendation	5%
New Mexico Gas recommendation or information	4%
Program's financial incentive / New Mexico Gas rebate	4%
Other	4%

3.4.1.4 Program 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 84% of respondents being satisfied or very satisfied. Respondents were least satisfied with the wait-time to receive the rebate, with 65% saying they were satisfied, 13% being neither satisfied or dissatisfied, and 21% 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. The main theme of complaints reported was a long waiting period for an appointment or receiving the rebate:

> *"It hasn't saved me money also the 80% it just turn on and off all the time."*
>
> *"The plumbers need to get educated on the rebate forms, so that the invoice they send makes retrieving the rebate without any glitches and misinformation."*
>
> *"We had to get inspected four times, and we failed the first three, and it took more than a month to get an appointment."*
>
> *"I thought it would save me a lot more."*

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:

> *"I think it's a great program and more people should use it."*
>
> *"It was real easy to do."*
>
> *"It is a really great program and offers incentive."*
>
> *"I'm grateful for it."*

Several respondents encouraged more advertising and more information about where to get rebate forms. Figure 3-4 summarizes satisfaction reported for many aspects of the program.

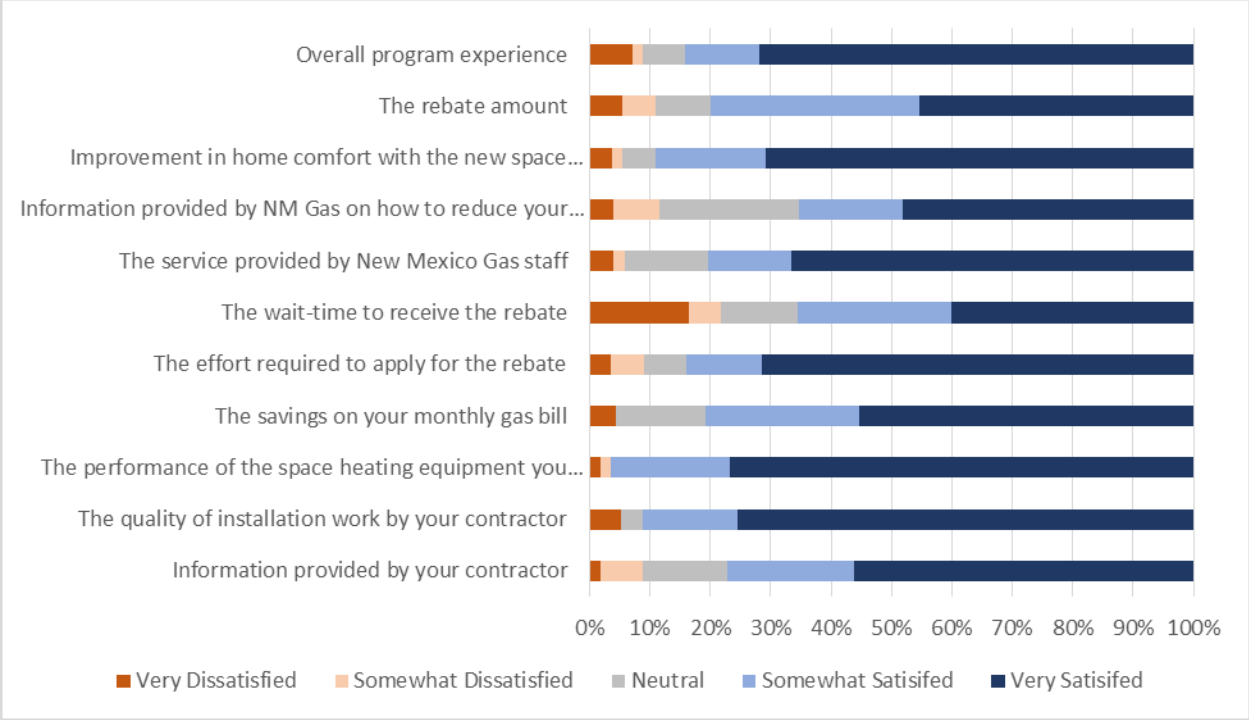


Figure 3-4 Participant Program Satisfaction

3.4.1.5 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 3-7 shows, 91% of respondents have a single-family home. In addition, 32% of respondents have homes built prior to 1980. Table 3-8 summarizes home age.

Table 3-7 Participant Home Type

Which of the following best describes your home?	***Percent of Respondents (n = 57)***
A single-family home	91%
A duplex	4%
A townhome	2%
Mobile or manufactured home	4%

Table 3-8 Participant Home Vintage

When was your home built?	***Percent of Respondents (n = 57)***
Before 1970's	18%
1970's	14%
1980's	12%
1990's	21%
2000-2009	28%
2010 or newer	2%
Don't Know	5%

Sixty-three percent of respondents reported a household income over $50,000, and 26% said their income was over $100,000. 2% did not answer the question. Table 3-9 summarizes the income distribution.

Table 3-9 Participant Household Income

What is your approximate total household income?	***Percent of Respondents (n = 57)***
Less than $25,000	4%
$25,000 - $35,000	11%
$36,001 - $50,000	20%
$51,001 - $75,000	22%
$76,001 - $100,000	15%
Greater than $100,000	26%
Refuse	2%

3.4.2 Insulation Survey Responses

3.4.2.1 Program Awareness and Decision to Participate

Respondents were asked how they initially learned of the program, and were able to select multiple sources. The single most common response was that customers learned of the program through a vendor or contractor, reported by 58.1% of respondents. Fifteen percent of respondents stated that they received a flyer about the program in the mail. Figure 3-5 summarizes the sources of program awareness.

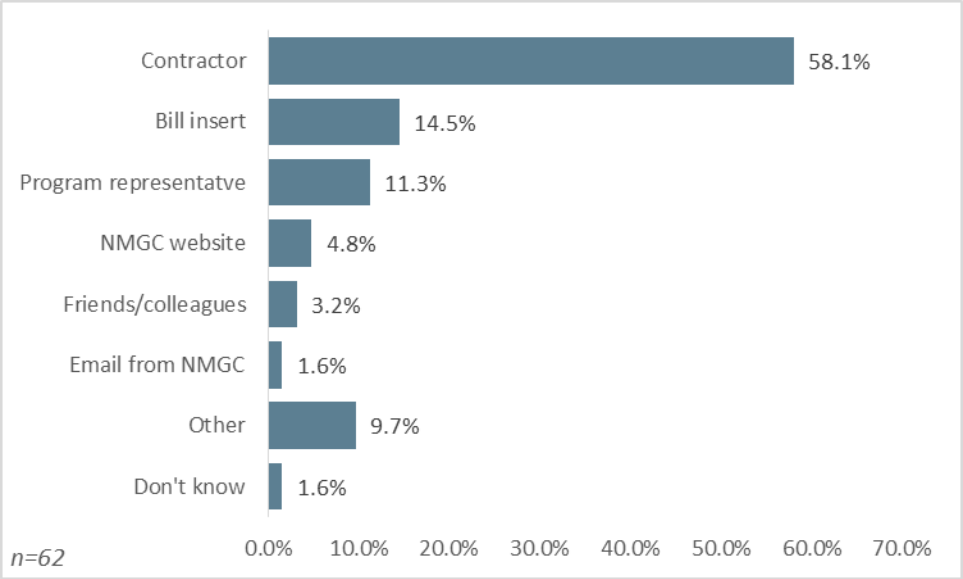


Figure 3-5 Insulation Sources of Program Awareness

Respondents were asked if they were aware that their homes needed insulation before learning about the Residential Insulation program. Eighty-four percent said that they had been aware that their homes needed additional insulation. Of this eighty-four percent, 79% also said that they had been planning to install additional insulation before participating in the program. Of those who had had pre-existing plans to install new insulation, 41% learned of the Residential Insulation Program after receiving a quote for the insulation from their contractor and 27% learned of the program before receiving a quote.

Of the 253 insulation participants, 14 (5.5%) were directed to NMGC's program through their participation in the PNM Home Energy Checkup program.

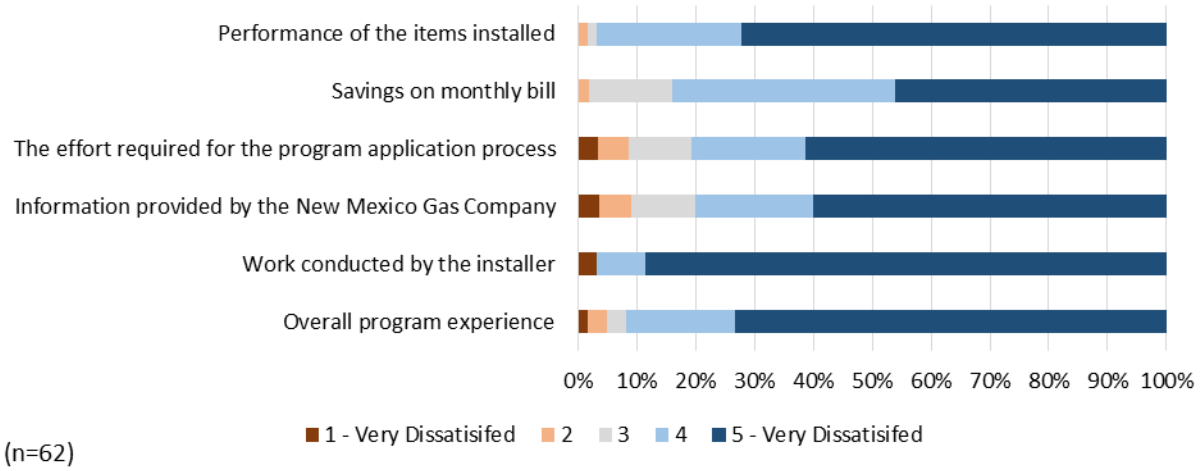
Table 3-10 When Participants Who Had Planned to Install Insulation Learned of the Program

Program Elements	***% Respondents (n=41)***
After planning to install insulation but before receiving a quote from a contractor	27%
After receiving a contractor quote for the insulation	41%
After installing insulation	5%
Some other time	12%
Don't know	15%

All respondents were asked how likely they would have been to install insulation in the absence of the Residential Insulation Program. Ranking their likelihood on a scale of 0 to 10, where 0 indicates that the respondent was not at all likely to install insulation in the absence of the program and 10 indicates that the respondent definitely would have installed insulation, the average score was 7.14. Thirty-five percent of respondents gave a score of 10.

3.4.2.2 Overall Satisfaction

Respondents were asked to rate their satisfaction with various program elements on a scale of 1 to 5, where 1 means "very dissatisfied" and 5 means "very satisfied." Overall, satisfaction with the various program elements was high. Satisfaction was highest with the performance of the insulation, the work conducted by the installer, and the overall program, all of which received scores of 4 or 5 from at least 89% of respondents. Satisfaction was lower with monthly bill savings, the effort required for the program application, and the information provided by the New Mexico Gas Company. However, at least 68% of respondents gave these program elements a satisfaction score of 4 or 5.



(n=62)

Respondents who indicated that they were dissatisfied with one of more program element were given an opportunity to describe their reasons for dissatisfaction. The most commonly cited sources of dissatisfaction included complications with the application or rebate process. A sample of respondent comments appears below:

"They lost the [application] form and had to resubmit it, including the pictures, then they had to send someone out again to verify it."

"My application got sent back to me for no apparent reason and I had to do it all over again."

"I was inspecting what the contractor was doing and they didn't do half the insulation they should have."

At the end of the survey, respondents were given an opportunity to provide additional commentary about their overall experience with the program. Most of the feedback was complementary. A sample of respondent comments appears below:

"I'm happy you offer it. It's good for natural gas customers and the environment."

"I'm happy about the rebates and the offers. Please keep it up, we need this."

"It's a great program and they should continue offering it to New Mexico residents."

3.4.2.3 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.

Table 3-11 Participant Home Vintage

When was your home built?	***Percent of Respondents (n = 62)***
Before 1970's	35%
1970's	39%
1980's	13%
1990's	5%
2000-2009	2%
2010 or newer	0%
Don't Know	6%

Sixty-three percent of respondents reported a household income over $50,000, and 26% said their income was over $100,000. 2% did not answer the question. Table 3-9 summarizes the income distribution.

Table 3-12 Participant Household Income

What is your approximate total household income?	***Percent of Respondents (n = 62)***
Less than $25,000	2%
$25,000 - $35,000	7%
$36,001 - $50,000	9%
$51,001 - $75,000	24%
$76,001 - $100,000	10%
Greater than $100,000	21%
Refused	28%

3.4.3 Builder Interview Responses

Two builders who had participated in the ENERGY STAR Space Heating program were asked about their experiences installing energy-efficiency furnaces.

Respondents were first asked how they became involved with the New Mexico Gas Company program. Both respondents identified specific individuals who brought the program to their attention—one from ICF and one from New Mexico Gas.

Both respondents said that between 90-95% of their homes are built with ENERGY STAR-rated furnaces. When asked what could be done to ensure that all of their homes are built with ENERGY STAR-rated furnaces, one builder said that they expected that all of their homes would be built with high efficiency furnaces within 6 months and one said that roughly 5% of their homes are built in areas that do not have natural gas service and use liquid propane. Both said that the percentage of their homes built with high efficiency furnaces would be the same in the absence of the rebates provided by New Mexico Gas Company. One respondent said that they probably would have, and one respondent said that they definitely would have built homes with high efficiency furnaces in the absence of the program rebates.

Both respondents said that they mention the energy-saving features of their homes in their marketing materials. When asked how customers respond to these marketing measures, the builders affirmed that their customers appreciate energy saving features of their homes. One respondent said that New Mexico Gas Programs help the marketability of their products by attracting customers with additional energy savings. The other respondent was not sure if New Mexico Gas improves product marketability. When asked for their view on the best way to market energy efficient products, one builder suggested allowing potential customers to see a model home, and the other suggested showing customers expected annual energy savings.

Both respondents confirmed that they will participate in the program next year, at either the same or a higher level of activity. When asked to explain their expected level of participation in the next program year, both respondents shared positive comments about the program. One respondent said that they appreciate the energy savings, and the other commented on the benefits of the rebates.

Respondents were asked to rate their satisfaction with various program elements on a scale of 0 to 10, where 10 means that the respondent was very satisfied and 0 that they were very dissatisfied. Overall satisfaction scores for each program element were high, with both participants giving the program element a score of between 8 and 10. Satisfaction was slightly lower with the effort required to apply to the program, which received an average score of 7. All responses are summarized in Table 3-13 below.

Table 3-13 Overall Program Satisfaction Levels

Element of Program Experience	*Mean Score*
The effort required to apply for the program	7.00
The wait-time to receive the rebate	9.00
The service provided by ICF staff	9.50
The rebate amount	9.00
Overall program experience	9.00

Additionally, both builders had contact with ICF staff over the course of their participation in the program. Both characterized those interactions positively and said that staff were helpful and easy to communicate with.

These results suggest that the program is running well and meeting the needs of participating builders; however, given their commitment to installing energy efficient equipment and customer's interest in saving energy, it may also be the case that the program rebates do not dramatically influence builder behavior. It is also possible that builders who are not as commitment to energy efficiency or who had less positive experiences with the program may not responded to the request for feedback.

3.5 Conclusions & Recommendations

3.5.1 Conclusions

The Evaluators' conclusions are as follows:

- **Satisfaction with the program operation is very high.** Satisfaction with the program operation includes customers' interactions with NMGC, satisfaction with wait times, savings realized from program participation, and ease of the application process. Participants found the process to be very straightforward, with most participants facing little difficulty in completing the documentation needed to participate.
- **Overall program participation was driven largely by new construction.** Seventy-five percent of furnace rebates were for new construction projects. The participating builders had in prior years participated in NMGC programs.
- **The insulation measure has a significant share of low income participation.** 9.23% of survey respondents from the insulation program channel gave answers for income and household occupants that would put the household below 200% of the federal poverty limit. These customers would potentially be eligible for higher service levels through NMGC's Low Income Weatherization Program.

3.5.2 Recommendations

The Evaluators' recommendations are as follows:

- **Consider flagging insulation applications that may be low income households.** With 9.23% of survey respondents from the insulation participant group reporting income and occupancy levels placing them below 200% of the poverty limit, there may be a lost opportunity for deeper savings and an enhanced service level. This customer group should be processed in the Low Income Weatherization Program. Applications for insulation could be cross-referenced with LIHEAP, or the application could include a sidebar explaining the benefits of the Low Income Weatherization Program for qualified households. The effectiveness of this is limited by the constraints the Mortgage Finance Authority (MFA) operates as a Department of Energy Weatherization Assistance Program (WAP) provider, but the referral list could still possibly be put to some use.

4. Efficient Buildings

4.1 Program Description

The Efficient Buildings Program (EBP) provides outreach and incentives to NMGC's commercial and industrial customers. Program offerings include:

- Direct install. Direct installation of select no-cost natural gas and water-saving measures to add additional energy and cost savings.
- Prescriptive incentives. Fixed incentives and savings levels are provided for a range of measures including space heating, water heating, and food service equipment.
- Custom incentives. Non-Prescriptive Equipment Rebates offers $0.60/therm for measures with a EUL of up to five years, and $0.90/therm for measures with a EUL of more than five years, based on M&V conducted according to IPMVP protocols.

4.2 M&V Methodologies

Evaluation of the Efficient Buildings Program (EBP) requires the following:

- Stratified random sampling, selecting large saving sites with certainty;
- Review of deemed savings parameters;
- Onsite verification inspection to verify installation of direct install projects; and
- Monitoring or metering as needed for custom projects.

Parameters required for evaluation of the EBP are presented in Table 4-1.

Table 4-1 Data Sources for Gross Impact Parameters – Efficient Buildings Program

Parameter	***Source***
Project Details	Program Tracking Data
Equipment Specifications	Manufacturer's Literature
Hours of Use	Literature review of prior low flow studies
Effective Useful Life	Comparison against CA DEER values
Net-to-Gross Ratio (NTGR)	Participant Surveying

4.2.1 Efficient Buildings Gross Savings Estimates

The 2016 EBP included the following:

- Direct-Install Low Flow Aerators;
- Direct –Install Low Flow Pre-Rinse Spray Valves;
- Prescriptive incentives for food service, HVAC, and water heating equipment; and

- A range of custom projects

4.2.1.1 Gross Savings Methodology for Direct Install Measures

Savings for low flow measures were calculated using fully deemed values as described in the New Mexico TRM. ADM's field visits were used to validate in-service rates (ISRs), in order to account for customer retention rates of the low flow devices installed.

4.2.1.2 Gross Savings for Custom Projects

Custom projects completed through the EBP can comprise a wide range of measures, including water heating, HVAC, building envelope, and industrial process improvements. A census of custom projects is evaluated, with a project-specific M&V plan and approach developed. The specific approaches are detailed in the site reports presented in Appendix A.

4.2.2 Efficient Buildings Net Savings Estimates

The Evaluators applied 2015 net-to-gross findings to the 2016 EBP. We describe the methodology here to detail how the NTGRs were developed in the 2015 EM&V report.

We used information collected through surveys of program participants to develop estimates of free-ridership from 2015 EBP. 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 terciles, 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.

4.2.2.1 Direct Install Free-Ridership

For the direct install component, free-ridership is determined through two questions:

> Question DI-1: Prior to participating in the Efficient Buildings Program, had you ever installed any low-flow faucet aerators or pre rinse spray valves at company facilities?
>
> Question DI-2: Prior to participating in the Efficient Buildings Program, were you aware of the energy savings available from low flow faucet aerators or spray valves?

If the respondent answers “yes” to either of these questions, they are scored at 50% free-ridership for each “yes” indicated. This allows for free-ridership scores of 0%, 50%, and 100% per respondent.

4.2.2.2 Custom Project Free-Ridership

4.2.2.2.1 Importance of Technical Assistance

Following this, customers are asked about to what extent they learned of the custom measure through the program. Respondents are asked

Question FI-1: Before participating in the Efficient Buildings Program, had you installed any equipment or measure similar to [Rebated Equipment/Measure] at your facility?

Question TA-4: Was [EQUIPMENT/MEASURE] recommended to you through this technical assistance??

Question TA-3d: How would you rate the reasonableness and appropriateness of the audit recommendations for your business?

If the respondent states “No” to FI-1, “Yes”, TA-4, and a score of 8 or higher on TA-3d, then they are granted 100% NTGR due to learning of the measure through the program. If they were unaware of the measure before the audit, then the project can be considered to have been generated by the program.

If the customer knew of the measure before the program, they still may have been influenced by the incentive. This is then evaluated through the following series of questions.

4.2.2.2.2 Financial Ability

For Part 1 of the NTGR analysis of the incentive component, customers were asked:

Question FI-4: Would you have been financially able to install the measure without the incentive from NMGC?

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.

4.2.2.2.3 Prior Planning

Following this, customers are asked about to what extent they learned of the custom measure through the program. Respondents are asked:

FI-9: When did you learn of the Efficient Buildings Program?

FI-2: Did you have plans to install the equipment before participating in the program?

FI-2a: Would you have gone ahead with this planned installation without the program rebates?

FI-2b: Would this installation have included the same equipment without the program rebates?

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.

4.2.2.2.4 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 DM-3a: How important was NMGCs' rebate in your decision to buy high efficiency equipment?

Question FI-4: If the financial incentive from the program had not been available, how likely is it that you would have installed [Equipment/Measure] anyway?

Questions DM-5 and FI-5 directly address the importance of the rebate, by having the respondent weigh its importance in the decision-making process for the project. If the respondent indicates that the rebates are unimportant and that they would have installed without them, then they are considered to be a free-rider on this component.

4.2.2.2.5 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:

FI-3a How important was previous experience with the NMGC energy efficiency programs in making your decision to install [EQUIPMENT/MEASURE]?

FI-5 If the rebate through Retrofit Rebates program were not available for this project, what would you have done differently?

If the respondent indicates that they did not modify the project and that they had no historic relationship with the program that affected their decision-making, they are a free-rider on this component.

4.2.2.3 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 Terciles, 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 4-2 below presents the associated free-ridership score for each permutation of answers in the four free-ridership components.

Table 4-2 Free-Ridership Scoring

Financial Ability	*Prior Planning*	*Rebate Was Important*	*Likely to Install w/o Rebate*	*Aggregated Category*	*Free-Ridership Score*
Y	N	N	Y	YNNY	.67
Y	N	N	N	YNNN	.33
Y	N	Y	Y	YNYY	.33
Y	N	Y	N	YNYN	0
Y	Y	N	Y	YYNY	1
Y	Y	N	N	YYNN	.67
Y	Y	Y	Y	YYYY	.67
Y	Y	Y	N	YYYN	.33
N	N	N	Y	NNNY	0
N	N	N	N	NNNN	0
N	N	Y	Y	NNYY	0
N	N	Y	N	NNYN	0
N	Y	N	Y	NYNY	0
N	Y	N	N	NYNN	0
N	Y	Y	Y	NYYY	0
N	Y	Y	N	NYYN	0

4.3 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 NMGC, 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 aerators or pre-rinse spray valves was conducted to obtain more accurate information on operating characteristics.

Table 4-3 summarizes the total participation in the 2016 EBP.

Table 4-3 EBP Participation Summary

Component	# Applicants	# Projects	Expected Therms
Custom	12	28	406,764
Direct Install	23	34	12,934
Prescriptive	16	62	23,541
Total	**17**	**124**	**443,239**

Data provided by NGMC showed that during 2016, there were 88 projects by 59 applicants in the EBP, which were initially expected to provide gross savings of 319,018 therms. The resulting overall sample is presented in Table 4-4 below.

Table 4-4 EBP Sample Summary

Component	# Sites in Population	Sample Size
Custom	28	10
Direct Install	34	0
Prescriptive	62	4
Total	124	14

4.3.1 EBP Gross Savings Estimates

Sampling for evaluation of NMGC's EBP was developed using the Stratified Random Sampling procedure detailed in Section 2.4.2. 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.

4.3.1.1 Efficient Buildings Sample Design

The participant population for Efficient Buildings was divided into four strata. Table 4-5 summarizes the strata boundaries and sample frames for the program.

Table 4-5 Efficient Buildings Sample Design

	Stratum 1	Stratum 2	Stratum3	Stratum 4	Stratum 5	Totals
Strata boundaries (Therms)	< 100	101-1,000	1,001-10,000	10,001-20,000	> 20,001	
Number of sites	94	8	6	11	5	124
Total Therm savings	32,041	18,271	32,116	157,674	203,137	443,239
Average Therm	341	2,284	5,353	14,334	40,627	7,287
Standard deviation of Therm savings	246	713	2,407	2,461	25,936	13,384
Coefficient of variation	0.72	0.31	0.45	0.17	0.64	1.84
Final sample	4	1	2	2	5	14

4.3.1.2 Efficient Buildings 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 4-6 shows the expected and realized energy savings for the program by project.

Table 4-6 Expected and Realized Savings by Project

Project ID(s)	City	Facility Type	Measure	Expected Therm Savings	Realized Therm Savings
PRJ-862864	Carlsbad	Industrial	Boiler Control	82,209	85,599
PRJ-862864	Albuquerque	Medical	Boiler Control	50,110	66,955
PRJ-725514	Albuquerque	K-12 School	Boiler Control	24,413	24,413
PRJ-965042	Albuquerque	Government	Boiler Replacement	24,085	29,612
PRJ-886427	Albuquerque	Medical	Boiler Replacement	22,320	22,320
PRJ-878377	Albuquerque	K-12 School	Boiler Control	18,872	18,872
PRJ-894936	Albuquerque	K-12 School	Boiler Control	14,031	14,031
PRJ-965052	Albuquerque	Hospitality	Boiler Replacement	7,286	6,154
PRJ-1247247	Albuquerque	K-12 School	Boiler Control	3,504	3,504
PRJ-832582	Albuquerque	Medical	Boiler Replacement	2,239	304
PRJ-1014464	Albuquerque	Restaurant	Tankless Water Heater	536	278
PRJ-943658	Albuquerque	Restaurant	Kitchen Equipment	294	129
PRJ-1225889	Albuquerque	Industrial	Furnace Replacement	64	157

4.3.1.3 Efficient Buildings Program-Level Gross Realization

Using the stratum-level realization rates, the Evaluators extrapolated results from sampled sites to non-sampled sites in developing gross savings estimates. Table 4-7 presents results by stratum for the program.

Table 4-7 Efficient Buildings Program-Level Gross Realization by Stratum

Stratum	# Sites	Expected Therm Savings	Realized Therm Savings	Gross Realization Rate
1	1	64	157	245.3%
2	2	830	407	49.0%
3	3	13,029	9,962	76.5%
4	5	103,721	109,248	105.3%
5	2	203,137	228,899	112.7%

4.3.2 Efficient Buildings Net Savings Estimates

The Evaluators estimated net savings for the Efficient Buildings Program via detailed participant surveying of a representative sample of decision makers from the program. These questionnaires were used to provide estimates of free-ridership. Free-ridership scores were assessed for each respondent. These scores were then weighted by the total Therms represented by that respondent into an overall program NTGR.

Table 4-8 Free-Ridership Scoring

Items	Percentage
Overall Free-Ridership Score from 2015	17.4%
Overall NTGR	82.6%

The resulting NTGR of 82.6% was applied to prescriptive and custom measures. A NTGR of 100% was applied to direct install measures.

4.3.3 Efficient Buildings Net Realization Summary

After evaluating the program, we compiled net savings to provide an overall net realization rate. These results are summarized in Table 4-10.

Table 4-9 Efficient Buildings Gross Realization Summary

Annual Energy Savings (Therms)		Lifetime Energy Savings (Therms)		Gross Realization Rate
Ex Ante	Ex Post	Ex Ante	Ex Post	
443,239	438,014	6,336,288	6,231,284	98.82%

Table 4-10 Efficient Buildings Net Realization Summary

Annual Energy Savings (Therms)		Lifetime Energy Savings (Therms)		Net Realization Rate
Ex Ante	Ex Post	Ex Ante	Ex Post	
357,178	362,837	5,094,540	5,157,223	101.58%

4.4 Conclusions & Recommendations

4.4.1 Conclusions

The Evaluators' conclusions are as follows:

- **Participation was largely driven by custom projects.** One project accounted for 25.8% of program savings. The program produced a significant number of custom projects in the 2016 program year, with facility audits yielding an increasing volume of high-return projects.
- **Participants were very satisfied with the program.** All interviewed participants displayed very high satisfaction.
- **Approaches for boiler retrofit projects were inconsistent.** Boiler retrofit projects displayed inconsistency in approaches by implementation staff; not all projects completed appropriate weather normalization, and it was not apparent when a project was using an early retirement baseline.
- **Participant tracking information was often not populated.** The Evaluators needed to submit a supplementary request to implementation staff to receive contact names, phone numbers, and address for completed projects.

4.4.2 Recommendations

Based on the EM&V findings, the Evaluators recommend the following:

- **Clearly mark boiler replacement projects that are calculated as early retirement in program tracking data.** These projects have higher uncertainty and warrant additional attention from the Evaluators.
- **Ensure that project contact information is available in standard tracking exports.**
- **Ensure consistent approaches for custom boiler replacement projects.** This includes factors such as normalization procedures for weather or production, and a consistent definition of when to apply an early retirement baseline.

5. Low Flow Showerhead Program

The Low Flow Showerhead Program (LFSP) provides no-cost low flow kits to New Mexico Gas Company residential customers. These kits may contain:

- Up to two 1.5 gallons per minute (GPM) low flow showerheads, available in chrome and white finish; and
- One 1.5 GPM kitchen aerators (with a shutoff valve) and two 1.0 GPM bathroom aerators (without a shutoff valve).

In addition, the program co-funded kit deliveries by PNM through the following channels:

- **Low Income Easy Savings.** This PNM program provides a lighting and low flow device kit to income-qualified customers. NMGC cofounded kits delivered to PNM customers that had natural gas water heating.
- **Home Energy Checkup.** This program provides an in-home audit to PNM customers, long with direct install and rebate measures. NMGC co-funded installation of low flow devices for PNM customers that had natural gas water heating.

5.1 The Low Flow Showerhead Program Participation Summary

In 2016, New Mexico Gas Company distributed 4,335 kits to their residential customers. Table 5-1 presents a summary of the composition of the kits delivered.

Table 5-1 Low Flow Kit Composition

Low Flow Packs	***Total Participants***	***Total Therms***
Low Flow Kit Delivery (NMGC)	2,360	95,334
Easy Savings Kit Delivery (PNM)	1029	37,612
HEC Direct Install (PNM)	946	37,901
Total	4335	170,857

Table 5-2 shows the quantities of measures installed in the HEC program[1].

[1] The totals in Table 5-2 are comprised in the 946 kits shown in Table 5-1

Table 5-2 Equivalent Low Flow Kit Composition

Measure	Quantity	Therms
Gas Faucet Aerator - Bathroom	859	6,872
Gas Faucet Aerator - Chrome	49	515
Gas Faucet Aerator - White	699	7,340
Gas Low Flow Showerhead - Chrome	886	20,369
Gas Low Flow Showerhead - White	60	1,452
Gas Pipe Wrap (from PNM)	144	1,353
Total	2,697	37,901

5.2 M&V Methodology

5.2.1 Data Collection Activities

The process evaluation of the Low Flow Showerhead Program included the following data collection activities:

- *Desk Review*. The Evaluators reviewed calculations provided by New Mexico Gas Company to validate that they used prior-year M&V findings for in-service-rates (ISRs) and natural gas water heating rates.
- *Participant Surveying*. The Evaluators surveyed 80 NMGC kit recipients to develop in-service rates (ISRs) and net-to-gross ratios (NTGRs). ISRs and NTGRs for the PNM co-fund channels were developed as part of ADM's impact evaluation of the 2016 PNM Home Energy Checkup and Easy Savings programs.

5.2.2 Process Evaluation

The evaluators conducted a process evaluation of the Low Flow Showerhead Program in order to address a range of issues:

- What drives measure installation and retention (or lack thereof)?
- Is the kit meeting the customers' needs?
- What is the participant response to the program?

For this program, the Evaluators are presenting process findings before impact findings, as the issues surrounding measure installation and retention directly relate to the subsequent impact values.

The program provides a kit that includes:

- 1 or 2 1.5 GPM showerheads (customers may elect to receive a second device)
- (1) 1.5 GPM kitchen aerator
- (2) 1.0 GPM bathroom aerator

5.2.3 Impact Evaluation

5.2.3.1 Faucet Aerators

Savings from faucet aerators are based upon Section 4.3 of the NM TRM. Savings for faucet aerators are calculated as follows:

$$Svgs = (FlowPre - FlowPost) \times DeltaT \times Minutes \times Days \times HeatCapacity \times Density \times Const / EffDHW$$

Where:

Svgs	=	Annual energy savings, in Therms
FlowPre	=	Baseline flow rate, 2.2 GP<
FlowPost	=	Measure flow rate, 0.5, 1.0, or 1.5 GPM
DeltaT	=	Temperature difference between cold and usage, 50 °F
Minutes	=	Minutes per day faucet is used, depends on facility type and location
Days	=	Days per year faucet is used, 365
HeatCapacity	=	Heat capacity of water, 1 Btu per pound per °F
Density	=	Density of water, 8.33 pounds per gallon
Const	=	Constant, 1 Therms/100,000 Btu, 1therm/0.03413 kWh
EffDHW	=	Thermal efficiency of water heater. For Natural gas 0.75, for electric 0.98

The resulting savings per unit are summarized in Table 5-3

Table 5-3 Residential Aerator Gas Savings Values

Facility Type	***Location***	***Efficient Flow Rate (GPM)***	***Savings (Therms/ yr/ housing unit)***	***Savings (kWh/ yr/ housing unit)***
Single Family	Kitchen	1.5	10.5	236
Single Family	Bathroom	1	8.0	180
Single Family	Bathroom	0.5	11.4	255
Multifamily	Kitchen	1.5	7.8	176
Multifamily	Bathroom	1	10.7	240
Multifamily	Bathroom	0.5	15.2	340

5.2.3.2 Low Flow Showerheads

Savings from faucet aerators are based upon Section 4.2 of the NM TRM. Savings for showerheads are calculated as follows:

$$Svgs = (Pre_F \times \text{PreHot\%} - Post_F \times PostHot\%) \times \Delta T \times Mins \times HtrEnergy$$

Where:

Svgs	=	Annual energy savings, in Therms
PreF	=	Baseline flow rate, 2.53 GPM
PreHot%	=	Baseline hot water percentage, 73.1%
PostF	=	Measure flow rate, nominal flow rate adjusted by an in situ flow percentage (90%), see below
PostHot%	=	Measure *hot* water percentage
ΔT	=	Water heater outlet temperature minus inlet temperature, 75 °F
Mins	=	Annual minutes showerhead is used, 3,307.1.
HeaterEnergy	=	Water heater heating energy, 0.0001112 Therms per °F per gallon. Factor composed of thermal efficiency of water heater, 0.75 and Therms per gallon °F, 0.0000834 (from heat capacity and density of water, and a conversion from Btu to Therms). For electric it is .002493 kWh per °F per gallon. Factor composed of thermal efficiency of water heater, 0.98 and Therms per gallon °F, 0.0000834 (from heat capacity and density of water, and a conversion from Btu to Therms) divided by the conversion factor of 0.03413 Therms/kWh

Table 5-4 Residential Showerhead Savings Values

Efficient Flow Rate (gpm)	***Savings (Therms/ yr/ showerhead)***
2.0	13.5
1.75	17.6
1.5	21.9

5.2.3.3 Pipe Wrap

Savings for pipe wrap is stipulated at 3.47 Therms per liner foot. This was vetted in a workpaper review by ADM for deemed savings developed by ICF International (PNM's implementer for the HEC Program).

5.2.4 Gas Water Heating Rates

For the PNM co-funded channels, the fuel type is known and the rate of natural gas water heating is 100% (NMGC only co-funds homes that have been identified as having natural gas water heating systems). For the mailer kits distributed by NMGC, this is not af actor that the program can control. The Evaluators determined the percent of residences with gas water heating in the participant survey. The summary is provided in Table 5-5 below.

Table 5-5 Water Heater Fuel

What type of water heating do you have in your home? Is it…	***Percent of Respondents (n=80)***
Gas	92%
Electric	6%
Other	3%

5.2.5 In-Service Rates

The Evaluators applied in-service rates developed in 2016 participant surveying for the NMGC mailer kits. ISRs for the other channels were determined in the 2016 evaluation of PNM's Easy Savings and Home Energy Checkup programs.

Table 5-6 ISRs by Program Channel and Measure

Program Channel	***Shower Head***	***Kitchen Aerator***	***Bathroom Aerator***	***Pipe Wrap***
Low Flow Kit Delivery (NMGC)	70.4%	51.3%	42.5%	NA
Easy Savings Kit Delivery (PNM)	75.5%	62.7%	62.7%	NA
HEC Direct Install (PNM)	88.5%	100.0%	100.0%	100.0%

5.2.6 Net-to-Gross

The Evaluators were tasked with providing net savings estimates. The NTGR applied to 2016 savings was derived from the 2016 surveys and methodology described in the sections below.

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 energy efficient lighting or lighting controls without the program 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 the 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.

5.2.6.1 Financial Ability

For Part 1, customers were asked:

> *Q1: Would you have been able to install the measure without the financial incentive?*

If the customer answered No to this, then they are assigned 0% free-ridership, as without the financial ability to purchase high efficiency lighting 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.

5.2.6.2 Prior Planning

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

> *Q2: Would you have installed the measure without the program?*

If the respondent indicates that they would have gone ahead with the project without participating in the program, then they can be considered a partial-free rider on this component.

5.2.6.3 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 high vs. standard efficiency lighting equipment. To address this, we examined responses to the following question:

> *Q3: Before participating in the program, had you installed similar equipment in your home?*

Question 3 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.

5.2.6.4 Likelihood of Installing Similar Equipment without Rebate

Finally, customers are asked regarding the timing of measure installation if they planned to do so without program assistance. This is addressed in the following question:

> Q4: How soon would you have installed the measure without the program?

If the respondent indicates they would have installed the measure “Less than 6 months” or between “6-12 months”, then they can be considered a partial-free rider on this component.

5.2.6.5 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 5-7 presents the associated free-ridership score for each permutation of answers in the four free-ridership components. The free-ridership for this program is 17.9%.

Table 5-7 Free-Ridership Scoring

Financial Ability	Prior Planning	Rebate Was Important	Likely to Install w/o Rebate	Aggregated Category	Free-Ridership Score
Y	N	N	Y	YNNY	.67
Y	N	N	N	YNNN	.33
Y	N	Y	Y	YNYY	.33
Y	N	Y	N	YNYN	0
Y	Y	N	Y	YYNY	1
Y	Y	N	N	YYNN	.67
Y	Y	Y	Y	YYYY	.67
Y	Y	Y	N	YYYN	.33
N	N	N	Y	NNNY	0
N	N	N	N	NNNN	0
N	N	Y	Y	NNYY	0
N	N	Y	N	NNYN	0
N	Y	N	Y	NYNY	0
N	Y	N	N	NYNN	0
N	Y	Y	Y	NYYY	0
N	Y	Y	N	NYYN	0

5.2.6.6 Spillover Assessment

Spillover measures any impacts the program had on additional energy efficiency purchases by program participants as a result of the program. This is addressed in the following questions:

> S1: Since January 2016 and while living in this home, have you installed any energy efficient equipment that you have not received an incentive for?
>
> S2: On a scale of 1 to 10, where 1 is not at all and 10 is very influential, how influential was information provided by NMGC in your decision to purchase this high efficiency equipment?
>
> S3: What type of equipment did you install?

If the respondent indicates they installed energy efficient equipment without an incentive and the decision to purchase was primarily motivated by the NMGC program, the additional installed efficient equipment is considered spillover. The energy savings associated with these additional purchases are distributed evenly across the program measures

The survey identified spillover for 6.3% of program respondents and lists which measures were implemented by respondents as a result of the Low Flow Showerhead Program's influence.

The NTGRs applied by program channel are summarized in Table 5-8

Table 5-8 NTGRs by Program Channel

Program Channel	NTGR
Low Flow Kit Delivery (NMGC)	88.2%
Easy Savings Kit Delivery (PNM)	100.0%
HEC Direct Install (PNM)	100.0%

5.3 Verified Savings

Table 5-9 summarizes the total gross savings for the Low Flow Showerhead Program. Net savings are summarized in Table 5-10.

Table 5-9 Low Flow Showerhead Program Verified Gross Savings

Measure Category	Annual Therms Savings		EUL	Lifetime Therms Savings		Gross Realization Rate
	Ex Ante	Ex Post		Ex Ante	Ex Post	
Low Flow Pack – NMGC	95,344	52,552	7.71	953,440	405,176	55.12%
Low Flow Pack - PNM	37,612	26,193	5.52	376,120	144,585	69.64%
HEC DI Showerheads	21,821	19,304	10	218,210	193,040	88.47%
HEC DI Kitchen Aerators	7,854	7,854	5	78,540	39,270	100.00%
HEC DI Bathroom Aerators	6,872	6,872	5	68,720	34,360	100.00%
HEC DI Gas Pipe Wrap	1,353	1,353	11	13,530	14,883	100.00%
Total Gross Savings	170,857	114,128	7.28	1,708,560	831,314	66.80%

Table 5-10 Low Flow Showerhead Program Verified Net Savings

Measure Category	Annual Therms Savings		EUL	Lifetime Therms Savings		Net Realization Rate
	Ex Ante	Ex Post		Ex Ante	Ex Post	
Low Flow Pack – NMGC	57,206	46,351	7.71	572,060	357,366	81.02%
Low Flow Pack - PNM	22,567	26,193	5.52	225,670	144,585	116.07%
HEC DI Showerheads	13,093	19,304	10	130,930	193,040	147.44%
HEC DI Kitchen Aerators	4,712	7,854	5	47,120	39,270	166.68%
HEC DI Bathroom Aerators	4,123	6,872	5	41,230	34,360	166.67%
HEC DI Gas Pipe Wrap	812	1,353	11	8,120	14,883	166.63%
Total Net Savings	102,514	107,926	8	1,025,130	783,505	105.28%

Though gross savings realization appears low, this is not due to issues with the program and is instead the result of how NMGC accounts for parameters that affect savings. NMGC applied a 40% reduction to the TRM unit energy savings and labeled it “free ridership”. Their intent in doing so was to capture all parameters which may affect savings, including in-service rates and rates of electric water heating as well as net-to-gross effects. The result of this accounting of savings was that net realization was high (105.28%) while gross realization was low (66.80%) which may erroneously convey that

the program has gross savings issues. The Evaluators concluded that no such issues exist because the net realization was high (105.28%).

5.4 Process Evaluation Results

5.4.1 Program Awareness

Respondents were asked how they initially learned of the Low Flow Showerhead program, and respondents were able to select multiple sources. The single most common response was that customers learned of the program from a NMGC bill message (29%). Additionally, NMGC websites were cited as a common source by 26% of respondents. Figure 5-1 summarizes the sources of program awareness.[2]

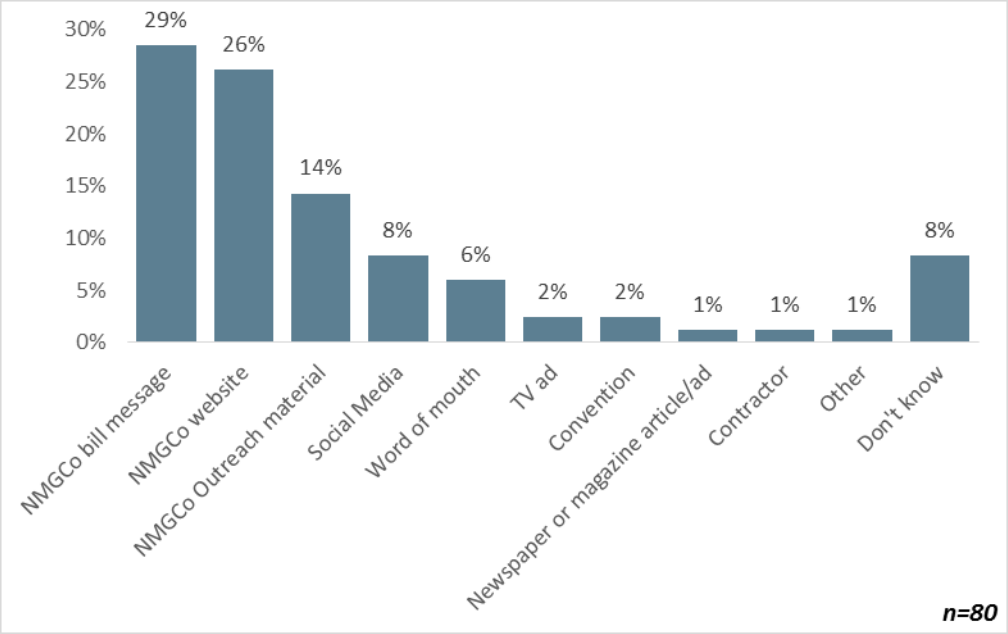


Figure 5-1 Sources of Awareness

Respondents were then asked about their reason for program participation, and they were able to provide multiple responses. Figure 5-2 shows a summary of reasons for participation in the program. The most frequent reason respondents chose to participate was they thought it would be good for the environment (31%). Other common responses included, to save money on electric bill (14%), to save money on the gas bill (13%), and because the measures were provided free or charge (16%).

[2] Respondents providing a response of *Other* were asked to provide an open-ended comment specifying how they learned of the program. In addition to the initial list of response options, the Evaluators then identified common *Other* responses and assigned these open-ended comments to one additional response category: *Social media*.

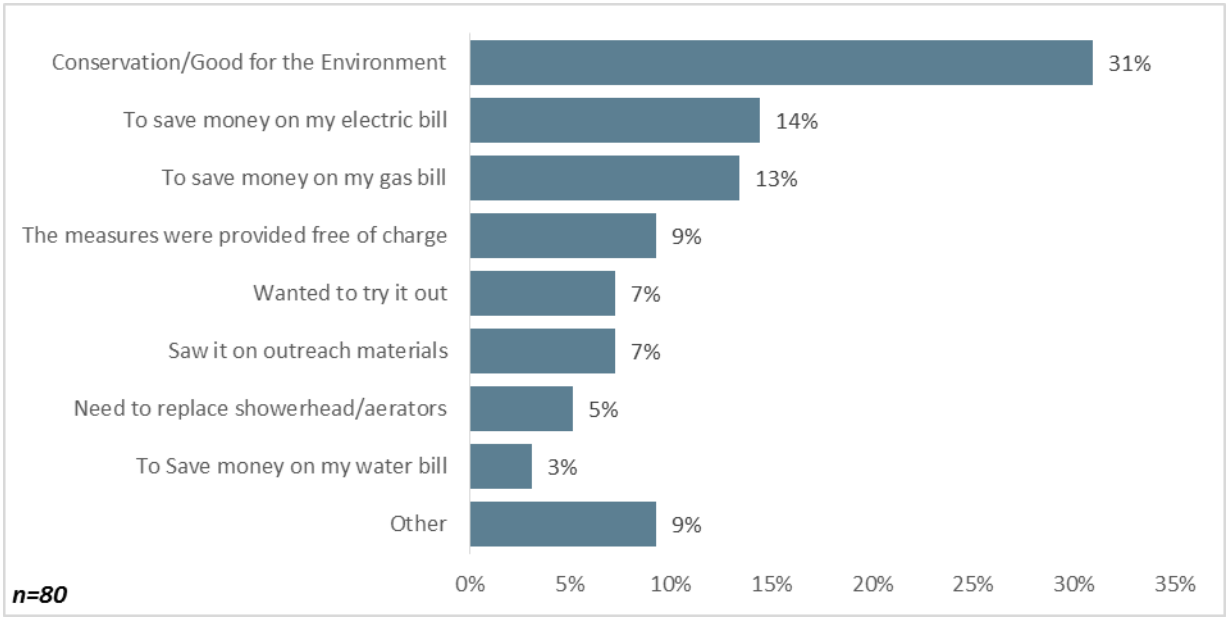


Figure 5-2 Reasons for Participation

Lastly, respondents were asked to provide feedback on the importance of energy efficiency to their household. As Table 5-11 shows, the majority of respondents said energy efficiency was very or somewhat important to them (94%).

Table 5-11 Importance of Energy Efficiency

How important is energy efficiency to your household?	Percent of Respondents (n=80)
Very important	74%
Somewhat important	20%
Only slightly important	5%
Not important at all	1%

5.4.2 Satisfaction with Program Measures

Respondents were asked a series of questions relating to their satisfaction with individual program measures. Figure 5-3 shows participant satisfaction with the low flow showerheads provided by the program. Overall, participants were quite satisfied, with at least 80% of respondents reporting satisfaction with each of the queries relating to the showerheads. The highest level of satisfaction was with the ease of the installation (95%), followed by, the way it looked compared to the old one (89%), the look of the showerhead (88%), and the amount of flow (80%). Six percent of respondents reported being dissatisfied with the amount of flow from the new showerhead.

Respondents were also asked whether they had removed and replaced any of the installed showerheads, and 8% (5 respondents) reported that they had. Of these respondents, 4 of them removed and replaced the showerhead due to low flow.

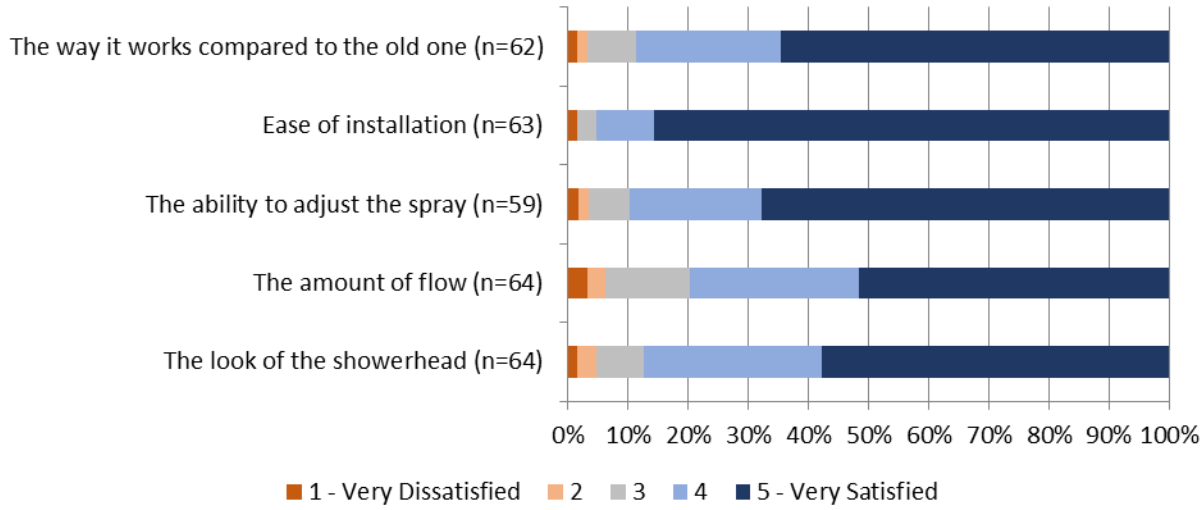


Figure 5-3 Satisfaction with Low Flow Showerheads

Figure 5-4 shows participant satisfaction with the kitchen aerators provided by the program. Overall, participants were quite satisfied, with at least 93% of respondents reporting satisfaction with each of the queries relating to the kitchen aerators. The highest level of satisfaction was with the ability to adjust the spray (100%), followed by, the ease of installation (98%), and the way it works compared to the old one (98%).

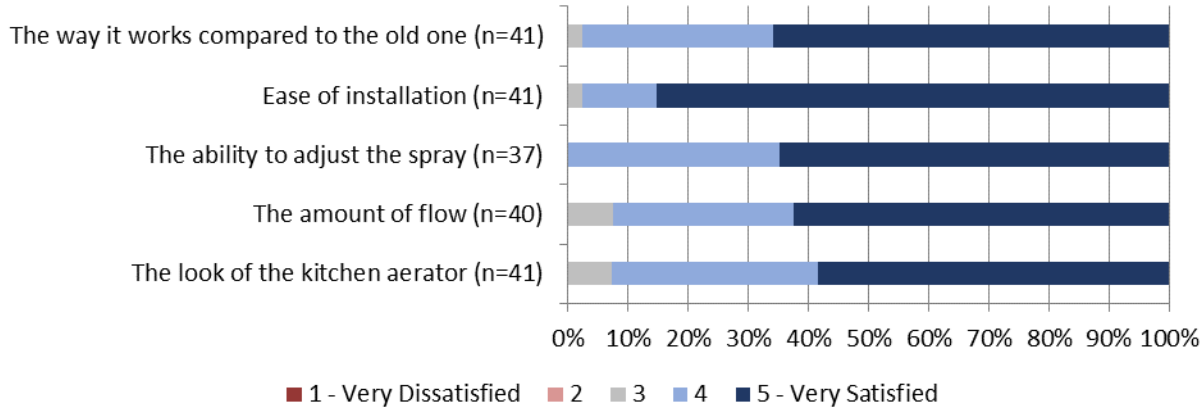


Figure 5-4 Satisfaction with Kitchen Aerators

Figure 5-5 shows participant satisfaction with the bathroom aerators provided by the program. Overall, participants were satisfied, with at least 91% of respondents reporting satisfaction with each of the queries relating to the bathroom aerators. The highest level of satisfaction was with the amount of flow (100%), followed by, the ease of installation (98%), the look of the bathroom aerators (95%), and the way it works compared to the old one (95%). Six percent of respondents reported being dissatisfied with the ability to adjust the spray.

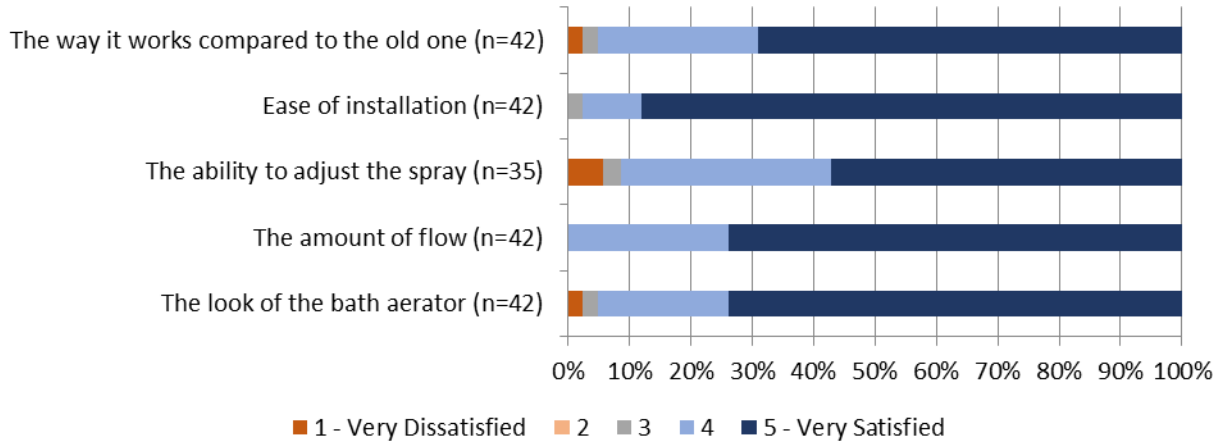


Figure 5-5 Satisfaction with Bathroom Aerators

5.4.2.1 Overall Program Satisfaction

Overall satisfaction with the program is high. Respondents were most satisfied with customer service from NMGC staff (92%) and the overall program experience (91%). The lowest levels of satisfaction were with savings on the monthly bill (62%), although only 6% of respondents reported being dissatisfied with monthly savings.

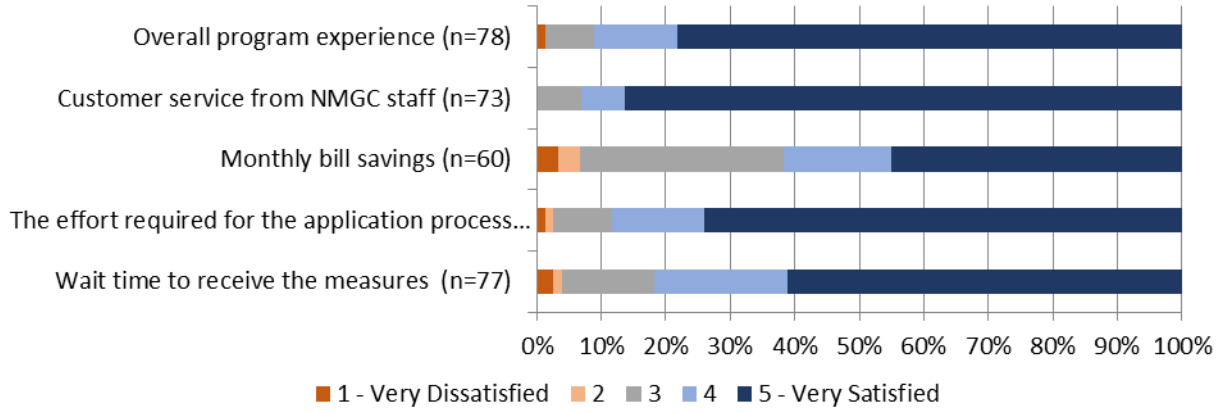


Figure 5-6 Participant Program Satisfaction

Respondents who expressed dissatisfaction with one or more program elements were asked to provide further information regarding the reasons for their dissatisfaction. Examples of these responses included:

> *"They took a while to come, then I get them and they didn't fit."*
>
> *"My gas has been high and it stays high"*
>
> *"We still haven't received the aerators"*

While these comments suggest that some participants had issues with the program, instances of dissatisfaction were very infrequent. As these comments were provided by only a small percentage of respondents, they do not likely reflect any systematic issues with program delivery.

Respondents were also given the opportunity to provide other open-ended feedback about the program, and many participants used this opportunity to express their praise for and satisfaction with program services. Examples of this type of commentary included:

> *"No, it was just really nice to learn about rebates for appliances for future purchase."*
>
> *"The programs are awesome! The programs are great!"*
>
> *"I think this program to think about saving, energy and money and it's a good program!"*

Overall, a high majority of the open-ended commentary consisted of positive remarks.

5.4.3 Participant Demographics

Respondents were asked a number of questions relating to their home, income, and educational level, and their responses are summarized below. Table 5-12 and

Table *5-13* summarize home vintage and size.

Table 5-12 Participant Home Vintage

When was your home built?	***Percent of Respondents (n=80)***
Before 1970's	25%
1970's	11%
1980's	14%
1990-1994	5%
1995-1999	5%
2000-2005	13%
2006 or newer	4%
Don't know	11%
Refused	0%

Table 5-13 Participant Home Size

What size is your home?	***Percent of Respondents (n=80)***
Less than 1,000 ft.^{2}	13%
1,001-1,500 ft.^{2}	28%
1,501-2,000 ft.^{2}	21%
2,001-2,500 ft.^{2}	10%
Greater than 2,500 ft.^{2}	14%
Don't know	14%
Refused	1%

Education and income levels are summarized in Table 5-14 and Table 5-15, respectively.

Table 5-14 Participant Education Level

What's the highest level of education you've completed?	***Percent of Respondents (n=80)***
Did not graduate high school	0%
High school graduate	25%
Associates degree, vocational/technical school, or some college	34%
Four-year college degree	21%
Graduate or professional degree	18%
Don't know	3%
Refused	0%

Table 5-15 Participant Income Level

What's the highest level of education you've completed?	***Percent of Respondents (n=80)***
Less than $25,000	15%
$26,000 - $35,000	19%
$36,000 - $50,000	24%
$51,000 - $75,000	19%
$76,000 - $100,000	5%

Greater than $100,000	11%
Refused	8%

5.5 Conclusions & Program Recommendations

5.5.1 Conclusions

The Evaluators' conclusions for the Low Flow Showerhead Program are presented below. The Evaluators have found that:

- **NMGC and PNM have been successful in cross-fuel coordination.** 31% of ex post net savings came from NMGC co-funding PNM programs. This minimizes program costs and assigns benefits to the appropriate utilities, and is a program best practice. This is acutely necessary for programs assed via the Utility Cost Test.
- **The second showerhead has been a cost-effective addition to the program.** In the last evaluation of the LFSP, it was recommended that NMGC add a second showerhead to the kit. Participants with two showerheads had a slightly higher ISR than single-showerhead participants (71% versus 68%), though this difference was not statistically significant. There were concerns that a second showerhead as a program option would have a lower ISR, but the evaluation findings demonstrate that this has not been an issue for the LFSP.
- **Participants are highly satisfied with the program.** Respondents indicated high satisfaction across all metrics other than observed bill savings. This is to be expected as this program type produces modest savings that a participant may not readily distinguish in their billed use.

5.5.2 Recommendations

- **Expand co-funding efforts with Xcel Energy kit programs.** The coordination model NMGC has developed with PNM has demonstrated success and could be expanded with Xcel Energy's Home Energy Service program. Other opportunities for coordination may include their Home Lighting Program, as that program derives significant savings from lighting kit giveaways.
- **Consider breaking out the ex ante 40% reduction in savings to account for differing net and gross effects.** NMGC applied a 40% reduction to the TRM unit energy savings and labeled it "free ridership". Their intent in doing so was to capture all parameters which may affect savings, including in-service rates and rates of electric water heating as well as net-to-gross effects. The result of this accounting of savings was that net realization was high (105.28%) while gross realization was low (66.80%) which may erroneously convey that the program has gross savings issues. The Evaluators recommend that NMGC:

- Reduce gross savings estimates by 33.2%
- Apply NTGRs as follows:
  - Either a program-level NTGR of 94.56%, or component-level NTGRs of:
  - NMGC Delivery: 88.2%
  - PNM Easy Savings Co-funding: 100.0%
  - PNM Home Energy Check-up Co-funding: 100.0%

6. Appendix A: Site Reports

This appendix contains the site reports for the Efficient Buildings program.

Project Number PRJ-682812
Program Efficient Buildings

Project Background

The participant is an industrial facility that received incentives from New Mexico Gas Company for decommissioning old boilers and piping heating load to newer boilers:

- (1) 200 HP (8,370 MBH) Cleaver Brooks Boiler decommission
- Connecting heating load from old boiler to newer boilers on site
- (2) Direct Fire Water Heaters take on additional heating load

Baseline

The baseline for this project is the 200 HP (8,370 MBH) Cleaver Brooks boiler which was measured to operate at 69% average efficiency.

M&V Methodology

Desk review was done by evaluator this project as the implementer provided photographic proof of decommissioned baseline boilers. The savings calculated by estimating the baseline gas consumption based on hours of operation described by the facility manager. The heating demand is calculated using the baseline gas consumption and multiplied by its measured efficiency.

$$Therms_{Baseline} = \left(\frac{Cap \times Hr \times LF}{10{,}000}\right)$$

Where,

$Therms_{Baseline}$	*Baseline gas consumption, therms*
Cap	*Baseline boiler capacity, 8,370,000 BTU*
Hr	*Boiler operating hours, 8,640 hours, 24/7 for 360 days*
LF	*Baseline boiler average load factor, 40%*

The baseline gas consumption is calculated to be 289,267 therms/year.

The evaluator assumed the heating demand remained the same for post installation case therefore, the final savings is calculated as follows,

$$Therms_{Savings} = Therms_{Baseline} \times \left(1 - \frac{Eff_{Baseline}}{Eff_{New}}\right)$$

Where,

$Therms_{Savings}$	*Total Gas Savings, therms/year,*

$Therms_{Baseline}$ *Baseline Gas Consumption, 289,267 therms/year*

$Eff_{Baseline}$ *Baseline Efficiency of boiler, 69%*

Eff_{New} *New boiler efficiency, 98%.*

The total gas savings project is calculated as 85,599 therms/year

Results

PRJ-682812 has a realization rate of 104%. The evaluator used the same field data collected by the implementer but approached this project using different savings algorithm. The ex ante savings were calculated based on calculating the baseline gas usage then subtracted gas consumption from the new boilers based on estimated demand. This method estimates two different heating demands and it is not comparing identical heating load for pre and post case. Despite this difference, the evaluator calculated nearly 100% realization because the ex ante savings approach under estimated savings by using conservative input.

Verified Gross Savings/Realization Rates

Measure	*Ex Ante (therms)*	*Ex Post (therms)*	*Realization Rate*
Boiler Load Managing	82,209	85,599	104.1%

Program Efficient Buildings
Project ID PRJ-862864

Project Background

The participant is a hospital facility that received incentives from NMGC for installing controls on boiler equipment. The scope of this project included:

- Installing O2 Trim/Parallel Positioning Controls

The boiler controls were installed on Boiler 2 (one of four boilers), which will now handle 90% of the facility process and space heating loads. The savings are the result of the increased combustion efficiency and the more efficient operating characteristics of Boiler 2 subsequent to the installation of the new controls.

Baseline

Boiler 1 was the leader boiler prior to the measure implementation. The baseline energy usage was determined using billing analysis.

M&V Methodology

The M&V effort for this project follows the guidelines of the 2016 International Performance Measurement and Verification Protocol (IPMVP) – Option C "Whole Facility".

The Evaluators approach to estimating savings for this project was as follows:

- Facility bills were collected for a 20-month pre-retrofit period, and for 6 weeks during the post-retrofit period.
- Therms/day over each billing period was regressed against Heating Degree Days. Heating Degree Days were pulled from www.degreedays.net, which aggregated data from www.wunderground.com. Weather data was recorded at Albuquerque, NM (station ID KABQ). A model was created separately for each period (pre and post retrofit).
- From the regressions, typical year load was estimated by multiplying the model Intercept term by the number of days in a year.
- The Evaluators then calculated typical year HDD using average HDD over the past 5 years and multiplied this number by the HDD intercept.

Baseline Regression Model

The table below contains the facility's billed use (therms/day), and HDD/day over the examined billing period.

Facility Billing & Weather Data

Month	Days	Therms/day	HDD/day
5/1/2013	31	1569.59	3.38
6/1/2013	30	1162.03	0.10
7/1/2013	31	1109.65	0.08
8/1/2013	31	1150.05	0.04
9/1/2013	30	1274.52	1.74
10/1/2013	31	1925.98	10.02
11/1/2013	30	2325.90	20.54
12/1/2013	31	2610.00	29.75
1/1/2014	31	2516.23	26.45
2/1/2014	28	2150.30	19.54
3/1/2014	31	1906.19	15.33
4/1/2014	30	1781.93	9.65
5/1/2014	31	1455.07	5.17
6/1/2014	30	1053.91	0.25
7/1/2014	31	992.78	0.03
8/1/2014	31	1007.88	0.31
9/1/2014	30	1084.66	0.89
10/1/2014	31	1323.70	5.51
11/1/2014	30	2328.36	19.57
12/1/2014	31	2700.14	26.18

The table below summarizes the model coefficients.

Baseline Regression Model Coefficients

Variable	*Coefficient*	*Standard Error*	*T-Stat*	*P-Value*	*Lower 90.0%*	*Upper 90.0%*
Intercept	1,130.100	38.846	29.092	0.000	1,062.739	1,197.461
HDD/Day	55.663	2.762	20.156	0.000	50.874	60.451

The model had an Adjusted R Square of 0.96.

Post Regression Model

To shorten the post-retrofit M&V period, the post model was developed using daily weather and consumption data. 48 days of data were collected.

The table below summarizes the model coefficients.

Post Regression Model Coefficients

Variable	Coefficient	Standard Error	T-Stat	P-Value	Lower 90.0%	Upper 90.0%
Intercept	1,316.593	22.974	57.307	0.000	1,278.010	1,355.177
HDD/Day	21.049	2.312	9.105	0.000	17.167	24.931

The model had an Adjusted R Square of .65

Measure Life

The EUL of this measure is 15 years.

Source: California DEER

Savings Results

The following data were used in calculating baseline consumption:

- Days: 365 (multiplied by the intercept)
- HDD: 4,509

Used in the baseline regression model, baseline consumption is 663,450Therms annually.

The following data were used in calculating post consumption:

- Days: 365 (multiplied by the intercept)
- HDD: 4,509

Used in the post regression model, post consumption is 575,460 Therms annually.

The savings for this project is:

Annual Therm Savings: (663,450 – 575,460) x 90% = 791,192 therms because 90% of the time the measure boiler operates as the lead boiler at the facility.

In program year 2015, the project received savings for 12,237 therms and it is 50,110 therms were claimed in program year 2016. The ex post savings for 2016 program year is 66,955 therms with 134% realization rate. The higher realization rate is due to change in ex post regression because a few days of data were omitted in ex ante analysis without explanation and the evaluator could not figure out the basis of omission, therefore, those data were included in the ex post regression for post installation data.

Program Efficient Buildings
Project ID PRJ-725514

Project Background

The participant is a public school that received incentives from New Mexico Gas Company for installing Fireye NMX2G controls on spacing heating hot water boilers. The evaluators verified that the site had installed:

- (3) Fireye NMX2G on Peerless 211A-25-W Boilers

Baseline

This project is an energy efficient boiler control and the baseline is without the boiler controller.

M&V Methodology

The implementer performed a pilot study of the measure at a pilot facility. The pilot study was conducted from December 6th, 2015 through February 3rd, 2016. During the pilot study period, the facility alternated boilers operation with fireye controller and without the controller. Based on facility trend data of boiler operation and heating degrees during monitoring period, the implementer calculated the boilers operate 11.3% less with Fireye controller than without it. This savings factor is applied to other Fireye projects in public schools.

The evaluator used whole building utility billing data to calculate typical gas consumed by space heating hot water boilers then applied savings factors from the pilot study.

The savings factor was calculated using International Measurement and Verification Protocol (IPMVP) Option A, “Key Parameter Measurement.” The site level analysis was done suing IPMVP option C “whole facility measurement.”

The evaluator constructed the regression model as following:

$$Therms = A \times HDD + B$$

Where,

A	*Regression coefficient dependent to heating degree days,*
B	*Regression coefficient for non-weather dependent consumption,*
HDD	*Heating Degree Days.*

The result of the regression is detailed below.

Regression Result

Coefficient	Coefficient Value	Standard of Error	T-Statistics
A	40.42	1.72	23.44
B	586.18	871.21	0.67

The regression model has coefficient of determination (R-square) of 96%.

Applying the regression model to TMY3 weather for Albuquerque, this facility typically consumes 229,724 therms per year.

From the typical annual gas consumption, non-space-heating consumptions were subtracted and those are domestic hot water boilers and cooking equipment.

Domestic hot water consumption was calculated based on the New Mexico TRM.

$$Therms = \frac{(N \times Usage \times Days) \times \Delta T \times C_p \times 8.34}{100{,}000 \times Eff}$$

Where,

N *Number of people in school,*

Usage *Typical hot water usage per person, 1.8 gal/person,*

Days *The total number of school days in a year,*

ΔT *Temperature difference between inlet and outlet, 55F,*

C_p *Heat Capacity of Water, 1 BTU/lb/F,*

8.34 *Density of water, 8.34 lb/gal,*

100,000 *Conversion from BTU to therms,*

Eff *Boiler Efficiency, 80%.*

Annual Domestic Hot Water Consumption

Enrolled Students	Staffs	HW Consumption (Gal/person)	Number of School Days	HW Produced (Gal/year)	ΔTemp. (F)	Boiler Efficiency	Annual Usage (therms/year)
2,509	258	1.8	172	859,557	55	80%	4,928

The annual gas consumption from cooking equipment was also estimated based on 4 hours of daily usage and 172 days of school days per year.

Annual Gas Consumption from Cooking Equipment

Type	BTU	Annul Operating Hours	Annual Usage (therms)
Gas Oven	50,000	688	344
Gas Oven	50,000	688	344
Gas Oven	50,000	688	344
Gas Oven	50,000	688	344
Gas Griddle	50,000	688	344
Total			**1,720**

Following table shows the total annual usage and non-space-heating gas consumptions by components, as well as the total annual savings.

Energy Consumption by Components and Savings

Total Annual Usage	DHW Base load	DHW Usage	Cooking Equipment	Heating Usage	Savings Factor	Annual Savings (therms/year)
229,724	7,034	4,928	1,720	216,041	11.3%	24,413

Savings Results

This project has 100% realization rate because the implementer and the evaluator collaboratively worked on creating savings factor from the pilot study. Through exchange of monitoring data and comments on analysis methodology, both parties agreed on the methodology and the savings factor.

Verified Gross Energy Savings and Realization Rate

Measure	Ex Ante (therms)	Ex Post (therms)	Realization Rate
Fireye Controller	24,413	24,413	100%

Program Efficient Buildings
Project Number PRJ-965042

Summary

Project Background

The participant is a correctional facility that received incentives from New Mexico Gas Company for installing energy efficient water heaters. On-site, the evaluators verified the participant had installed:

- 2 efficient domestic hot water heaters with BTH-300 (300,000 btu input) and BTH-500 (499,900 btu input); 96% and 95% efficiency respectively

Baseline

This project had two units with 5,021 Mbh output and 6,273 Mbh output which had 80% efficiency.

M&V Methodology

Efficient Hot Water Heater

On-site, evaluators verified the presence of all water heaters listed on the project application. Savings for the hot water measures were calculated using 3.11 High Efficiency Water Heaters in the New Mexico TRM.

Savings Parameters

$Efficiency_{Post}$	$Efficiency_{Pre}$
0.96	0.80

The evaluator constructed the regression model as following:

$$Therms = A \times \#\ of\ days + B\ x\ HDD$$

Where,

A *Regression coefficient dependent to heating degree days per day,*

B *Regression coefficient for non-weather dependent consumption per day, # of days is the # per billing cycle*

HDD *Heating Degree Days per day.*

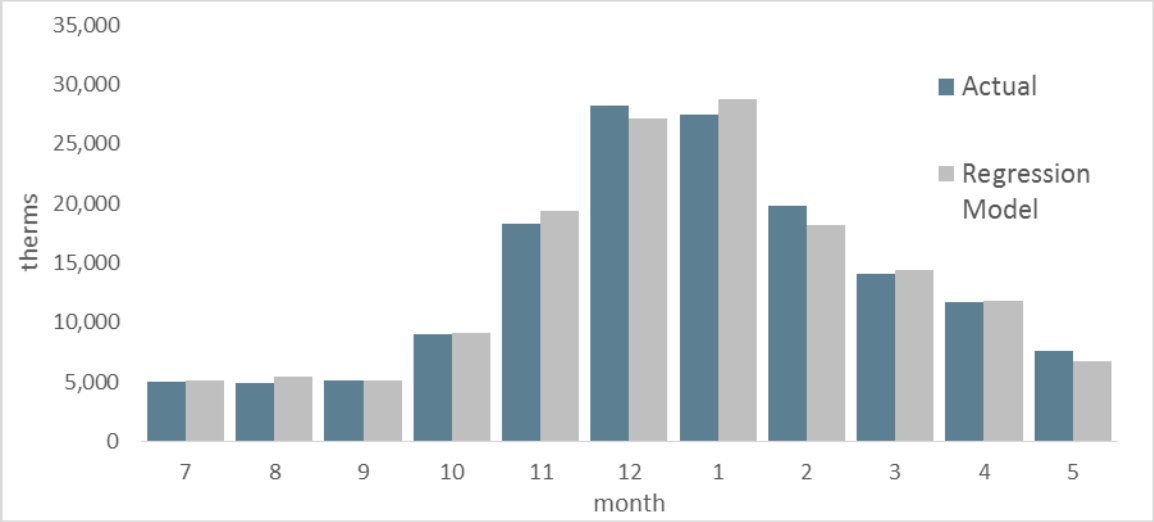
The result of the regression is,

Regression Result

Coefficient	Coefficient Value	Standard of Error	T-Statistics
Intercept	170.2793	13.6957	12.43318
Therms/HDD	30.8450	1.0830	28.4824

The regression model has coefficient of determination (R-square) of 98.9%.

Actual Billing Data vs Regression Model



Applying the regression model to TMY3 weather for Albuquerque, this facility typically consumes 190,362 therms per year.

Typical year annual gas consumption

Month	Number of Days	HDD at 60 degrees F	Gas Consumption
1	31	1,446.58	49,898.56
2	28	590.63	22,985.67
3	31	399.25	17,593.54
4	30	184.83	10,809.57
5	31	78.38	7,696.14
6	30	16.88	5,628.89
7	31	0.00	5,278.66
8	31	0.46	5,292.79
9	30	13.58	5,527.36
10	31	207.92	11,691.85
11	30	465.79	19,475.74
12	31	752.29	28,483.12
Total:	**365**	**4,157**	**190,362**

Savings Calculations

Savings are based on the following equation:

$$Therms_{Savings} = Therms_{Baseline} \times \left(1 - \frac{Eff_{Baseline}}{Eff_{New}}\right)$$

Where,

$Therms_{Savings}$	*Total Gas Savings, therms/year,*
$Therms_{Baseline}$	*Baseline Domestic Hot Water Gas Consumption, 190,362 therms*
$Eff_{Baseline}$	*Baseline Efficiency of boiler, 80%*
Eff_{New}	*New boiler efficiency, 96%.*

Results

PRJ-965042 had a realization rate of 122.9%. This site has a higher realization rate because analysts changed the regression methodology to have 60 degrees F as a reference temperature, resulting in a more reliable R squared result. Analysts also used TMY3 weather data instead of 5 year average weather data. The regression also used HDD dependent on billing period rather than an aggregated HDD of each month.

Verified Gross Savings/Realization Rates

Measure	*Ex Ante (therms)*	*Ex Post (therms)*	*Realization Rate*
Energy Efficient Boiler	24,085	29,612	122.9%

Program Efficient Buildings
Project Number PRJ-886427

Project Background

The participant received incentives from New Mexico Gas Company for replacing steam traps.

ECM1: Steam Trap and Valve Replacement

Summary of Steam Traps Replaced

Line Size (inches)	*Orifice Size (inches)*	*Inlet Pressure (PSIG)*	*Outlet Pressure (PSIG)*	*Applied Discharge Rate*
2	11/16"	15	5	206

M&V Methodology

The M&V effort for this project follows the guidelines of the 2016 International Performance Measurement and Verification Protocol (IPMVP) – Option A "Key Parameter Measurement."

The evaluators approach to estimating savings for this project was as follows:

- $Therm_{savings} = \frac{Steam\ Trap\ Discharge\ Rate \times Hours \times h_{fg}}{Ec_{Base} \times Therm\ Conversion\ Factor}$

  - Where:
  - $Steam\ Trap\ Discharge\ Rate$ = Steam loss in lb/hr.

- $EFLH_H$ = Hours of system pressurization
- h_{fg}= Latent heat of evaporation in Btu/lb from steam tables.
  - Ec_{Base} = Combustion efficiency for boiler, if unavailable estimate efficiency to 70%
  - $Therm\ Conversion\ Factor$ = 100,000BTU/Therm (assumed)

Data Collection Procedures

Data used in calculating savings with this project were collected as follows:

- Visual and photographic verification of installed steam trap
- Boiler efficiency: 83%

- Hours of system pressurization: determined to be 8,760 based on facility staff interviews.

Estimated Useful Life

- Steam Trap FTO15C-8 has an estimated 5 years (EUL)
- Results from on NYSERDA Natural Gas Database

Savings Results

Verified savings for for this project is 22,320 therms/year, with a realization rate of 100%.

Program Efficient Buildings
Project ID PRJ-878377

Project Background

The participant is a public school that received incentives from New Mexico Gas Company for installing Fireye NMX2G controls on spacing heating hot water boilers. The evaluators verified that the site had installed:

- (6) Fireye NMX2G on Peerless 211A-13-W Boilers

Baseline

This project is an energy efficient boiler control and the baseline is without the boiler controller.

M&V Methodology

The implementer performed a pilot study of the measure at a pilot facility. The pilot study was conducted from December 6th, 2015 through February 3rd, 2016. During the pilot study period, the facility alternated boilers operation with fireye controller and without the controller. Based on facility trend data of boiler operation and heating degrees during monitoring period, the implementer calculated the boilers operate 11.3% less with Fireye controller than without it. This savings factor is applied to other Fireye projects in public schools.

The evaluator used whole building utility billing data to calculate typical gas consumed by space heating hot water boilers then applied savings factors from the pilot study.

The savings factor was calculated using International Measurement and Verification Protocol (IPMVP) Option A, “Key Parameter Measurement.” The site level analysis was done suing IPMVP option C “whole facility measurement.”

The evaluator constructed the regression model as following:

$$Therms = A \times HDD + B$$

Where,

A	*Regression coefficient dependent to heating degree days,*
B	*Regression coefficient for non-weather dependent consumption,*
HDD	*Heating Degree Days.*

The result of the regression is,

Regression Result

Coefficient	Coefficient Value	Standard of Error	T-Statistics
A	47.44	1.34	35.51
B	341.28	493.16	0.69

The regression model has coefficient of determination (R-square) of 97%.

Applying the regression model to TMY3 weather for Albuquerque, this facility typically consumes 175,904 therms per year.

From the typical annual gas consumption, non-space-heating consumptions were subtracted and those are domestic hot water boilers and cooking equipment.

Domestic hot water consumption was calculated based on the New Mexico TRM.

$$Therms = \frac{(N \times Usage \times Days) \times \Delta T \times C_p \times 8.34}{100{,}000 \times Eff}$$

Where,

N	*Number of people in school,*
Usage	*Typical hot water usage per person, 1.8 gal/person,*
Days	*The total number of school days in a year,*
ΔT	*Temperature difference between inlet and outlet, 55F,*
C_p	*Heat Capacity of Water, 1 BTU/lb/F,*
8.34	*Density of water, 8.34 lb/gal,*
100,000	*Conversion from BTU to therms,*
Eff	*Boiler Efficiency, 80%.*

Annual Domestic Hot Water Consumption

Enrolled Students	Staffs	HW Consumption (Gal/person)	Number of School Days	HW Produced (Gal/year)	ΔTemp. (F)	Boiler Efficiency	Annual Usage (therms/year)
1,881	233	1.8	172	656,705	55	80%	3,765

The annual gas consumption from cooking equipment was also estimated based on 4 hours of daily usage and 172 days of school days per year.

Annual Gas Consumption from Cooking Equipment

Type	BTU	Annul Operating Hours	Annual Usage (therms)
Gas Oven	50,000	688	344
Gas Oven	50,000	688	344
Gas Griddle	50,000	688	344
Total			**1,032**

Following table shows the total annual usage and non-space-heating gas consumptions by components, as well as the total annual savings.

Energy Consumption by Components and Savings

Total Annual Usage	DHW Base load	DHW Usage	Cooking Equipment	Heating Usage	Savings Factor	Annual Savings (therms/year)
175,904	4,095	3,765	1,032	167,011	11.3%	18,872

Savings Results

This project has 100% realization rate because the implementer and the evaluator collaboratively worked on creating savings factor from the pilot study. Through exchange of monitoring data and comments on analysis methodology, both parties agreed on the methodology and the savings factor.

Verified Gross Energy Savings and Realization Rate

Measure	Ex Ante (therms)	Ex Post (therms)	Realization Rate
Fireye Controller	18,872	18,872	100%

Program Efficient Buildings
Project ID PRJ-894936

Project Background

The participant is a public school that received incentives from New Mexico Gas Company for installing Fireye NMX2G controls on spacing heating hot water boilers. The evaluators verified that the site had installed:

- (2) Fireye NMX2G on Weil McLain MGB-34 Boilers
- (1) Fireye NMX2G on Weil McLain LGB-7 Boiler
- (1) Fireye NMX2G on Weil McLain LGB-9 Boiler

Baseline

This project is an energy efficient boiler control and the baseline is without the boiler controller.

M&V Methodology

The implementer performed a pilot study of the measure at a pilot facility. The pilot study was conducted from December 6th, 2015 through February 3rd, 2016. During the pilot study period, the facility alternated boilers operation with fireye controller and without the controller. Based on facility trend data of boiler operation and heating degrees during monitoring period, the implementer calculated the boilers operate 11.3% less with Fireye controller than without it. This savings factor is applied to other Fireye projects in public schools.

The evaluator used whole building utility billing data to calculate typical gas consumed by space heating hot water boilers then applied savings factors from the pilot study.

The savings factor was calculated using International Measurement and Verification Protocol (IPMVP) Option A, “Key Parameter Measurement.” The site level analysis was done suing IPMVP option C “whole facility measurement.”

The evaluator constructed the regression model as following:

$$Therms = A \times HDD + B$$

Where,

A	*Regression coefficient dependent to heating degree days,*
B	*Regression coefficient for non-weather dependent consumption,*
HDD	*Heating Degree Days.*

The result of the regression is detailed below.

Regression Result

Coefficient	Coefficient Value	Standard of Error	T-Statistics
A	35.56	2.59	13.74
B	585.08	896.25	0.65

The regression model has coefficient of determination (R-square) of 90%.

Applying the regression model to TMY3 weather for Albuquerque, this facility typically consumes 135,809 therms per year.

From the typical annual gas consumption, non-space-heating consumptions were subtracted and those are domestic hot water boilers and cooking equipment.

Domestic hot water consumption was calculated based on the New Mexico TRM.

$$Therms = \frac{(N \times Usage \times Days) \times \Delta T \times C_p \times 8.34}{100{,}000 \times Eff}$$

Where,

N	*Number of people in school,*
Usage	*Typical hot water usage per person, 1.8 gal/person,*
Days	*The total number of school days in a year,*
ΔT	*Temperature difference between inlet and outlet, 55F,*
C_p	*Heat Capacity of Water, 1 BTU/lb/F,*
8.34	*Density of water, 8.34 lb/gal,*
100,000	*Conversion from BTU to therms,*
Eff	*Boiler Efficiency, 80%.*

Annual Domestic Hot Water Consumption

Enrolled Students	Staffs	HW Consumption (Gal/person)	Number of School Days	HW Produced (Gal/year)	ΔTemp. (F)	Boiler Efficiency	Annual Usage (therms/year)
1,824	191	1.8	172	625,951	55	80%	3,589

The annual gas consumption from cooking equipment was also estimated based on 4 hours of daily usage and 172 days of school days per year.

Annual Gas Consumption from Cooking Equipment

Type	BTU	Annul Operating Hours	Annual Usage (therms)
Gas Oven	50,000	688	344
Gas Oven	50,000	688	344
Gas Griddle	50,000	688	344
Total			**1,032**

Following table shows the total annual usage and non-space-heating gas consumptions by components, as well as the total annual savings.

Energy Consumption by Components and Savings

Total Annual Usage	DHW Base load	DHW Usage	Cooking Equipment	Heating Usage	Savings Factor	Annual Savings (therms/year)
135,809	7,021	3,589	1,032	124,167	11.3%	14,031

Savings Results

This project has 100% realization rate because the implementer and the evaluator collaboratively worked on creating savings factor from the pilot study. Through exchange of monitoring data and comments on analysis methodology, both parties agreed on the methodology and the savings factor.

Verified Gross Energy Savings and Realization Rate

Measure	Ex Ante (therms)	Ex Post (therms)	Realization Rate
Fireye Controller	14,031	14,031	100%

Program Efficient Buildings
Project Number PRJ-965052

Project Background

The participant is a casino that received incentives from New Mexico Gas Company for implementing energy efficient boiler measures. On-site, the evaluators verified the participant had installed:

- 1 efficient domestic hot water boiler

M&V Methodology

Efficient Gas Boiler

On-site, evaluators verified the presence of all boilers listed on the project application. Savings for the boiler measures were calculated using 4.11 High Efficiency Gas Boiler in the 2015 New Mexico TRM. The effective full load hours (EFLH) were derived from a billing data analysis which estimates annual domestic water usage under typical weather conditions (TMY). EFLH was derived with the following formula:
EFLH = Adjusted Base Load (therms) / Input Capacity$_{Post}$ (btu/hour) * 100,000, where Adjusted Base Load = TMY Adjusted Base Load*(EF$_{Pre}$-EF$_{Post}$)

Savings Parameters

Input Pre (MBH)	Input Post (MBH)	Output Pre (MBH)	Output Post (MBH)	EFLH	EF_{Post}	EF_{Pre}
1.200	1.050	1.000	0.987	4,923	0.94	0.84

Savings Calculations

Savings are based on the following equation, with an adjustment to account for different sizing of the pre and post boilers (1.20 MBH vs. 1.05 MBH):

$$Savings = CAP * \left(\frac{1}{EF_{Pre}} - \frac{1}{EF_{Post}}\right) * EFLH_{CR}$$

where:

Savings = Annual energy savings, therms

CAP = Efficient boiler rated output capacity, MBH

EF_{Post} = Efficient boiler rated AFUE

EF_{Pre} = Original boiler rated AFUE

$EFLH_{CR}$ = Effective full load hours of boiler operation for the climate region

Results

The overall therms realization rate for PRJ-965052 is 84%. The difference in savings was due to several factors:

1) EFLH in ex-ante used the ex-ante base load to derive EFLH. We used base load adjusted for change in efficiency to derive EFLH.
2) The linear regression used in ex ante savings estimate has coefficient of variance (R square) of 62% because it was using billing month as the usage month. The usage month need to be the month prior to the billing month because the facility is billed for the usage of prior month. With this correction R square value increases from 62% to 96%.
3) TMY3 weather data for Albuquerque was used to calculate a typical year savings instead of average weather for the past 5 years.

Verified Gross Savings & Realization Rates

Measure	***Verified***	
	Therms Savings	***Therms Realization Rate***
Efficient Gas Boiler	6,154	84.46%
Total	**6,154**	**84.46%**

Program Efficient Buildings
Project ID PRJ-1247247

Project Background

The participant is a public school that received incentives from New Mexico Gas Company for installing Fireye NMX2G controls on spacing heating hot water boilers. The evaluators verified that the site had installed:

- (2) Fireye NMX2G on Weil McLain B-G688-WS Boilers

Baseline

This project is an energy efficient boiler control and the baseline is without the boiler controller.

M&V Methodology

The implementer performed a pilot study of the measure at a pilot facility. The pilot study was conducted from December 6th, 2015 through February 3rd, 2016. During the pilot study period, the facility alternated boilers operation with fireye controller and without the controller. Based on facility trend data of boiler operation and heating degrees during monitoring period, the implementer calculated the boilers operate 11.3% less with Fireye controller than without it. This savings factor is applied to other Fireye projects in public schools.

The evaluator used whole building utility billing data to calculate typical gas consumed by space heating hot water boilers then applied savings factors from the pilot study.

The savings factor was calculated using International Measurement and Verification Protocol (IPMVP) Option A, “Key Parameter Measurement.” The site level analysis was done suing IPMVP option C “whole facility measurement.”

The evaluator constructed the regression model as following:

$$Therms = A \times HDD + B$$

Where,

A *Regression coefficient dependent to heating degree days,*

B *Regression coefficient for non-weather dependent consumption,*

HDD	*Heating Degree Days.*

The result of the regression is,

The regression model has coefficient of determination (R-square) of 97%.

Applying the regression model to TMY3 weather for Albuquerque, this facility typically consumes 35,723 therms per year.

From the typical annual gas consumption, non-space-heating consumptions were subtracted and those are domestic hot water boilers and cooking equipment.

Domestic hot water consumption was calculated based on the New Mexico TRM.

$$Therms = \frac{(N \times Usage \times Days) \times \Delta T \times C_p \times 8.34}{100{,}000 \times Eff}$$

Where,

N	*Number of people in school,*
Usage	*Typical hot water usage per person, 1.8 gal/person,*
Days	*The total number of school days in a year,*
ΔT	*Temperature difference between inlet and outlet, 55F,*
C_p	*Heat Capacity of Water, 1 BTU/lb/F,*
8.34	*Density of water, 8.34 lb/gal,*
100,000	*Conversion from BTU to therms,*
Eff	*Boiler Efficiency, 80%.*

The annual gas consumption from cooking equipment was also estimated based on 4 hours of daily usage and 172 days of school days per year.

Following table shows the total annual usage and non-space-heating gas consumptions by components, as well as the total annual savings.

Savings Results

This project has 100% realization rate because the implementer and the evaluator collaboratively worked on creating savings factor from the pilot study. Through exchange of monitoring data and comments on analysis methodology, both parties agreed on the methodology and the savings factor.

Regression Result

Coefficient	Coefficient Value	Standard of Error	T-Statistics
A	9.76	0.35	28.18
B	197.83	113.70	1.74

Annual Domestic Hot Water Consumption

Enrolled Students	Staffs	HW Consumption (Gal/person)	Number of School Days	HW Produced (Gal/year)	ΔTemp. (F)	Boiler Efficiency	Annual Usage (therms/year)
659	75	1.8	172	228,014	55	80%	1,307

Annual Gas Consumption from Cooking Equipment

Type	BTU	Annul Operating Hours	Annual Usage (therms)
Gas Oven	50,000	688	344
Gas Oven	50,000	688	344
Gas Griddle	50,000	688	344
Total			**1,032**

Energy Consumption by Components and Savings

Total Annual Usage	DHW Base load	DHW Usage	Cooking Equipment	Heating Usage	Savings Factor	Annual Savings (therms/year)
35,723	2,207	3,589	1,032	31,009	11.3%	3,504

Verified Gross Energy Savings and Realization Rate

Measure	Ex Ante (therms)	Ex Post (therms)	Realization Rate
Fireye Controller	3,504	3,504	100%

Program Efficient Buildings
Project ID PRJ-832582

Project Background

The participant is a medical office that received incentives from New Mexico Gas Company for installing domestic hot water heater. The evaluators verified that the site had installed:

- (1) A.O. Smith BTH-400A 399,900 BTU Boiler with 115 Gallon storage tank

Baseline

This project is an A.O. Smith BTP-150 720,000 BTU boiler which has 80% efficiency

M&V Methodology

The evaluator used regression model on baseline billing data to calculate the domestic hot water gas consumption. This method qualifies as International Measurement and Verification Protocol (IPMVP) option C "whole facility measurement.

The evaluator constructed the regression model as following:

$$Therms = A \times HDD + B$$

Where,

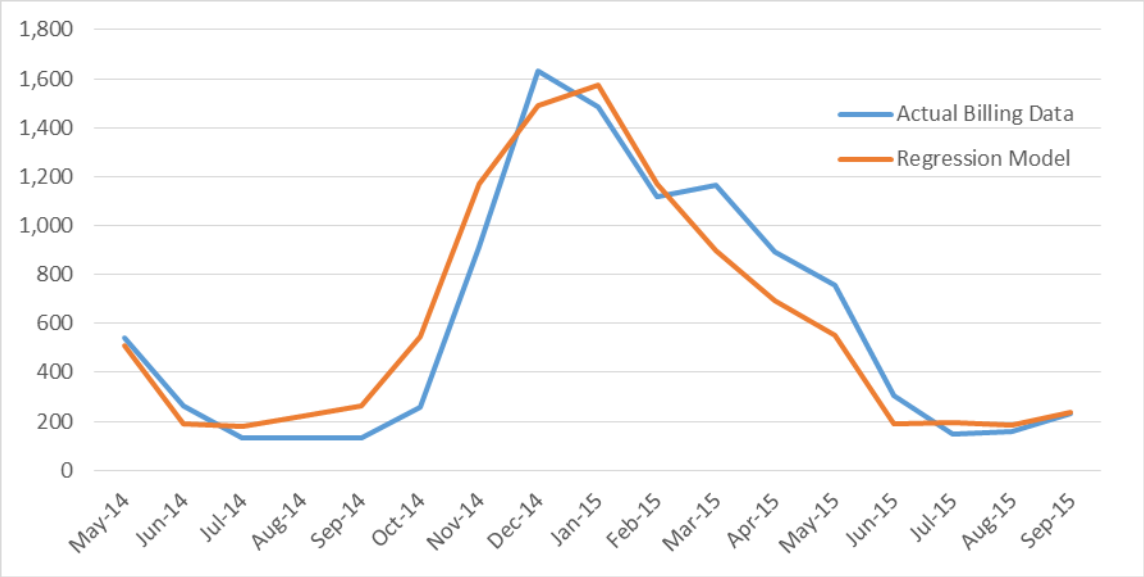
A	*Regression coefficient dependent to heating degree days per day,*
B	*Regression coefficient for non-weather dependent consumption per day,*
HDD	*Heating Degree Days per day.*

The result of the regression is detailed below.

Regression Result

Coefficient	*Coefficient Value*	*Standard of Error*	*T-Statistics*
A	1.378	0.115	11.997
B	5.006	1.774	2.822

The regression model has coefficient of determination (R-square) of 90.5%.



Applying the regression model to TMY3 weather for Albuquerque, this facility typically consumes 9,789.98 therms per year and 1,827.25 therms for domestic hot water.

Typical year annual gas consumption

Month	Days	HDD 70	Total Usage	DHW usage
1	31	1033.08	1,578.94	155.19
2	28	848.08	1,308.96	140.17
3	31	689.25	1,105.08	155.19
4	30	405.71	709.31	150.18
5	31	246.46	494.85	155.19
6	30	98.54	285.99	150.18
7	31	22.17	185.74	155.19
8	31	42.92	214.34	155.19
9	30	128.29	326.99	150.18
10	31	436.67	756.98	155.19
11	30	764.38	1,203.61	150.18
12	31	1062.29	1,619.19	155.19
Total	**365**	**5777.83**	**9,789.98**	**1,827.25**

From the typical annual gas consumption, non-space-heating consumptions were subtracted and those are domestic hot water boilers and cooking equipment.

Domestic hot water consumption was calculated based on the New Mexico TRM.

$$Therms_{Savings} = Therms_{Baseline} \times \left(1 - \frac{Eff_{Baseline}}{Eff_{New}}\right)$$

Where,

$Therms_{Savings}$	*Total Gas Savings, therms/year,*
$Therms_{Baseline}$	*Baseline Domestic Hot Water Gas Consumption, 1,827 therms/year,*
$Eff_{Baseline}$	*Baseline Efficiency of boiler, 80%*
Eff_{New}	*New boiler efficiency, 95%.*

Following table shows the total annual usage and non-space-heating gas consumptions by components, as well as the total annual savings.

Energy Consumption by Components and Savings

Annual DHW Usage	Baseline Efficiency	New Efficiency	Annual Savings (therms/year)
1,827	80%	95%	303.70b

Savings Results

This project has 13.6% realization rate because the implementer claimed double savings from a single domestic hot water boiler. The savings claimed as a boiler and as a water heater. The evaluator used billing regression to isolate domestic hot water gas consumption from a typical year annual gas consumption then calculated the savings based on difference in boiler efficiency.

Verified Gross Energy Savings and Realization Rate

Measure	Ex Ante (therms)	Ex Post (therms)	Realization Rate
DHW Boiler	2,239	304	13.6%

Program Efficient Buildings
Project Number PRJ-1014464

Project Background

The participant is a restaurant that received incentives from New Mexico Gas Company for implementing energy efficient water heater measures. On-site, the evaluators verified the participant had installed:

- 1 tankless water heater

M&V Methodology

Tankless Water Heater

On-site, evaluators verified the presence of all water heaters listed on the project application. Savings for the water heater measures were deemed using 3.11 Efficient Water Heaters in the 2016 New Mexico TRM. The following table shows the deemed savings value based on the building type, the type of water heater, input capacity, and energy factor.

Deemed Savings Value

Building Type	*Type*	*Input Capacity (MBtuh)*	*EF*	*Savings (therms)*
Sit-down Restaurant	Tankless	199	0.82	278

Savings Calculations

Energy savings are based on the deem savings value defined in section 3.11 Efficient Water Heaters in the 2016 New Mexico TRM.

Results

The overall project realization rate for PRJ-1014464 is 52%.

Verified Gross Savings & Realization Rates

Measure	*Verified*	
	Therms Savings	*Therms Realization Rate*
Tankless Water Heater	278	52%
Total	**278**	**52%**

The installed tankless water heater is CEE Tier 1 product because its energy factor is 0.82. If the tankless water heater is CEE Tier 2 product, the deemed savings is 557 therms per year which is similar to ex ante savings of 536 therms. Ex ante savings may have estimated savings based on tier 2 product rather than installed tier 1 product.

Program Efficient Buildings
Project ID PRJ-943658

Project Background

The participant is a restaurant that received incentives from New Mexico Gas Company for installing Energy Star compliance oven. The evaluator verified that the site had installed:

- (1) Blodgett BDO-100-G-ES Full-Size Convection Oven

Baseline

The baseline for this project is a none-Energy Star compliance convection oven.

M&V Methodology

The evaluator used the same method as Energy Star commercial kitchen equipment calculator which is the following equation,

$$Therms = Therm_{cooking} + Therm_{Idle} \times Hr_{Idle}$$
$$= \frac{C_{p\_Food} \times Q_{daily}}{Eff} + Therm_{Idle} \times \left(Hr_{op} - \frac{Q_{daily}}{Q_{cap}} \right)$$

Where,

C_{p_Food}	*Convection cooking energy to food, 250 btu/pound*
Q_{daily}	*The amount of food cooked per day, 100 pounds*
Eff	*Cooking energy efficiency*
$Therm_{idle}$	*Idle energy consumption, therms/hour*
Hr	*Average daily operation, 12 hours*
Q_{cap}	*Production Capacity, pounds/hour.*

The inputs are as follows:

Energy Star Savings Calculation Inputs

	Cooking Energy Efficiency	***Idle energy consumption (Btu/hour)***	***Production Capacity (pounds/hour)***
Baseline Product	44%	15,100	83
Energy Star Product	46%	12,000	86

Following table shows the total annual usage for baseline and Energy Star product, as well as the total annual savings.

Energy Consumption by Components and Savings

Baseline Consumption (therms)	***Energy Star Consumption (therms)***	***Annual Savings (therms/year)***
802	673	129

Savings Results

This project has 43.9% realization rate. The evaluator used Energy Star calculator to calculate the savings from this project and unable to identify how ex ante savings is based upon. The inputs to Energy Star calculation is conservative estimated based on site interviews collected from the store manager.

Verified Gross Energy Savings and Realization Rate

Measure	***Ex Ante (therms)***	***Ex Post (therms)***	***Realization Rate***
Energy Star Convection Oven	294	129	44%

Program Efficient Buildings
Project Number PRJ-1225889

Project Background

The participant is an industrial site that received incentives from New Mexico Gas Company for implementing energy efficient furnace measures. On-site, the evaluators verified the participant had installed:

- (2) 95.5 AFUE gas furnaces

M&V Methodology

Gas Furnace

On-site, evaluators verified the presence of all high efficiency gas furnaces listed on the project application. Savings for the furnace measures were calculated using equations from 4.10 High Efficiency Gas Furnace in the 2016 New Mexico TRM. Key parameters inputs include the efficient furnace AFUE and Albuquerque HDD

Savings Parameters

Region	*HDD*	*AFUE*
Albuquerque	4,180	95.5%

Savings Calculations

Savings are determined with the following equation,

$$Savings = 0.78 * T_o \left(\frac{1}{0.80} - \frac{1}{EF_E}\right)$$

where:

Savings = Annual energy savings, therms

T_o = Pre-existing furnace therm consumption

EF_E = Efficient boiler rated AFUE

$$To = M * HDD + B$$

where:

M = Slope, 0.12

B = y-intercept, -5.6

HDD = *Heating Degree Days*

Results

The overall therms realization rate for PRJ-1225889 is 245%.

Verified Gross Savings & Realization Rates

Measure	*Verified*	
	Therms Savings	*Therms Realization Rate*
Efficient Gas Furnace	157	245%
Total	**157**	**245%**

The high realization rate is possible from ex ante only consider 1 unit installed on site but the facility installed 2 units.