Evaluation of the 2019 Public Service Company of New Mexico Energy Efficiency and Demand Response Programs

Final Report

April 7, 2020

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Executive Summary

This report presents the independent evaluation results for Public Service Company of New Mexico (PNM) energy efficiency and demand response programs for program year 2019 (PY2019).

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

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

For PY2019, the following PNM programs were evaluated:

- Commercial Comprehensive
- Residential Lighting
- Easy Savings
- Home Works
- Large Customer Self-Direct
- Power Saver
- Peak Saver

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[1] NMSA §§ 62-17-1 *et seq* (SB 644). Per the New Mexico Public Regulation Commission Rule: Pursuant to the requirements of the EUEA, the NMPRC issued its most recent *Energy Efficiency Rule* (*17.7.2 NMAC*) effective September 26, 2017, that sets forth the NMPRC's policy and requirements for energy efficiency and load management programs. This Rule can be found online at http://164.64.110.134/parts/title17/17.007.0002.html

For each of the evaluated programs, the evaluation team estimated realized gross and net impacts (kWh and kW) and calculated program cost effectiveness using the UCT.[2] Brief process evaluations were also conducted for the Commercial Comprehensive and Residential Comprehensive programs.

The remaining programs that were not evaluated in 2019 are still summarized in this report. The accomplishments for the non-evaluated programs are reported using the following parameters:

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

The analysis methods used for the evaluated PY2019 programs are summarized as follows:

Commercial Comprehensive. The measures eligible for the Commercial Comprehensive program are primarily prescriptive in nature, but the program also includes custom projects. Gross impacts were estimated based on a review of the deemed savings values combined with engineering desk reviews of a statistically representative sample of projects covering a range of major measure types in each of the sub-programs. A small number of site visits were also conducted to confirm operating conditions for a select few projects. A phone survey was used to verify installation and to collect information needed for a self-report analysis of free ridership to determine net impacts.

Residential Lighting. Through this upstream program, **i**n-store price reductions are provided for a variety of energy efficient lightbulbs at a variety of retail channels. Deemed savings values included in PNM's tracking data (and used for the *ex ante* impacts) were compared with the values contained in the New Mexico Technical Reference Manual (TRM). If the values did not match, they were carefully reviewed to determine if the values were reasonable and the source appropriately documented. Net impacts were estimated using a lighting elasticity model.

Easy Savings. The Easy Savings program provides a kit for households with easy-to-install measures such as LEDs, faucet aerators, and low flow showerheads. A deemed savings review was conducted to determine gross impacts for measures provided in these

[2] The evaluation team consists of Evergreen Economics, EcoMetric, Demand Side Analytics, and Research & Polling.

kits. An NTG ratio of 1.0 is assumed for this program, given that the customer is required to request the kit directly from PNM and there is an emphasis on serving low income households.

Home Works. This program is implemented through participating schools using a 60-minute interactive presentation. Participating teachers are also provided with supplemental instructional materials and optional lessons. A deemed savings review was conducted to determine gross impacts for the measures provided to students as part of the Home Works curriculum. An NTG ratio of 1.0 is assumed for this program. Students filled out a survey as part of the Home Works curriculum, and these survey responses were analyzed as part of the PY2019 evaluation.

Large Customer Self-Direct. One project in this category was completed in PY2019. Gross impacts were estimated based on an engineering desk review of the project details. An NTG ratio of 1.0 was assumed for this project.

Power Saver and Peak Saver. PNM had two demand response programs in PY2019. The Power Saver program focuses on single-family, multifamily, and small and medium commercial customers. For all Power Saver customers, the five-minute interval load data were analyzed during event periods and compared to load shapes from a control group. The Peak Saver program is for larger customers that typically have unique load shapes, which makes finding a matched control group difficult. For these customers, savings were estimated based on the differences in load shapes between event and non-event weekdays for the same customer.

Table 1 summarizes the PY2019 evaluation methods.

Table 1: Summary of PY2019 Evaluation Methods by Program

Program	Deemed Savings Review	Participant Survey	Engineering Desk Reviews	Site Visits	Elasticity Model	Billing Regression
Commercial Comprehensive	◆	◆	◆	◆		
Residential Lighting	◆				◆	
Easy Savings	◆		◆			
Home Works	◆	◆				
Large Customer Self-Direct			◆			
Power Saver (Res & Small/Med Commercial)						◆
Peak Saver (Large Commercial & Industrial)						◆

The results of the PY2019 impact evaluation are shown in Table 2 (kWh) and Table 3 (kW), with the programs evaluated in 2019 highlighted in blue. For the non-evaluated programs, the totals are based on the *ex ante* savings and NTG values from the PNM tracking data.

Table 2: PY2019 Savings Summary – kWh

Program	# of Projects	Expected Gross kWh Savings	Engineering Adjustment Factor	Realized Gross kWh Savings	NTG Ratio	Realized Net kWh Savings
Commercial Comprehensive						
Retrofit Rebate	259	33,868,160	1.0376	35,140,655	0.6400	22,490,019
Midstream	40	1,026,000	0.9439	968,460	0.8400	813,506
Quick Saver	257	7,344,950	0.9729	7,145,630	1.0000	7,145,630
Building Tune-Up	30	1,117,073	0.5165	577,019	0.8700	502,007
New Construction	31	4,758,337	0.9155	4,356,088	0.8400	3,659,114
Multifamily	5,446	2,648,648	1.000	2,648,648	0.8360	2,214,270
Residential Lighting	1,026,426	27,503,984	1.3600	37,405,418	0.6800	25,435,684
Home Works	9,540	1,946,135	0.9714	1,890,535	1.0000	1,890,535
Energy Smart	218	359,850	1.0000	359,850	1.0000	359,850
Residential Comprehensive						
Home Energy Checkup	1,926	1,747,890	1.0000	1,747,890	0.8977	1,569,081
Refrigerator Recycling	6,760	7,301,240	1.0000	7,301,240	0.6800	4,964,843
Cooling	3,078	5,645,278	1.0000	5,645,278	0.5463	3,084,015
Easy Savings	6,542	2,446,708	1.0200	2,495,642	1.0000	2,495,642
New Home Construction	711	1,513,244	1.0000	1,513,244	0.8000	1,210,595
Large Customer Self-Direct	1	100,781	1.0000	100,781	1.0000	100,781
Power Saver	47,839	259,159	0.4341	112,490	1.0000	112,490
Peak Saver	92	329,873	0.5798	191,262	1.0000	191,262
Total	**115,035**	**99,917,309**		**109,600,130**		**78,239,324**

Table 3: PY2019 Savings Summary - kW

Program	# of Projects	Expected Gross kW Savings	Engineering Adjustment Factor	Realized Gross kW Savings	NTG Ratio	Realized Net kW Savings
Commercial Comprehensive						
Retrofit Rebate	259	6,436	1.0533	6,780	0.6400	4,339
Midstream	40	152	0.5868	89	0.8400	75
Quick Saver	257	1,767	0.5153	911	1.0000	911
Building Tune-Up	30	-	-	-	-	-
New Construction	31	1,018	1.0463	1,065	0.8400	895
Multifamily	5,446	237	1.0000	237	0.8360	198
Residential Lighting	1,026,426	5,376	1.2100	6,505	0.6800	4,424
Home Works	9,540	112	1.7429	195	1.0000	195
Energy Smart	218	36	1.0000	36	1.0000	36
Residential Comprehensive						
Home Energy Checkup	1,926	227	1.0000	227	0.8977	204
Refrigerator Recycling	6,760	1,145	1.0000	1,145	0.6800	779
Cooling	3,078	1,697	1.0000	1,697	0.5463	927
Easy Savings	6,542	89	1.7564	156	1.0000	156
New Home Construction	711	603	1.0000	603	0.8000	482
Large Customer Self-Direct	1	44	1.0452	46	1.0000	46
Power Saver	47,839	40,840	0.6885	28,120	1.0000	28,120
Peak Saver	92	28,754	0.5630	16,189	1.0000	16,189
Total	**115,035**	**88,533**		**64,001**		**57,975**

Lifetime kWh savings are shown in Table 4 by program and for the portfolio overall. This includes expected gross, realized gross, and realized net kWh lifetime savings. Based on the data collection and analysis conducted for this evaluation, the evaluation team found that, overall, PNM is operating high-quality programs that are achieving significant energy and demand savings and producing satisfied participants.

Table 4: PY2019 Savings Summary – Lifetime kWh

Program	Expected Gross kWh Lifetime Savings	Realized Gross kWh Lifetime Savings	Realized Net kWh Lifetime Savings
Commercial Comprehensive	450,463,170	451,123,891	326,009,912
Residential Lighting	233,233,784	317,197,946	215,694,603
Home Works	21,796,707	21,173,989	21,173,989
Energy Smart	5,731,286	5,731,286	5,731,286
Residential Comprehensive	128,244,424	128,244,424	80,311,072
Easy Savings	25,690,434	26,204,243	26,204,243
New Home Construction	22,532,203	22,532,203	18,025,763
Large Customer Self-Direct	100,781	100,781	100,781
Power Saver	259,159	112,490	112,490
Peak Saver	329,873	191,262	191,262
Total	**888,381,040**	**972,612,515**	**693,555,401**

Using net realized savings from this evaluation and cost information provided by PNM, the evaluation team calculated the ratio of benefits to costs for each of PNM's programs and for the portfolio overall. The evaluation team calculated cost effectiveness using the UCT, which compares the benefits and costs to the utility or program administrator implementing the program.[3] The evaluation team conducted this test in a manner consistent with the California Energy Efficiency Policy Manual.[4]

The results of the UCT are shown below in Table 5. All programs except Residential Comprehensive, Power Saver, and Peak Saver had a UCT of greater than 1.00, indicating

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

[4] California Public Utilities Commission. 2013. *Energy Efficiency Policy Manual, Version 5*. http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/Utilities_and_Industries/Energy_-_Electricity_and_Natural_Gas/EEPolicyManualV5forPDF.pdf

that they were cost effective. Overall, the portfolio had a UCT of 1.85 for PY2019 and therefore was cost effective.

Table 5: PY2019 Cost Effectiveness

Program	Utility Cost Test (UCT)
Commercial Comprehensive	2.07
Residential Lighting	5.37
Home Works	2.18
Energy Smart	1.14
Residential Comprehensive	1.12
Easy Savings	3.08
New Home Construction	2.34
Power Saver	0.85
Peak Saver	0.94
Overall Portfolio	**1.85**

The impact evaluation—which included engineering desk reviews for a sample of Commercial Comprehensive projects, deemed savings reviews, an elasticity model for the Residential Lighting program, and statistical models for the Power Saver and Peak Saver programs—resulted in relatively high realized gross savings. Adjustments to savings based on the Commercial Comprehensive desk reviews were primarily due to several factors: incomplete project documentation where savings calculations did not match up with the PNM work papers, adjustments to operating hour assumptions for lighting projects, and differences in HVAC baseline parameters. With the Building Tune-Up sub-program, there were additional engineering adjustments that resulted in a lower realization rate. For Residential Lighting, a separate recommendation is made to include HVAC interactive effects for all LED deemed savings, including for those bulbs distributed through the Home Works and Easy Savings programs.

The process evaluation activities included customer surveys for the Commercial Comprehensive program, student surveys for the Home Works program, and interviews with contractors involved in installing projects for the Commercial Comprehensive program. Across all these surveys and interviews, we found very high levels of satisfaction with PNM's 2019 programs.

1 Commercial Comprehensive Program

1.1 Commercial Comprehensive Gross Impacts

To verify gross savings estimates, the evaluation team conducted engineering desk reviews for a sample of the projects in the Commercial Comprehensive program and the single Large Customer Self-Direct project conducted in 2019. The goal of the desk reviews was to verify equipment installation, operational parameters, and estimated savings.

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

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

For projects in the Commercial Comprehensive program that used deemed savings values for prescriptive measures, the engineering desk reviews included the following:

- Review of measures available in the New Mexico TRM and the PNM work papers to determine the most appropriate algorithms which apply to the installed measure;
- Recreation of savings calculations using TRM/work paper algorithms and inputs as documented by submitted specifications, invoices, and post-installation inspection reports; and
- Review of TRM/work paper algorithms to identify candidates for future updates and improvements.

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

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

For the Large Customer Self-Direct project, the engineering desk review included the following:

- Review of measures available in the New Mexico TRM and the PNM work papers to determine the most appropriate algorithms which apply to the installed measure;
- Re-creation of savings calculations using TRM/work paper algorithms and inputs as documented by submitted specifications, invoices, and post-installation inspection reports; and
- Verification of operating parameters for lighting projects such as pre- and post-installation wattages and operating schedule.

In support of the engineering desk reviews, primary data were collected for select projects through on-site verification. The evaluation team visited sites to confirm the installation of efficiency measures and operational parameters. Based on participant feedback and visual inspection of equipment and controls, the evaluation team was able to make adjustments to the energy savings calculations to more accurately capture savings. The evaluation team also performed verification by requesting additional project-specific information from PNM and its implementers when clarification was needed and performing internet searches to confirm calculation parameters (e.g., operating hours).

The *ex ante* 2019 impacts are summarized in Table 6 for each Commercial Comprehensive sub-program, with the Retrofit Rebate and Quick Saver sub-programs accounting for most of the savings. In total, the Commercial Comprehensive program accounted for 54 percent of the *ex ante* energy impacts in PNM's overall portfolio.

Table 6: Commercial Comprehensive Savings Summary

Sub-Program	# of Projects	Expected Gross kWh Savings	Expected Gross kW Savings
Retrofit Rebate	259	33,868,160	6,436
Midstream	40	1,026,000	152
Quick Saver	257	7,344,950	1,767
Building Tune-Up	30	1,117,073	-
New Construction	31	4,758,337	1,018
Multifamily	5,446	2,648,648	237
Total	**6,063**	**50,763,168**	**9,611**

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

The final sample design is shown in Table 7. The resulting sample achieved a relative precision of 90/4.3 for the Commercial Comprehensive program overall, with precision ranging from 85/40 to 90/4.6 for the individual sub-programs.[5]

[5] The lower precision value (85/40) was for the Building Tune-Up sub-program, which had a low realization rate and greater variability in savings relative to the other sub-programs.

Table 7: Commercial Comprehensive Desk Review Sample

Sub-Program	Measure Group	Stratum	Count	Average kWh	Total kWh Savings	% of Savings	Final Sample
Retrofit Rebate	Custom	Certainty	2	2,935,998	5,871,995	12.2%	2
		1	22	91,483	2,012,626	4.2%	7
	HVAC	Certainty	4	227,406	698,308	1.5%	4
		1	4	61,129	244,514	0.5%	2
		2	24	9,672	232,124	0.5%	2
	Lighting	1	6	1,264,957	7,589,739	15.8%	4
		2	11	593,831	6,532,145	13.6%	4
		3	30	191,468	5,744,028	11.9%	4
		4	147	32,378	4,759,621	9.9%	4
	Other	Certainty	2	66,644	133,288	0.3%	2
		1	7	7,110	49,772	0.1%	4
Quick Saver		1	11	176,452	1,940,977	4.0%	4
		2	29	67,455	1,956,201	4.1%	4
		3	57	32,583	1,857,226	3.9%	4
		4	160	9,941	1,590,547	3.3%	4
Building Tune-Up		Certainty	4	225,896	802,048	1.7%	4
		1	26	12,116	315,025	0.7%	5
Midstream		Certainty	6	143,060	702,282	1.5%	6
		1	7	23,384	163,685	0.3%	2
		2	27	5,927	160,033	0.3%	2
New Construction		1	3	554,389	1,663,168	3.5%	2
		2	3	332,258	996,773	2.1%	2
		3	6	196,455	1,178,729	2.4%	2
		4	19	48,404	919,667	1.9%	2
Total			**617**	**304,600**	**48,114,520**	**100.0%**	**82**

The gross realized impacts for the Commercial Comprehensive program were determined by performing engineering desk reviews on the sample of projects. For prescriptive projects, the evaluation team found multiple measures that existed in both the New Mexico TRM and the PNM work papers, and the savings calculation approaches sometimes differed across sources. In these cases, we examined both sources to determine which approach offered greater detail and accuracy. Some of the other incentivized measures existed only in the PNM work papers, and in these cases, the algorithms were reviewed for accuracy and adjusted as necessary to calculate realized energy and demand savings. We also deferred to non-prescriptive values (e.g., custom lighting hours of use) assumed in the project files when possible, checking the values for reasonableness by corroborating with sources such as the TRM and posted business hours.

For custom projects, the *ex ante* savings calculations were recreated when possible (i.e., simple spreadsheet calculations). For more complex analyses (whole building energy simulations), the evaluation team audited the approaches taken and inputs used. When applicable, approaches and assumptions used in custom analyses were compared to those contained in the TRM.

A sub-sample of projects also received on-site verification visits from an engineer. Custom projects, lighting projects with savings of 650,000 kWh or greater, non-lighting projects with savings of 150,000 kWh or greater, and certainty stratum projects were identified as candidates for on-sites. Reviewing engineers contacted selected participants by phone and email to schedule appointments to come on site and confirm installation of incentivized equipment and verify operational parameters integral to the calculation of estimated savings. A total of nine site visits were completed for high impact and high uncertainty projects, and no major issues were identified during these visits.

The evaluation team, PNM, and its implementers regularly collaborated to discuss significant issues and questions that arose from the engineering desk reviews that were in progress. The implementers provided additional information, which the evaluation team was able to use to refine the results of the engineering desk reviews, often bringing verified results more in line with reported results.

The biggest engineering adjustments were to the Building Tune-Up savings, with an adjustment factor of almost 50 percent (0.5165). For these projects, the engineering review found several issues relating to HVAC interactive effects, unclear documentation of baseline conditions and other project specifics, and other site-specific issues that ultimately impacted the savings calculations. Additional detail on these and other engineering adjustments are included in the *Conclusions and Recommendations* section at the end of the Commercial Comprehensive chapter.

Table 8 and Table 9 show the results of the desk reviews and site visits and how the resulting engineering adjustments were used to calculated realized savings. For the Commercial Comprehensive program overall, these adjustments resulted in overall engineering adjustment factors of 1.001 for kWh and 0.945 for kW.

Table 8: PY2019 Commercial Comprehensive Gross kWh Impact Summary

Sub-Program	# of Projects	Expected Gross kWh Savings	Engineering Adjustment Factor	Realized Gross kWh Savings
Retrofit Rebate	259	33,868,160	1.0376	35,140,655
Midstream	40	1,026,000	0.9439	968,460
Quick Saver	257	7,344,950	0.9729	7,145,630
Building Tune-Up	30	1,117,073	0.5165	577,019
New Construction	31	4,758,337	0.9155	4,356,088
Multifamily	5,446	2,648,648	1.0000	2,648,648
Total	**6,063**	**50,763,168**	**1.0014**	**50,836,500**

Table 9: PY2019 Commercial Comprehensive Gross kW Impact Summary

Sub-Program	# of Projects	Expected Gross kW Savings	Engineering Adjustment Factor	Realized Gross kW Savings
Retrofit Rebate	259	6,436	1.0533	6,780
Midstream	40	152	0.5868	89
Quick Saver	257	1,767	0.5153	911
Building Tune-Up	30	-	-	-
New Construction	31	1,018	1.0463	1,065
Multifamily	5,446	237	1.0000	237
Total	**6,063**	**9,611**	**0.9450**	**9,082**

A summary of the individual desk review findings for each of the 82 projects is included in Appendix E.

1.2 Commercial Comprehensive Net Impacts

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

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

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

The method used for estimating free ridership (and ultimately the net-to-gross [NTG] ratio) using the self-report approach is based on the 2017 Illinois Statewide Technical Reference Manual (TRM).[6] For the PNM programs, questions regarding free ridership were divided into several primary components:

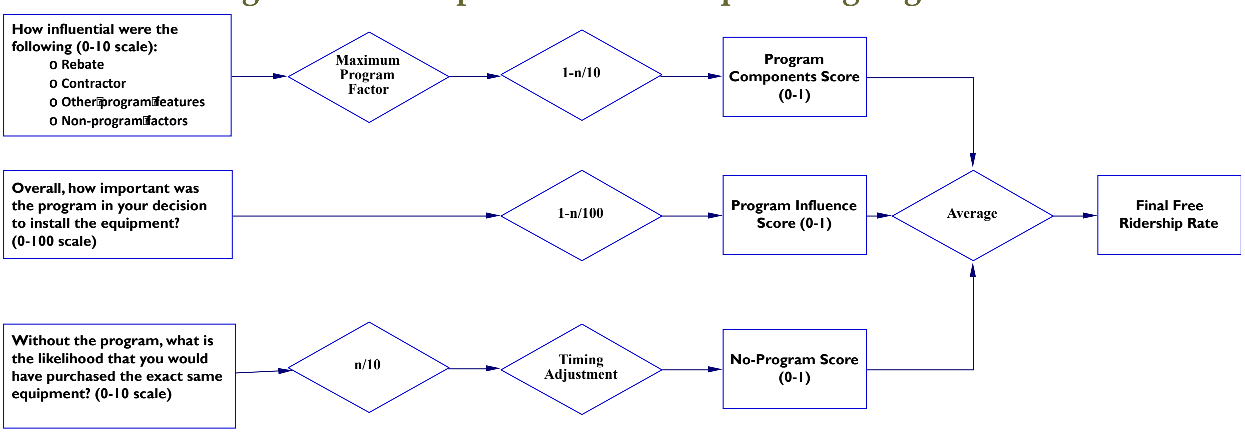
- A ***Program Component*** series of questions that asked about the influence of specific program activities (rebate, customer account rep, contractor recommendations, other assistance offered) on the decision to install energy efficient equipment;
- A ***Program Influence*** question, where the respondent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

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

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

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

Figure 1: Self-Report Free Ridership Scoring Algorithm



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

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

Program Component Questions

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

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

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

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

Program Influence Question

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

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

No-Program Component Questions

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

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

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

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

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

Free Ridership and NTG Calculation

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

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

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

1.3 Realized Gross and Net Impacts

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

Gross Realized Savings =
(*Ex Ante* Savings)*(Installation Adjustment)*(Engineering Adjustment Factor)

Net Realized Savings are then determined by multiplying the Gross Realized Savings by the net-to-gross ratio:

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

Net impacts for the Commercial Comprehensive program were calculated using NTG ratios from the participant phone survey or *ex ante* values, depending on the sub-program. For the Retrofit Rebate sub-program, the NTG ratio was developed using the self-report method and participant phone survey data. The resulting NTG ratio for the Retrofit Rebate sub-program is 0.64. For Midstream sub-program projects, customer contact information was not available, so a participant survey was not conducted. The *ex ante* NTG ratio of 0.84 was applied to the Midstream sub-program projects. For the Quick Saver sub-program, an NTG ratio of 1.00 was applied, due to the direct install design of this sub-program.

For both the New Construction and Multifamily sub-programs, little or no survey data were available for calculating free ridership due to the small amount of participant sample available. As a result, we did not calculate NTG ratios for these sub-programs based on these data. Instead, we have applied the *ex ante* NTG ratios for the New Construction and Multifamily sub-programs of 0.84 and 0.836, respectively.

Table 10 and Table 11 summarize the PY2019 net impacts for the Commercial Comprehensive program using the NTG ratios described above. Net realized savings for the program overall are 36,824,546 kWh, and net realized demand savings are 6,418 kW.

Table 10: PY2019 Commercial Comprehensive Net kWh Impact Summary

Sub-Program	# of Projects	Realized Gross kWh Savings	NTG Ratio	Realized Net kWh Savings
Retrofit Rebate	259	33,868,160	0.6400	22,490,019
Midstream	40	1,026,000	0.8400	813,506
Quick Saver	257	7,344,950	1.0000	7,145,630
Building Tune-Up	30	1,117,073	0.8700	502,007
New Construction	31	4,758,337	0.8400	3,659,114
Multifamily	5,446	2,648,648	0.8360	2,214,270
Total	**6,063**	**50,763,168**		**36,824,546**

Table 11: PY2019 Commercial Comprehensive Net kW Impact Summary

Sub-Program	# of Projects	Realized Gross kW Savings	NTG Ratio	Realized Net kW Savings
Retrofit Rebate	259	6,436	0.6400	4,339
Midstream	40	152	0.8400	75
Quick Saver	257	1,767	1.0000	911
Building Tune-Up	30	-	0.8700	-
New Construction	31	1,018	0.8400	895
Multifamily	5,446	237	0.8360	198
Total	**6,063**	**9,611**		**6,418**

1.4 Commercial Comprehensive Cost Effectiveness

The evaluation team calculated cost effectiveness using the Utility Cost Test (UCT) for the Commercial Comprehensive program, with the test calculations based on those prescribed in the California Energy Efficiency Policy Manual.[7]

[7] California Public Utilities Commission. 2013. *Energy Efficiency Policy Manual, Version 5*. http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/Utilities_and_Industries/Energy_-_Electricity_and_Natural_Gas/EEPolicyManualV5forPDF.pdf

In the UCT, the benefits of a program are considered to be the present value of the net energy saved, and the costs are the present value of the program's administrative costs plus incentives paid to customers. In order to perform the cost effectiveness analysis, the evaluation team obtained the following from PNM:

- Avoided cost of energy (costs per kWh over a 20+ year time horizon);
- Avoided cost of capacity (estimated cost of adding a kW/year of generation, transmission, and distribution to the system);
- Avoided cost of CO2 (estimated monetary cost of CO2 per kWh generated);
- Avoided transmission and distribution costs;
- Discount rate;
- Line loss factor; and
- Program costs (all expenditures associated with program delivery).

For the Commercial Comprehensive program, the program-weighted average effective useful life values were provided by PNM, calculated by dividing lifetime savings by annual savings. The evaluation team performed a spot check of measure-specific effective useful life values to confirm reasonableness and alignment with the TRM when applicable. The final net energy savings values estimated from the PY2019 impact evaluation for Commercial Comprehensive were used in the final cost effectiveness calculations.

The evaluation team also tested the cost effectiveness of the one Large Customer Self-Direct project using the UCT. PNM does not claim any administrative costs for self-directed projects, so the project cost paid by the customer, as documented in the submitted project files, was input as the cost for the UCT. Additionally, the evaluation team calculated the simple payback period of the project, as the New Mexico Energy Efficiency Rule requires that self-directed projects have a simple payback period of more than one year but less than seven years. For this single Self-Direct project, the UCT value was 3.61.

For the 2019 Commercial Comprehensive program, the UCT value was 2.07.

1.5 Quick Saver and Retrofit Rebate Participant Surveys

A participant phone survey was fielded in late 2019 for participants in the Retrofit Rebate and Quick Saver sub-programs of the Commercial Comprehensive program. The surveys averaged about 20 minutes in length and covered the following topics:

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

- Customer characteristics.

Additional interviews with Commercial Comprehensive program participants were also conducted by engineers if additional information was needed for the individual project desk reviews.

The original goal was to complete 100 phone surveys for the Commercial Comprehensive program, and given the number of participants, we attempted to contact a census of Retrofit Rebate and Quick Saver sub-program participants. Ultimately, 81 phone surveys were completed, with about one-third completed by Retrofit Rebate (prescriptive and custom projects) sub-program participants and two-thirds completed by Quick Saver (direct install) sub-program participants. Table 12 shows the distribution of completed surveys for the Commercial Comprehensive program.

Table 12: Commercial Comprehensive Phone Survey Sample

Sub-Program	Count of Customers with Valid Contact Info	Target # of Completes	Completed Surveys
Retrofit Rebate	95	40	31
Quick Saver	142	60	50
Total	**237**	**100**	**81**

The final survey instrument for the Commercial Comprehensive program is included in Appendix A of this report.

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

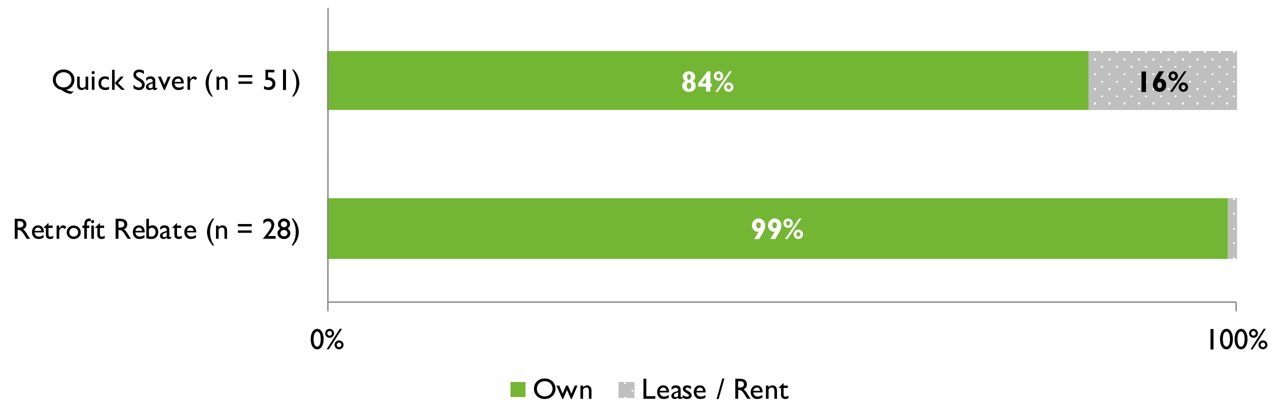
Throughout the analysis described here, we present the survey results as weighted percentages based on the proportion of savings represented by survey respondents relative to the total savings of all program participants.

1.5.1 Company Demographics

We asked survey respondents whether their company owns or leases the building where the project was completed. Counterintuitive to what would be expected of Quick Saver sub-program participants, Figure 2 shows that 84 percent of Quick Saver sub-program participants own their building, which is somewhat unexpected as direct install programs typically target customers that rent their spaces. On the other hand, 99 percent of Retrofit

Rebate sub-program participants reported they own the building where the measures were installed, which is more in line with what would be expected for this group.

Figure 2: Quick Saver and Retrofit Rebate Participant Own or Rent



The following two figures summarize the survey respondents' building and employee size by whether they participated in the Quick Saver or Retrofit Rebate sub-programs. Consistent with program design, Figure 3 and Figure 4 both show that larger customers are more likely to get rebates through the Retrofit Rebate sub-program, with 71 percent occupying buildings of 50,000 square feet or more. Additionally, 44 percent of Retrofit Rebate participants reported having more than 100 full-time employees and 31 percent reported having less than 20 full-time employees. Comparatively, mid- to small-sized customers were more commonly participants of the Quick Saver sub-program, with the majority of participant firms (49 percent) occupying buildings of less than 10,000 square feet. In addition, 89 percent of Quick Saver participants reported having more than 100 full-time employees.

Figure 3: Quick Saver and Retrofit Rebate Participant Building Size

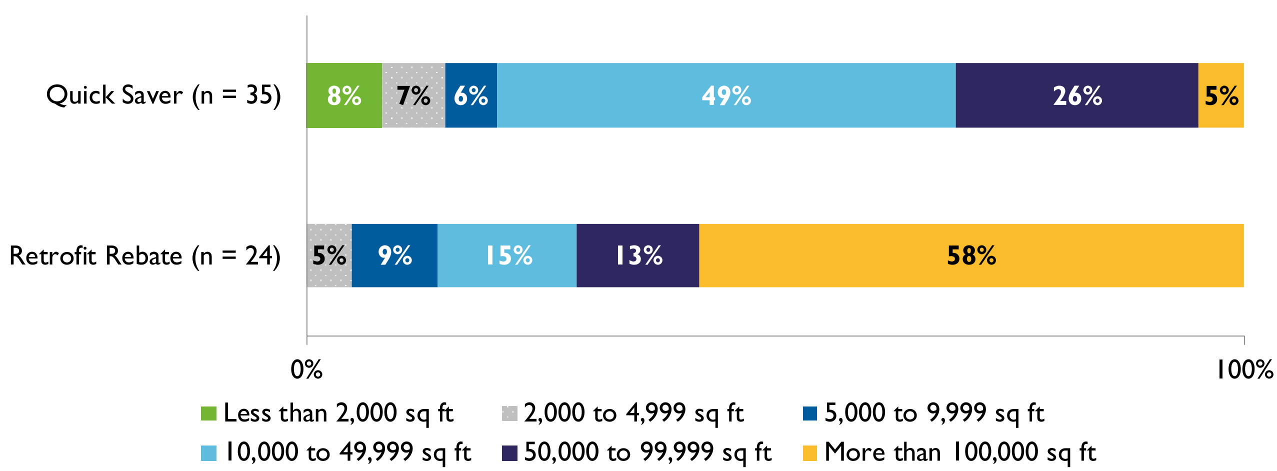


Figure 4: Quick Saver and Retrofit Rebate Participant Number of Employees

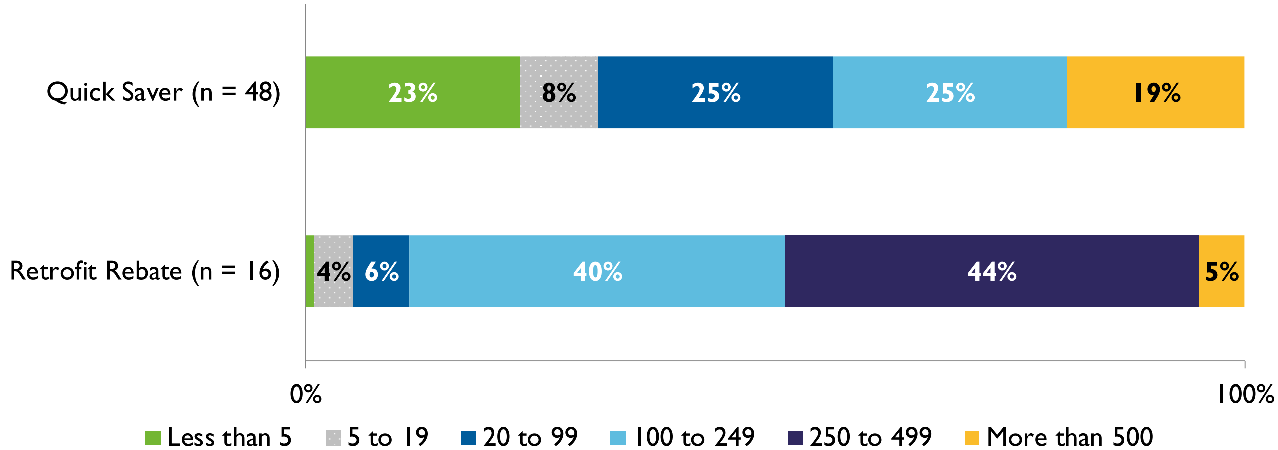
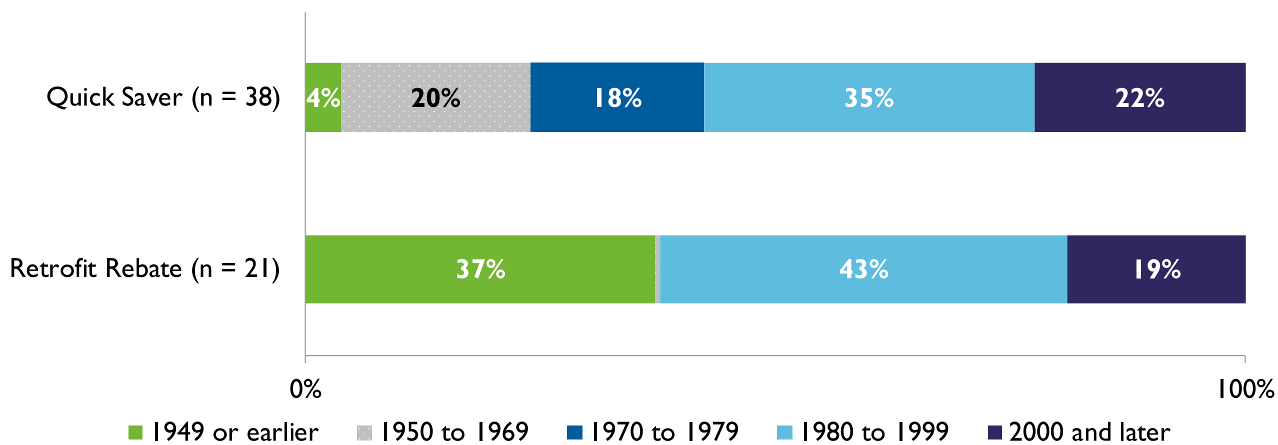


Figure 5 shows that the majority (43 percent) of Retrofit Rebate participants' buildings were built between 1980 and 1999 compared to 35 percent of Quick Saver participants' buildings. Quick Saver participants generally occupy newer buildings on average, with 22 percent reporting that their buildings were built sometime after 2000, and 57 percent of Quick Saver participants occupying buildings built after 1980. This suggests that both sub-programs could be doing more to target older buildings, where the potential for significant energy savings is the greatest.

Figure 5: Quick Saver and Retrofit Rebate Participant Building Age



1.5.2 Sources of Awareness

Both Retrofit Rebate and Quick Saver sub-program participants became aware of the program rebates/assistance through a variety of channels, including contractors/distributors, online web searches, and previous participation in a PNM rebate program. As shown in Figure 6, Retrofit Rebate participants most commonly learn about program offerings through interactions with contractors and distributors. Additionally, the most frequently reported channels were contractors/distributors (61 percent) and through online searches (23 percent).

For those who indicated that they learned about the program through multiple sources, the evaluation team asked which source was most useful in their decision to participate. As shown in Figure 7, the most useful source of awareness for Retrofit Rebate participants was past participation (94 percent), while Quick Saver sub-program participants found contractor/distributor recommendations (82 percent) the most useful source. This indicates that interactions with PNM (whether through direct contact, marketing, and/or previous participation) are significant drivers for both sub-programs.

Figure 6: Initial Source of Awareness

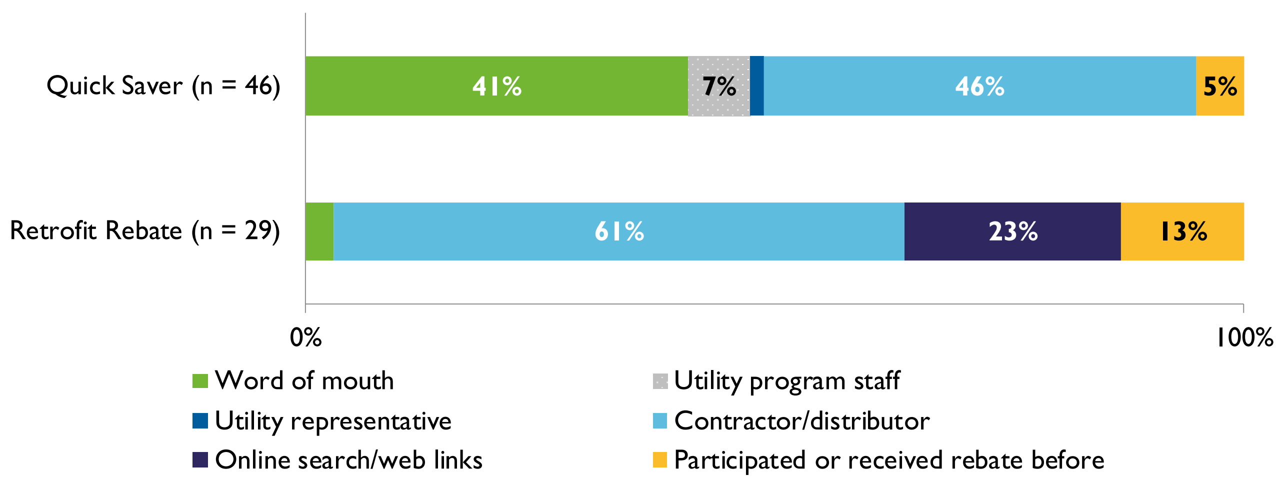
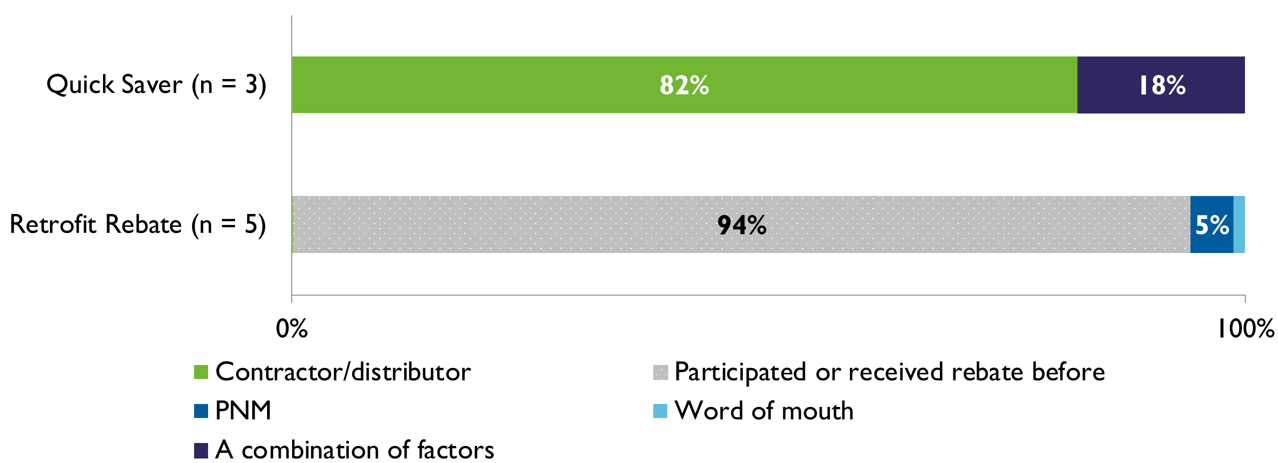


Figure 7: Most Useful Source of Awareness



1.5.3 Motivations for Participation

Figure 8 and Figure 9 show the level of importance placed on a variety of factors that might be influencing participation.

The money the participants expected to save on their energy bill was the most influential factor; 95 percent of Quick Saver and 64 percent of Retrofit Rebate participants reported that these expected savings were extremely important in their decisions to participate in the sub-programs. Other factors Quick Saver participants reported as important included upgrading out-of-date equipment and contractor recommendation. Additionally, improving air quality among Retrofit Rebate participants was also important, with 73 percent reporting that it was "extremely important."

Improving comfort was observed to be the least important factor for both Quick Saver participants and Retrofit Rebate participants; only 44 percent of Quick Saver participants responded that improving comfort in the business was "extremely important," while 29 percent of Retrofit Rebate participants responded "extremely important" in their decision.

Figure 8: Quick Saver Motivations for Participation (n=51)

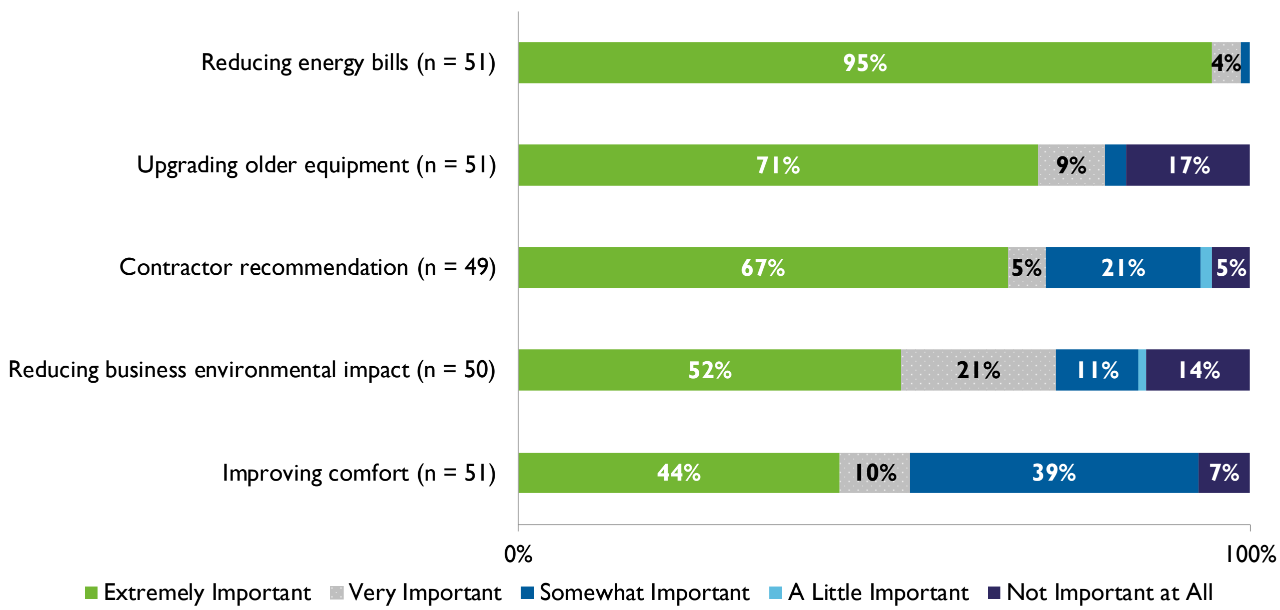
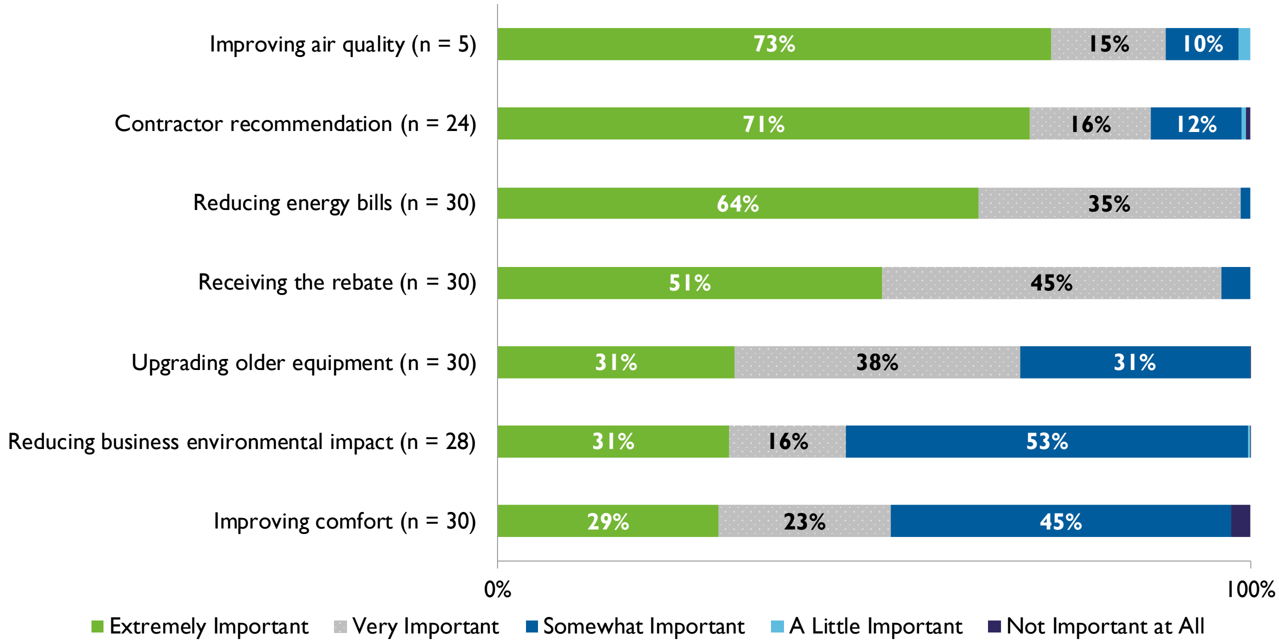


Figure 9: Retrofit Rebate Motivations for Participation (n=30)



In addition to motivations for participating, Retrofit Rebate respondents were given a list of potential program and non-program factors that may have influenced their decision about how energy efficient their equipment would be and were then asked to rate their importance on a 0 to 10-point scale.[8] As shown in Figure **10** below, the majority of Retrofit Rebate participants rated six of the eight program factors as very to extremely important (ratings of 8 to 10) or very important (6 or 7) in their decision to determine how energy efficient their project would be. The endorsement or recommendation by PNM staff was the highest-rated program factor.

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

Figure 10: Retrofit Rebate Importance of Program Factors (n=30)

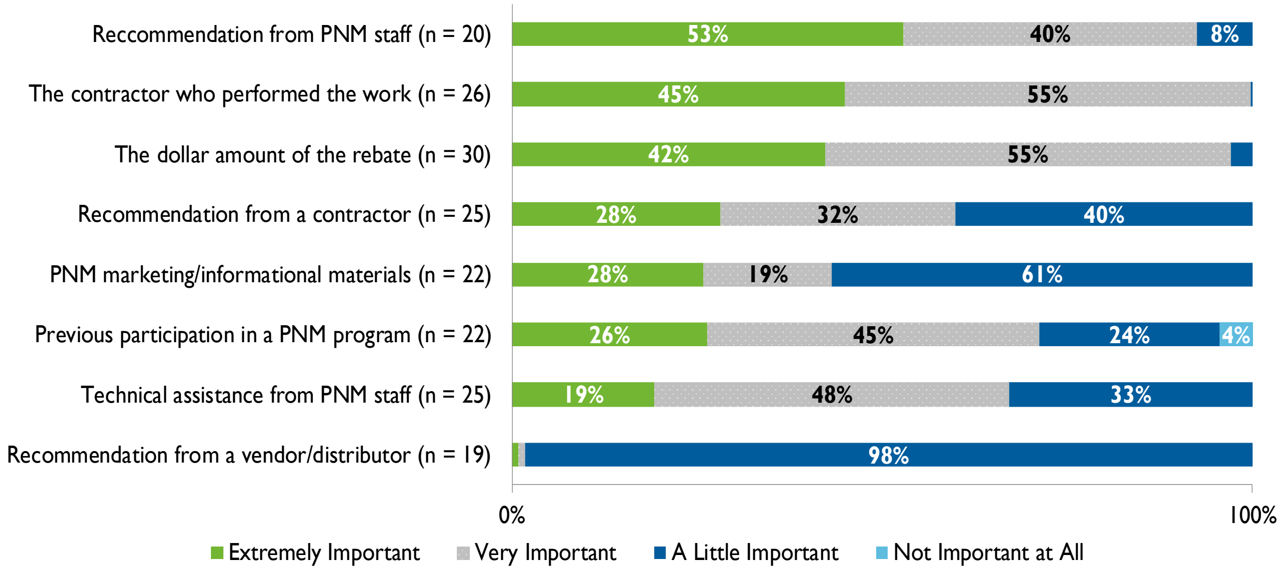
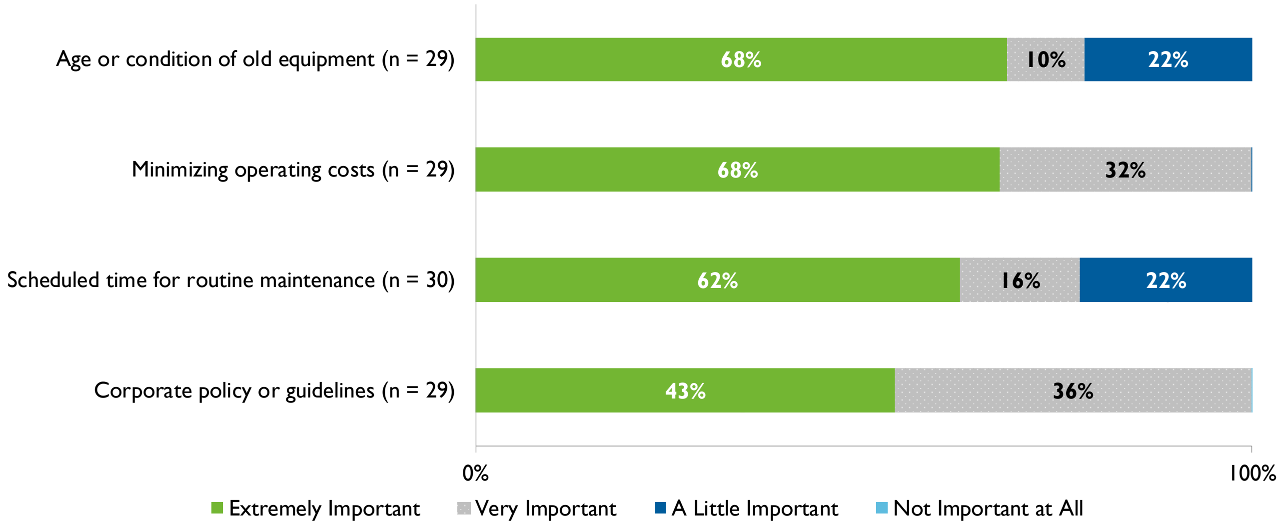


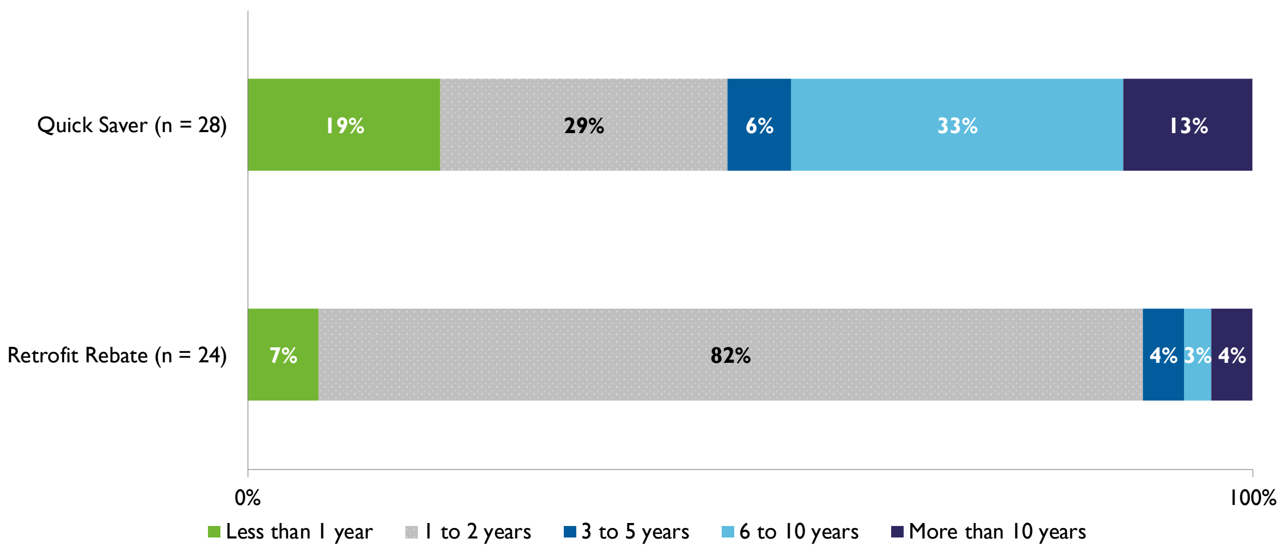
Figure **11** shows that the majority of Retrofit Rebate participants rated two of the four non-program factors as very to extremely important (ratings of 8 to 10) on the decision to determine how energy efficient their project would be. The age or condition of the old equipment and the minimization of operating costs were the most influential non-program factor in the decision regarding efficiency level of the equipment, with 68 percent of participants reporting it as extremely important. Corporate policy or guidelines were reported as less influential than other non-program factors, with 43 percent of participants reporting that it was "extremely important."

Figure 11: Retrofit Rebate Importance of Non-Program Factors (n=30)



To get a sense of the condition of the existing equipment, respondents were asked approximately how much longer the equipment would have lasted if it had not been replaced. Figure **12** shows that 52 percent of Quick Saver participants believed that their equipment would have lasted at least three years. This suggests that the program is doing a good job of targeting customers with functioning equipment, rather than those whose equipment is not working and would need to be replaced anyway (i.e., potential free riders). In contrast, the majority of Retrofit Rebate participants reported that their equipment would have lasted between one to two years.

Figure 12: Participant Equipment Remaining Life (n=28)



1.5.4 Participant Satisfaction

The participants evaluated their satisfaction with various components of the Quick Saver and Retrofit Rebate sub-programs on the following scale: very satisfied, somewhat satisfied, neither satisfied nor dissatisfied, somewhat dissatisfied, and very dissatisfied. The individual components that participants were asked to rank their satisfaction with included:

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

Overall, participants expressed high levels of satisfaction, with the majority of participants reporting ratings of "very satisfied" seven out of eleven program components. Ninety-three percent reported being "very satisfied" with the rebate program overall, and 91 percent were "very satisfied" with the contractor who installed the equipment. The program component with the lowest levels of satisfaction was the time it took participants to receive rebates with only 46 percent of participants reporting to be "extremely satisfied".

Figure 13 and Figure **14** below summarize the satisfaction levels for both the Quick Saver and Retrofit Rebate participants.

Overall, participants in both groups expressed high levels of satisfaction. Quick Saver participants were most satisfied with their interactions with PNM (97 percent), the overall value of the equipment for the price they paid (90 percent), and the rebate program overall (90 percent). Similarly, Retrofit Rebate program participants were most satisfied with the overall quality of the installation (99 percent), the contractor who installed the equipment (86 percent), and the overall value of the equipment for the price they paid (76 percent). Participants in both groups were least satisfied with the amount of time it took to participate in the program, although no participant indicated they were dissatisfied.

Figure 13: Quick Saver Program Satisfaction (n=52)

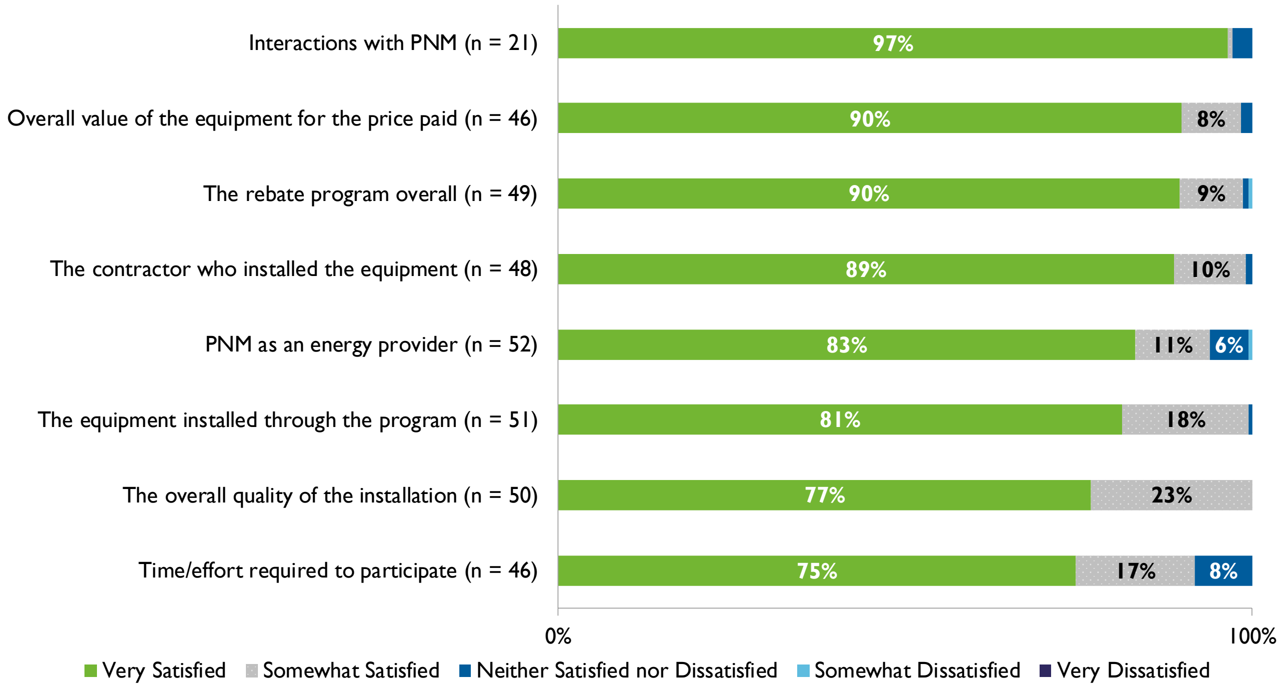
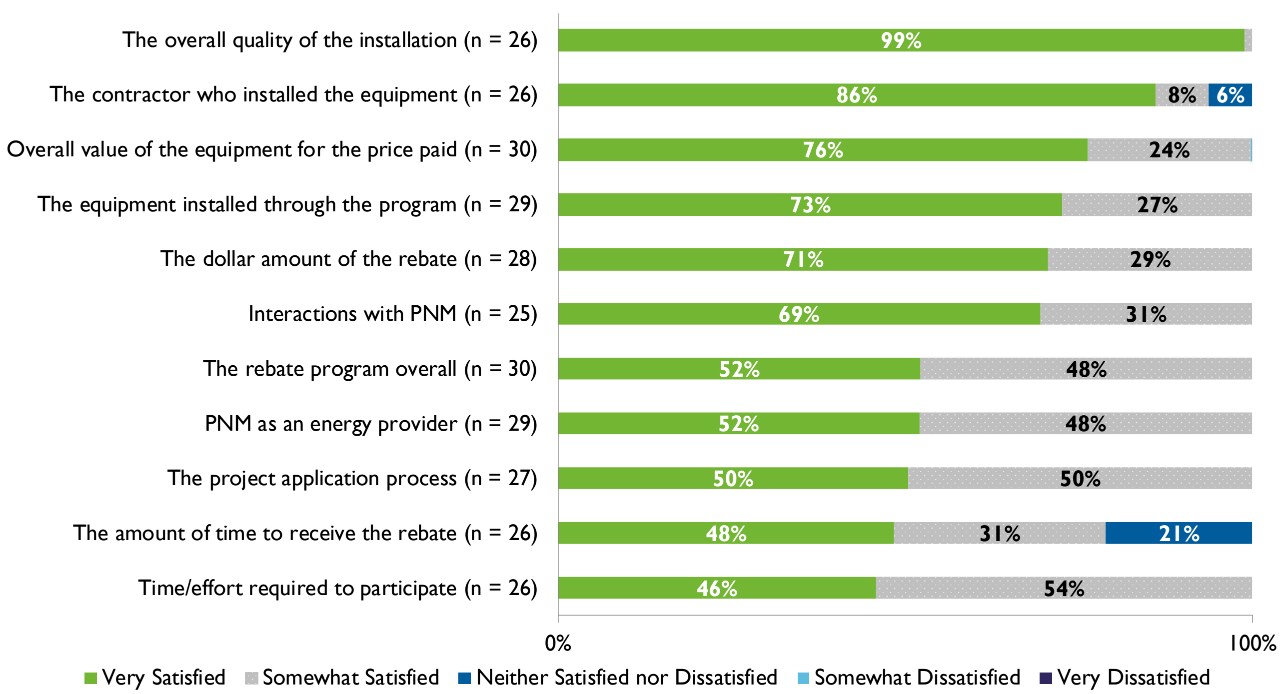


Figure 14: Retrofit Rebate Program Satisfaction (n=30)



1.6 Commercial Comprehensive Contractor Interviews

The evaluation team completed seven interviews with contractors and project managers who participated in the Commercial Comprehensive program in PY2019. For this evaluation round, the team concentrated on commercial retrofit rebates. The interviews focused on the following topics:

- Contractor background and program involvement;
- Program satisfaction; and
- Role and influence of the PNM program in the market.

Similar to last year, due to the low number of interviews and the depth of discussion, this section presents results in a qualitative fashion to show the range of perceptions and responses.

4.6.1 Contractor Background and Program Involvement

The interviewed participants varied in regards to the scope of their work and geographic reach of their businesses. Respondents included contractors from mid- to large-sized companies with wide-ranging services that span multiple PNM programs, contractors that specialize in such end uses as lighting, and program managers and operations managers for businesses who worked with contractors to complete projects. Most contractors reported to work on a local or state level, while one respondent reported to work on a national level.

Most contractors already had an understanding and awareness of utility energy efficiency programs prior to the 2019 program year. Respondents reported that they received information on rebates directly from PNM. One respondent reported that a PNM representative had directly come and talked to them about rebate opportunities. The interviewed program managers also reported that they were informed about rebate opportunities through their partnered contractors.

The contractors' overall knowledge of available programs across respondents suggests that PNM has done a successful job of making rebate information readily available to contractors.

4.6.2 Program Satisfaction

Contractors tended to rate the Commercial Comprehensive program relatively highly, although some did identify room for improvement. Interviewed contractors rated the program a 4 (three responses), or 5 (four responses) on a 5-point scale.[9]

Regardless of the ranking they provided, contractors did identify areas of potential improvement or ideas they wish PNM would consider. These included

- ***Improving communication with out of state contractors*** — One contractor expressed dissatisfaction with their communications with PNM, stating that they wished for PNM staff to be more "friendly to contractors not in state," pointing out that in order to reach large commercial contractors, the program would have to be dealing with contractors "not typically within New Mexico."
- ***Increasing or maintaining current rebate amounts*** — While participants had an understanding that the utility needs to calibrate the incentives to business considerations, many contractors expressed a desire for higher rebate amounts and feel that reductions in some past rebates have affected customer interest.

4.6.3 PNM Program Influence

To better understand the program influence on the market, the evaluation team explored how and when contractors communicate about the PNM rebates with customers and what role they play in the contractors' and customers' ultimate choices. The responses suggested that both contractors and resources provided by PNM were the main channels of information for customers. The responses also reflected that rebates greatly influenced customer decision making.

Many contractors identified themselves as the ones who inform customers of the efficiency opportunities (three responses), while others identified a combination of information made available by PNM and online resources such as the DSIRE website as the most important source of rebate information for customers (four responses).

All contractors reported that the rebates influenced their customers' decision making in terms of undergoing projects, as well as positively influencing their respective businesses. One contractor reported that the rebates helped both "increase customer satisfaction" as well as helped their business "up-sale to higher efficiency levels." Contractors also mentioned that the name recognition of PNM helped provide additional credibility for

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[9] The evaluation team asked contractors to rate the Commercial Comprehensive program overall on a 5-point scale that ranged from 1 ('very dissatisfied') to 5 ('very satisfied'). A 3 was defined as 'neither satisfied nor dissatisfied', while a 4 indicated the contractor was 'somewhat satisfied'.

their business and the specific rebate options they backed. Thereby, the PNM rebates increase consideration of efficient options through participating trade allies.

These results are based on a small number of interviews, however, and should be seen as informing the utility's understanding of *how* the program influences the market and not *how much*. It would take more research to determine how widespread these dynamics are or to measure market effect quantitatively.

1.7 Commercial Comprehensive Conclusions and Recommendations

Impact evaluation activities for the Commercial Comprehensive program included engineering desk reviews for a sample of the Retrofit Rebate, Quick Saver, Building Tune-Up, Midstream, and New Construction sub-programs. A subset of sampled projects also received a site visit by an evaluation engineer. Based on these desk reviews and site visits, an engineering adjustment factor of 1.001 was derived for kWh and 0.945 for kW savings.

Conclusions and recommendations resulting from these reviews are discussed below:

- Project-specific *ex ante* calculation steps for prescriptive projects were not always documented in the files available for the evaluation team's review.
    - Using inputs from the provided project documents and algorithms from the PNM work papers resulted in savings different (both higher and lower) than those reported by PNM for multiple projects.
    - Without additional documentation of the project-specific calculations performed by PNM, the reasons for differences between reported and verified savings were not always clear to the evaluation team.
    - **Recommendation:** Provide documentation of calculation steps made for each project, ensuring that submitted project documentation can be followed to reproduce the reported savings estimates.

- The evaluation team adjusted the lighting hours of use for multiple projects.
    - It is not clear what hours PNM used to calculate the savings for some of the lighting projects in the Quick Saver sub-program. The project documentation includes customer-reported operating hours.
    - For exterior light fixtures that operate from dusk to dawn, the evaluation team used 4,192 annual hours of use (dusk-to-dawn) as noted in the PNM work papers. It is not clear what annual hours of use were used to calculate the savings for some of the Quick Saver projects.

- **Recommendation:** Utilize customer-reported operating hours to ensure the operation of the lights is accurately captured, provided they are appropriate for the building type when cross-checked with the PNM work papers.
- **Recommendation:** Use 4,192 hours per year for lights that operate on a dusk-to-dawn schedule as noted in the PNM work papers.

- The evaluation team found projects that claimed peak demand savings for light fixtures that operate on a dusk-to-dawn schedule. As these fixtures are not on during the afternoon peak demand period, the evaluation team set the demand savings for these fixtures as zero.
    - **Recommendation:** Zero out peak demand savings for light fixtures that operate on a dusk-to-dawn schedule.
- The evaluation team was not able to reproduce the *ex ante* peak demand savings for several prescriptive high efficiency motor and prescriptive VSD projects using the PNM work papers.
    - Using assumptions, algorithms, baseline values, and project specific inputs from the documentation, the evaluation team calculated the *ex post* peak demand savings.
    - Without additional documentation of the project-specific calculations performed by PNM, the reasons for differences between reported and verified savings were not always clear to the evaluation team.
    - **Recommendation:** Provide calculations or a text summary of the calculation if deviations are made from the PNM work papers, such as averaging deemed values, for prescriptive projects.
- Project-specific *ex ante* HVAC savings for Midstream projects did not match up with savings determined using PNM work papers.
    - Using assumptions, algorithms, baseline values provided in the PNM work papers, and AHRI documentation on installed HVAC units, the evaluation team calculated *ex post* HVAC savings, which were different (both higher and lower) than those reported by PNM for multiple Midstream projects.
    - Without additional documentation of the project-specific calculations performed by PNM, the reasons for differences between reported and verified savings were not always clear to the evaluation team.
    - **Recommendation:** Provide more insight into the Midstream *ex ante* savings calculations/algorithm used by PNM, ensuring that either the PNM work papers or the New Mexico TRM is being applied correctly.

- Project-specific *ex ante* savings reported for hot food holding cabinets (food service equipment) under the PNM Midstream sub-program did not match *ex post* savings calculated by the evaluator.
    - PNM work papers did not provide the baseline idle rate for hot food holding cabinets.
    - The evaluator used a baseline idle rate of 70 Watts per cubic foot as per the Ohio TRM (2018) to calculate *ex post* savings, which were different than reported savings for hot food holding cabinets.
    - **Recommendation:** Update the PNM work papers and include the baseline idle rate for hot food holding cabinets utilized to calculate *ex ante* savings.
- Project-specific *ex ante* HVAC savings for New Construction projects did not match up with savings determined using PNM work papers.
    - Using assumptions, algorithms, baseline values provided in the PNM work papers, and AHRI documentation on installed HVAC units, the evaluation team calculated *ex post* HVAC savings, which were different (both higher and lower) than those reported by PNM for multiple new construction projects.
    - PNM application and post inspection workbooks did not provide enough detail about assumptions made by the implementer (such as EFLH, CF, baseline efficiencies, and methodology) to calculate *ex ante* savings.
    - Without additional documentation of the project-specific calculations performed by PNM, the reasons for differences between reported and verified savings were not always clear to the evaluation team.
    - **Recommendation:** Provide more insight into the New Construction *ex ante* HVAC savings calculations, ensuring that either the PNM work papers or the New Mexico TRM is being applied correctly.
- Project-specific *ex ante* lighting savings for New Construction projects considered non-Design Lights Consortium (DLC) fixtures to calculate proposed lighting power density (LPD).
    - As per PNM work papers and the New Mexico TRM, efficient lighting fixtures must be DLC or ENERGYSTAR® (ES)-rated LED fixtures. To calculate proposed LPD, the implementer used the total wattage being installed in the New Construction project and the total area marked for new construction.

- The evaluator decided to calculate effective proposed DLC/ES-rated LPD by eliminating non-DLC/ES fixtures and areas not having DLC/ES fixtures.
- The *ex post* savings were calculated using the effective DLC/ES-rated LPD and baseline LPD (as per the PNM work papers). The area under consideration was also scaled down to only DLC/ES areas.
- **Recommendation:** Consider only DLC and ES-rated fixtures for new construction LPD calculation and scale down areas to include DLC/ES fixtures only.

- The evaluation team adjusted multiple Building Tune-Up projects to align with the methodology and assumptions in the PNM work papers.
  - When possible, the evaluation team used the algorithms and assumptions (building type) listed in the PNM work papers to calculate the *ex post* energy and peak demand savings.
  - **Recommendation:** Ensure *ex ante* savings are calculated using the algorithms and inputs listed in the PNM work papers for applicable measures.
- The evaluation team identified several issues after reviewing the *ex ante* calculation approaches and documentation for the Building Tune-Up projects. The nature of this sub-program results in complex and site-specific measures. These projects can typically have extensive interactive effects between facility systems (HVAC) and are often fixing abnormal operation or improving upon outdated operating practices.
  - Three of the sampled projects utilized bottom-up models to predict the HVAC energy usage of the facility both before and after the recommended measures. The *ex ante* model for these projects included hardcoded values, which made verification difficult. Additionally, the project documentation did not describe the baseline operation condition, such as the actual setpoint changes implemented in the facility's energy management system. The *ex ante* savings for these projects overestimated energy savings compared to the verified savings from the customers utility bills. One customer appeared to have rolled back the changes after two months.
  - The *ex ante* calculation for one project mislabeled the units and used an additional conversion factor, which resulted in a significant increase in savings. A second measure for the same project was described in the documentation to be for the installation of thermostats. The evaluation team found through a customer interview that the customer did not install NEST thermostats in their office space. Instead, the customer replaced occupant-controlled thermostats with temperature sensors controlled by their energy management system. The project documentation did not clearly describe the

nature of the project and did not provide technical details, such as changes to the setpoint, which would be helpful during verification. The *ex ante* thermostat savings used estimated dollar savings per thermostat from a study, but the documentation did not contain a citation.

- There were two Building Operator Certificates projects evaluated during PY2019 as part of the Building Tune-Up program. The same customer completed two different projects at two different locations, and representatives from each site were certified. The evaluation team completed follow-up interviews, which revealed that the representative from one site had moved to a new position. The evaluation team completed a billing analysis using updated utility bills for each site. The site where the certified staff remained realized 100 percent of the anticipated savings. Alternatively, the site where the certified staff member had left showed no savings.
- **Recommendation:** Develop a robust review process with experienced staff that can navigate the complexity of these types of projects.
- **Recommendation:** Ensure that *ex ante* calculation methodologies and assumptions are fully documented and supported. This documentation should also include information on how the existing system was controlled and interacted with other systems in addition to the changes implemented.
- **Recommendation:** Encourage the development of calculations that do not require hardcoded values. Alternatively, PNM may provide documentation and explanation of the equations used to develop the hard-coded values to allow for the recreation of the values.
- **Recommendation:** Consider emphasizing that participants in the building operator certification should be those who are likely to stay involved in the energy and facilities management areas at the site. The evaluation team understands this is not in the program's direct control. However, the results of operator certification measures are linked to how long certified staff remain involved in energy decision making.

2 Residential Lighting Program

The residential lighting market in the U.S. has experienced significant change over the past decade as the Energy Independence and Security Act of 2007 (EISA) has led to the phase-out of incandescent bulbs, consumers have become more aware of LEDs, and the purchase price of LEDs has become increasingly affordable. PNM's Residential Lighting program promotes adoption of LED lighting by providing incentives to customers to replace less efficient light bulbs with LED bulbs through in-store rebates and coupons at participating retailers in PNM's service territory and rebated online sales for rural or homebound customers. Total PY2019 program bulb sales by store type is shown in Table 13.

Table 13: Sales of Bulbs Through the PNM Residential Lighting Program, 2019 Program Year

Retailer Type	Warehouse	Non-Warehouse	Total	Percent of Total
Standard	251,600	711,948	963,548	93.9%
Specialty	26,478	36,400	62,878	6.1%
Total	**278,078**	**748,348**	**1,026,426**	**100%**

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

While 12 retailers participated in the Residential Lighting program over the period analyzed, three participating retailers dominated bulb sales. These three retailers each fit a different retail channel (mass merchant, warehouse, and DIY) and serve an array of customer income demographics. Combined, these three retailers accounted for 91 percent of rebated sales through the program.

2.1 Residential Lighting Gross Impacts

For the Residential Lighting program measures, the gross impact analysis consisted of reviewing the calculations of per-unit savings values used for all the individual lighting measures covered by the program and then comparing those calculations to the algorithms and assumptions in the New Mexico TRM. In general, the evaluation team found that the formula used to calculate bulb savings was being applied correctly. However, the savings numbers can be improved by including an adjustment to account for the interactive effects with HVAC equipment. When this adjustment is applied (as shown in Table 14), the gross savings numbers increase by 36 percent for kWh and 21 percent for kW.

Table 14: Residential Lighting Gross Impacts

Residential Lighting	Expected Gross Savings	Engineering Adjustment Factor	Realized Gross Savings
kWh Savings	27,503,984	1.36	37,405,418
kW Savings	5,376	1.21	6,505

2.2 Residential Lighting Net Impacts

The evaluation team used a Poisson regression model to estimate free ridership and the net-to-gross (NTG) ratio for PNM's upstream Residential Lighting program.[10] The Poisson regression model approach utilizes actual price and quantity sales data on light bulbs purchased through the upstream Residential Lighting program to estimate the impact that rebates provided by PNM have on the demand for LED bulbs.[11] The impact is measured as a marginal effect, which is an estimate of the percent change in bulbs demanded associated with a one dollar increase in the rebate provided to customers.

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

The model specifications we used for the analysis is as follows:[12]

$$ln(bulbs_{i,t,s}) = \alpha + \beta_1 price_{i,t,s} + \beta_2 watts_i + \beta_3 lumens_i$$

$$bulbs_{i,t,s} = Number\ of\ bulb\ type\ i\ sold\ in\ period\ t\ by\ store\ s$$

$$price_{i,t,s} = Price\ of\ bulb\ type\ i\ sold\ in\ period\ t\ by\ store\ s$$

$$watts_i = Wattage\ of\ bulb\ type\ i$$

$$lumens_i = Lumens\ of\ bulb\ type\ i$$

Once the Poisson regression model was estimated, the model coefficients were used to estimate net program bulb sales using the following steps:

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[10] For programs with an upstream incentive, the rebate is provided to the retailer and then passed along to the customer as a rebate at the point of sale.

[11] This is in contrast to alternative net impact methods that rely on surveys or interviews (e.g., in-store intercept surveys) of a sample of customers that ask them how important the incentive was in their decision to purchase the light bulbs.

[12] Prior to model estimation, bulb sales data were normalized to a consistent 30-day sales period.

1. The total number of bulbs sold through the program was totaled from the program sales data (**Gross Program Sales**).
2. The average price per bulb ***with*** the rebate and ***without*** the rebate was calculated from the sales data.
3. The coefficients from the model were used to compute ***estimated bulb sales with the rebate*** and ***estimated bulb sales without the rebate***. The difference between these two estimates represents the **Net Program Sales**—i.e., bulb sales that are attributable to PNM's upstream Residential Lighting program.
4. The free ridership rate and NTG ratio were calculated using the following equation:

$$Free\ Ridership\ Rate = \frac{Estimated\ Bulb\ Sales\ without\ Rebate}{Estimated\ Bulb\ Sales\ with\ Rebate}$$

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

The evaluation team utilized the Poisson regression model and the analytical approach described above to estimate the net impacts of PNM's upstream Residential Lighting program. The quantity of bulbs sold is inversely related to price, as illustrated by the sales and price data shown in Table 15. About 71 percent of bulbs sold through PNM's Residential Lighting program were $2.00 or less, and another 20 percent were between $2.01 and $4.00. Relatively few bulbs sold through the program had a rebated cost greater than $4.00.

Table 15: Bulb Sales by Rebated Price of Bulb*

Rebated Price of Bulb	Average Pre-Rebate Price Per Bulb	Average Rebated Price Per Bulb	Proportion of Bulbs Sold
$2.00 or less	$2.72	$1.27	71.1%
$2.01 - $4.00	$4.76	$2.96	19.6%
$4.01 - $6.00	$8.02	$5.07	6.9%
$6.01 - $8.00	$11.68	$7.87	1.4%
$8.01 - $10.00	$12.65	$9.10	0.6%
More than $10.00	$12.74	$10.74	0.4%

* Results in table are for all bulb types included in data provided by PNM.

To develop the Poisson regression model, the evaluation team analyzed sales data for PNM's Residential Lighting program during 2019 to understand the impact that point-of-sale rebates had on the number of LED bulbs purchased by retail customers.[13] Since the customer receives the rebate at the time of purchase (as opposed to a mail-in rebate or a rebate on a future purchase), it acts to immediately lower the purchase price of the LED lighting.

The generalized Poisson model is specified as:

$$Ln(\lambda_{i,t}) = x_i'\beta$$

Where $\lambda_{i,t}$ is the total number of bulbs sold by retailer i during period t. The empirical model the evaluation team estimated for the PNM Residential Lighting program is specified as:

$$ln(bulbs_{i,t,s}) = \alpha + \beta_1 price_{i,t,s} + \beta_2 watts_i + \beta_3 lumens_i$$

$$bulbs_{i,t,s} = Number\ of\ bulb\ type\ i\ sold\ \ in\ period\ t\ by\ store\ s$$

$$price_{i,t,s} = Price\ of\ bulb\ type\ i\ sold\ \ in\ period\ t\ by\ store\ s$$

$$watts_i = Wattage\ of\ bulb\ type\ i$$

$$lumens_i = Lumens\ of\ bulb\ type\ i$$

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

For standard bulbs, we estimated separate models for warehouse and non-warehouse retailers. For specialty bulbs, there was not a sufficient number of records of bulb sales for warehouse stores to estimate separate models for warehouse and other retailers, and so we estimated a single Poisson regression model for specialty bulbs.[14] Warehouse and non-warehouse retailers differed significantly with respect to the average number of bulbs sold

[13] All bulb sales data provided by PNM were for sales that occurred in 2019, with the exception of one record that was for bulb sales that extended from 12/01/2018 to 12/31/2018.

[14] To be more precise, there was not a sufficient number of records of specialty bulb sales for warehouse retailers with variance in the price of the specialty bulbs. A requirement in estimating the Poisson regression model (or any elasticity type model) is variability in the price variable.

per store per day: 95 per day for warehouse stores and 13 bulbs per day for other stores. Warehouse retailers also typically sold bulbs in larger packs than non-warehouse retailers, but carried a narrower selection of bulbs.

Table 16 shows the estimates of price elasticity of demand for each of the three regression models and for the program as a whole. The price elasticity of demand is a measure of the change in the demand for a good or service when the price of that good or service increases by a small amount (generally 1 percent). Price elasticities are assumed to be negative—that is, as price goes up, demand for the good or service goes down; it is the magnitude of the elasticity (i.e., responsiveness) that is of primary interest.[15]

As Table 16 shows, the evaluation team found that the demand for LED bulbs is highly elastic for standard bulbs sold by warehouse retailers (price elasticity of demand of -1.28) and is unit elastic for standard bulbs sold by non-warehouse retailers (price elasticity of demand of -0.99). We found that the demand for specialty LED bulbs (from any retailer) is price inelastic (price elasticity of demand of -0.35). Overall, when weighting by all LED bulb sales from all retailers, the evaluation team estimated the price elasticity of demand for all program LED bulbs to be -1.02. This means that a 10 percent decrease in the price of LED bulbs will result in a 10.2 percent increase in demand for LED bulbs, holding all else constant.

Table 16: Estimates of Price Elasticity and NTG Ratio

LED Bulb Type and Retailer	Elasticity at Mean Rebated Price	NTG Ratio at Mean Rebated Price
Standard Non-Warehouse	-0.99	0.65
Standard Warehouse	-1.28	0.73
Specialty (all retailers)	-0.35	0.71
Residential Lighting Program	**-1.02**	**0.68**

Table 16 also shows estimates of the NTG ratio for PNM's Residential Lighting program using the Poisson regression model. The estimates of the NTG ratio also vary across the three combinations of bulb type and retailer. The highest NTG ratio estimate was for standard bulbs sold by warehouse retailers (0.73) and the lowest—but not by much—estimated NTG ratio was for standard bulbs sold at non-warehouse stores. The NTG ratio for specialty bulbs was 0.71, which is not statistically different from the elasticity for

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

standard bulbs from warehouse stores. A potential reason for the large NTG ratio given the relatively small elasticity is that the incentives offered for specialty bulbs are on average much greater than the incentives for standard bulbs (though the price of specialty bulbs are also on average greater). Nevertheless, it is likely that the relatively large incentives offered for specialty bulbs positively impacts the NTG ratio for specialty bulbs.

Figure 15 shows how expected rates of free ridership and NTG ratios vary by rebated bulb for each of the three combinations of bulb type and retailer. As the rebated price of LEDs drop, the proportion of purchasers that free ride decreases and the NTG ratio increases. The trajectories differ for each combination of bulb type and retailer because the types and prices of bulbs differ. It is also likely that the characteristics of customers who shop at warehouse and non-warehouse retailers differ.

It is important to note that the free ridership chart (upper panel of Figure 15) does not show the expected number of bulbs sold by rebated price, but rather the proportion of bulbs sold by rebated price that would have sold even without the rebate (the free ridership rate). As the rebated price decreases (moving from right to left along the horizontal axis), more and more consumers—who otherwise would not purchase LED bulbs—are motivated to purchase bulbs, resulting in a decreasing proportion of purchasers that are free riders.

The purpose of the rebates is to encourage those consumers who would not otherwise purchase an LED to make the purchase. However, since the rebate is available to all purchasers of the LED bulbs, even those who would have purchased the bulbs without the rebate receive the rebate. The larger the rebate, the greater the number of consumers who will purchase LED bulbs, leading to a lower rate of free ridership and a higher NTG ratio (lower panel of Figure 15).

Figure 15: Estimated Free Ridership and NTG Ratio by LED Bulb Type and Retailer

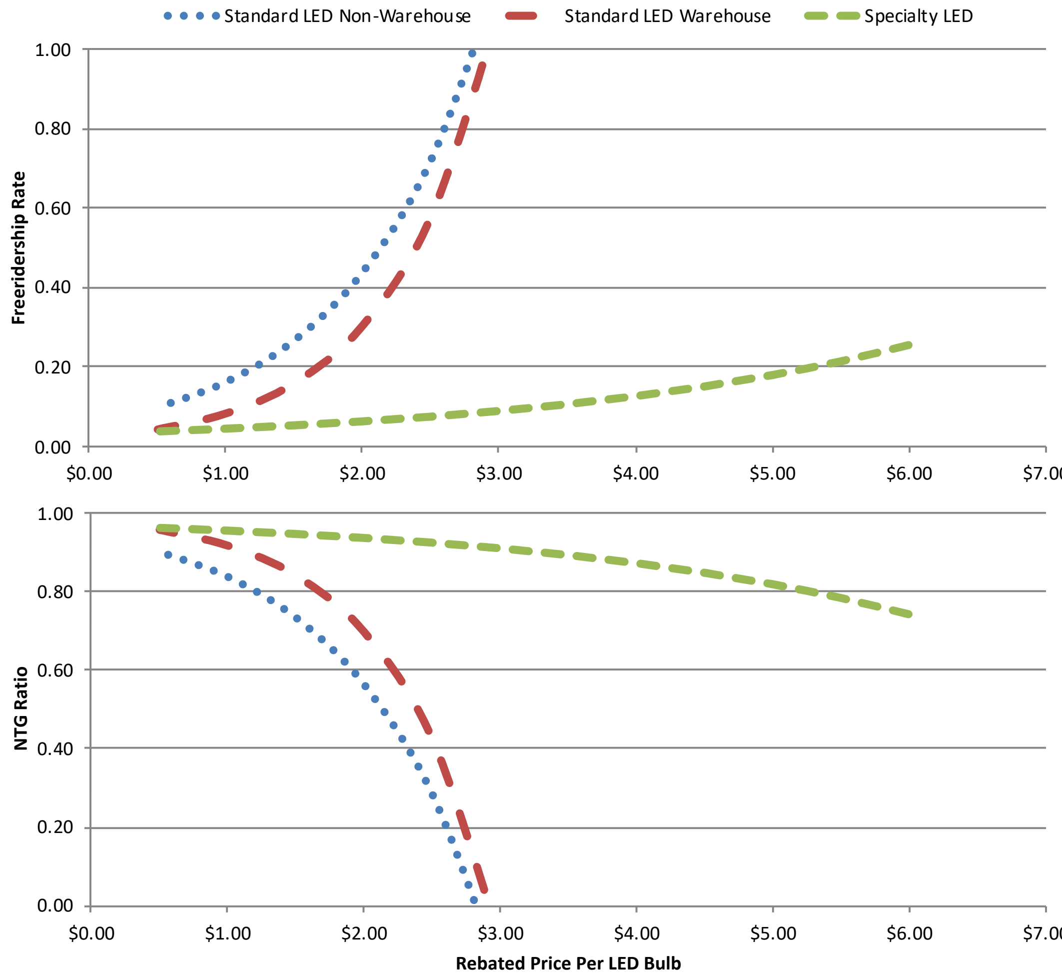


Table 17 summarizes the final gross and net impacts for the Residential Lighting program using the NTG ratio derived from the Poisson regression model. Using the overall NTG ratio of 0.68, the PY2019 net realized impacts for the Residential Lighting program are 25,435,684 kWh and 4,424 kW.

Table 17: Residential Lighting PY2019 Impact Summary

Residential Lighting	Expected Gross Savings	Engineering Adjustment Factor	Realized Gross Savings	NTG Ratio	Realized Net Savings
kWh Savings	27,503,984	1.36	37,405,418	0.68	25,435,684
kW Savings	5,376	1.21	6,505	0.68	4,424

2.3 Residential Lighting Cost Effectiveness

The evaluation team calculated cost effectiveness using the Utility Cost Test (UCT) for the Residential Lighting program, with the test calculations based on those prescribed in the California Energy Efficiency Policy Manual.

In the UCT, the benefits of a program are considered to be the present value of the net energy saved, and the costs are the present value of the program's administrative costs plus incentives paid to customers. To perform the cost effectiveness analysis, the evaluation team obtained the following from PNM:

- Avoided cost of energy (costs per kWh over a 20+ year time horizon);
- Avoided cost of capacity (estimated cost of adding a kW/year of generation, transmission, and distribution to the system);
- Avoided cost of CO2 (estimated monetary cost of CO2 per kWh generated);
- Avoided transmission and distribution costs;
- Discount rate;
- Line loss factor; and
- Program costs (all expenditures associated with program delivery).

For Residential Lighting, the program-weighted average effective useful life values were provided by PNM, calculated by dividing lifetime savings by annual savings. The evaluation team performed a spot check of measure-specific effective useful life values to confirm reasonableness and alignment with the TRM when applicable. The final net energy savings values estimated from the PY2019 impact evaluation for the Residential Lighting program were used in the final cost effectiveness calculations.

For the Residential Lighting program in PY2019, the UCT value was 5.37.

2.4 Residential Lighting Conclusions and Recommendations

The deemed savings values used by PNM are generally in line with those recommended in the New Mexico TRM, and the net impacts derived from the elasticity model are similar to those estimated previously as part of the PY2017 evaluation.

Recommendation: Include HVAC interactive effects in the deemed savings calculations. This applies to the Residential Lighting program as well as LEDs included in the Easy Savings and Home Works kits (discussed later). The addition of the HVAC interactive adjustment increased kWh savings by 36 percent and kW savings by 21 percent for the measures rebated through the Residential Lighting program.

3 Easy Savings Program

PNM's Easy Savings program provides LED light bulbs, an LED nightlight, an efficient showerhead, a kitchen and bathroom sink aerator, and a shower timer. PNM provides an Easy Savings kit to its customers (particularly low income households) that request one; in 2019, 6,542 kits were delivered.

The impact evaluation consisted of a deemed savings review for the measures included in the Easy Savings kits. Based on the measures provided in the kits, the evaluation team used the New Mexico TRM to calculate the total deemed savings for each kit. The most significant difference was due to including an HVAC interactive adjustment for the LED bulbs. This resulted in only a slight change in the kWh savings numbers, an increase of 2 percent relative to the original *ex ante* values. For the kW savings, the inclusion of the HVAC interactive effects had a much more significant impact, resulting in an increase in demand savings of about 76 percent.

Given the nature of how the Easy Savings kits are distributed and the focus on low income households, an NTG ratio of 1.0 is stipulated for this program for calculating net impacts.

Taking these adjustments into account, the final gross and net realized savings for both kWh and kW are shown below in Table 18.

Table 18: Easy Savings Gross and Net Impact Summary

Easy Savings	Number of Projects	Expected Gross Savings	Engineering Adjustment Factor	Realized Gross Savings	NTG Ratio	Realized Net Savings
kWh Savings	6,542	2,446,708	1.0200	2,495,642	1.0000	2,495,642
kW Savings	6,542	89	1.7564	156	1.0000	156

The UCT was also calculated for the Easy Savings program using the 2019 program costs combined with the lifetime benefits based on the 2019 net kWh savings. Based on these factors, we calculated a UCT value of 3.08 for the 2019 Easy Savings program.

4 Home Works Program

4.1 Home Works Gross and Net Impacts

PNM's Home Works program provides energy efficiency education and kits of easy-to-install energy efficiency and water saving measures such as LEDs, faucet aerators, and low-flow showerheads to elementary and high school students. These measures are accompanied by an in-class curriculum that is designed to increase energy efficiency education. In 2019, 9,540 kits were distributed, with a total of 1,946,135 kWh and 112 kW gross savings claimed.

To evaluate the impacts of the Home Works program, the evaluation team conducted a deemed savings review of the energy saving measures included in the school kits. As part of this review, we attempted to replicate the per unit savings values used by PNM based on the assumptions in the New Mexico TRM. For all school kit measures, we were able to create an estimate of kWh savings that was very close to the *ex ante* values. For the total Home Works kit savings, the engineering adjustment factor was 0.9714, meaning that the gross realized savings were found to be about 97 percent of the original values supplied by PNM.

For demand impacts, our savings review found that PNM was not accounting for HVAC interactive effects, similar to the issue discussed with Residential Lighting and Easy Savings program savings. To correct for this, an engineering adjustment factor of 1.7429 was used to calculate the realized gross impacts for the Home Works measures, which increased the original *ex ante* savings values by 74 percent.

For both kWh and kW savings, an NTG ratio of 1.0 is assumed, which results in the net impacts being equal to the gross realized impacts.

Table 19 summarizes the gross and net realized impacts for the 2019 Home Works program.

Table 19: Home Works Realized Gross and Net Impacts

Home Works	Number of Projects	Expected Gross Savings	Engineering Adjustment Factor	Realized Gross Savings	NTG Ratio	Realized Net Savings
kWh Savings	9,540	1,946,135	0.9714	1,890,535	1.0000	1,890,535
kW Savings	9,540	112	1.7429	195	1.0000	195

As with the other programs, cost effectiveness is assessed using the UCT based on net realized savings and the appropriate program costs. For 2019, the Home Works program had a UCT value of 2.18, indicating that the program is cost effective.

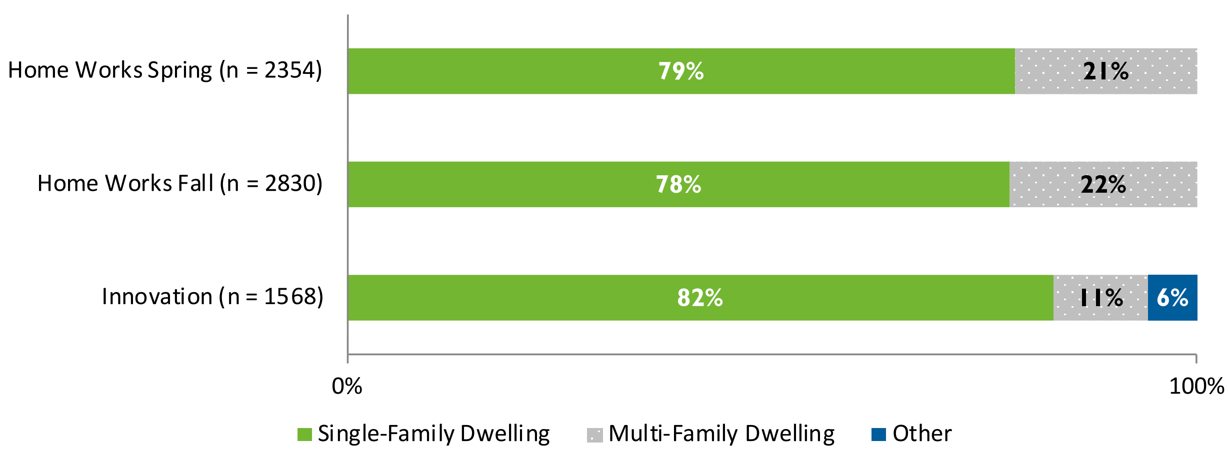
4.2 Home Works Student Surveys

As part of the Home Works program, the Think Energy classroom curriculum was designed to educate students on the importance of energy efficiency in the home. The survey results include students in the Home Works program (designed for elementary school fifth-graders) and the Innovation program (designed for secondary school students). The Home Works program was administered in both the fall and spring, and survey results were collected in both seasons. The following section presents survey results and figures from both programs. Note that these surveys were administered by the program implementer and not the evaluation team.

Demographics

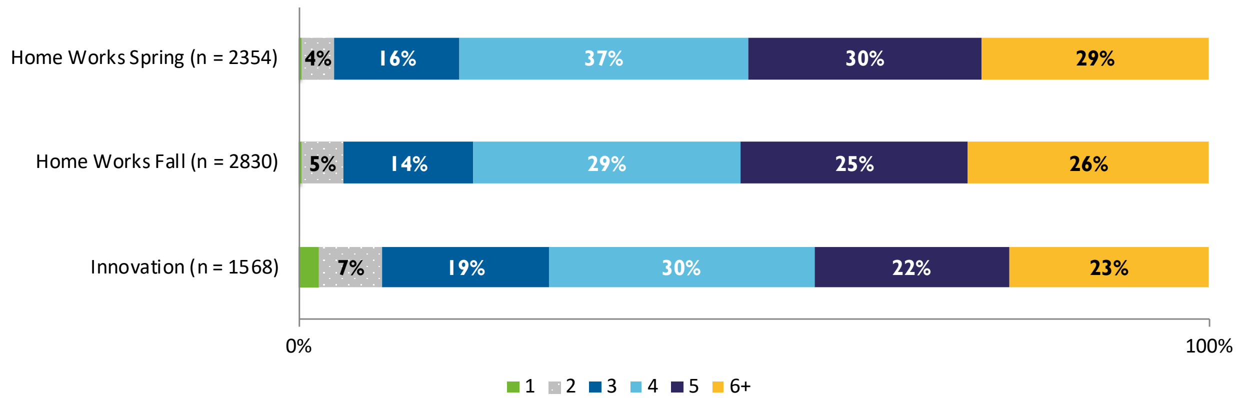
Overall, participants in the Home Works program and the Innovation program were most likely to live in a single-family dwelling, followed by a multi-family dwelling (Figure 16).

Figure 16: Type of Housing



Similarly, participants in both programs were most likely to report having at least three people in their household (Figure 17).

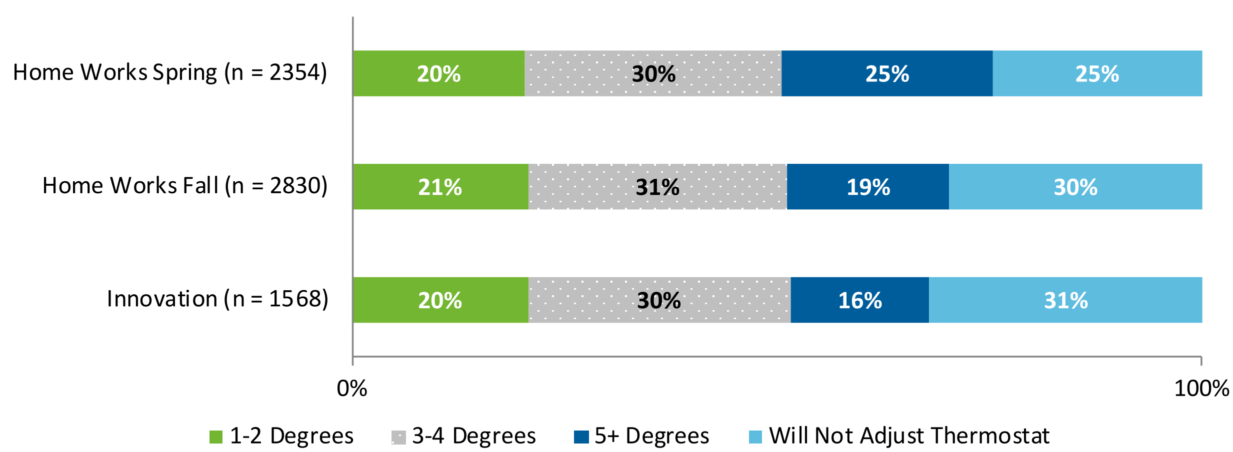
Figure 17: Number of People in Household



Thermostats

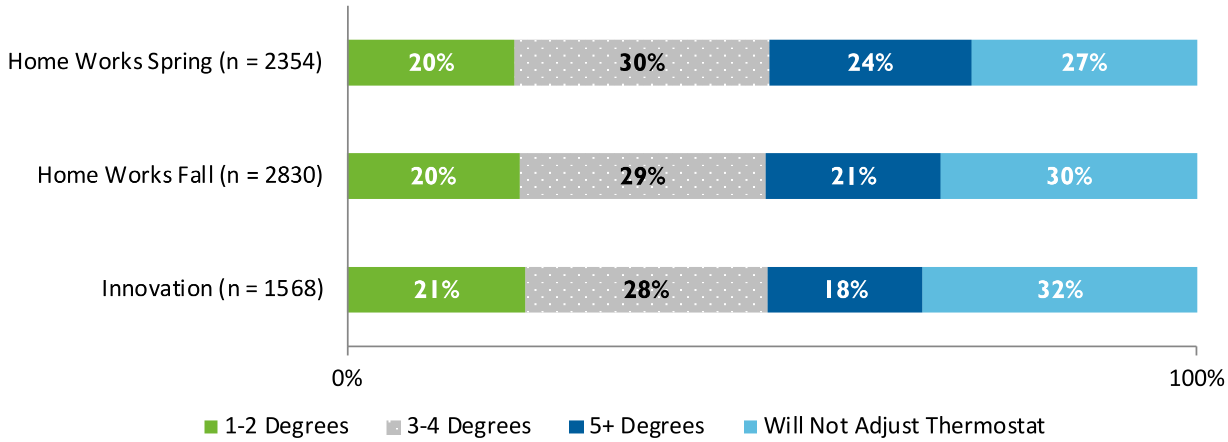
Participants were first asked how many degrees they would decrease their thermostat temperatures in the winter after participating in the program. Across both seasons, approximately 70 percent of participants in the Home Works program stated that they would make some change to their thermostats. Similarly, in the Innovation program, approximately 70 percent of participants also stated that they would be decreasing their thermostat temperature in the winter (Figure 18).

Figure 18: Thermostat Changes in Winter



In addition, participants were asked how many degrees they would increase their thermostats in the summer for cooling. Similar to the heating questions, approximately 70 percent of participants in the Home Works program and the Innovation program reported that they would increase their thermostats in the summer (Figure 19).

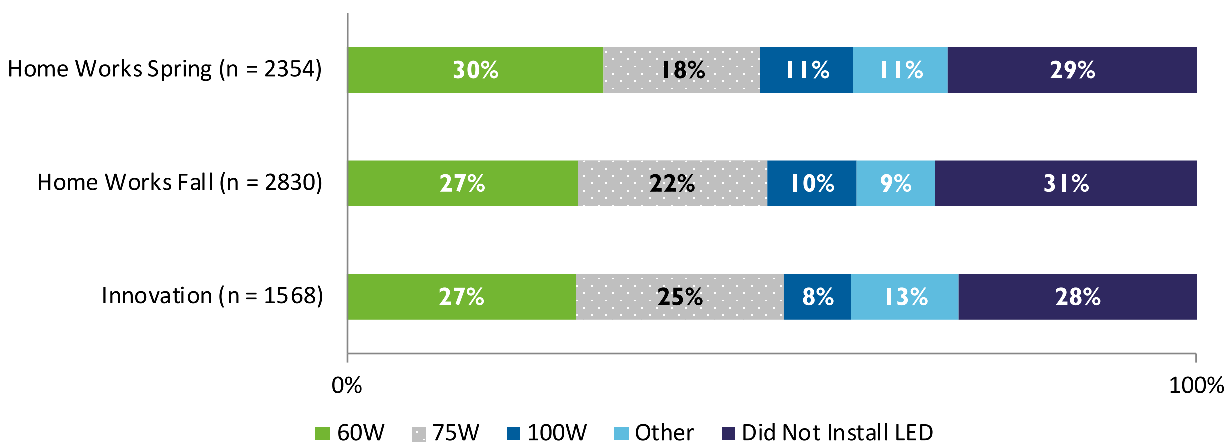
Figure 19: Thermostat Changes in Summer



Lightbulbs

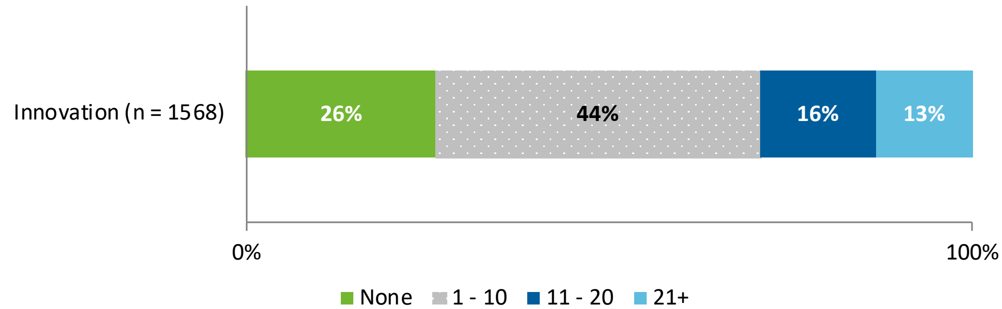
Respondents were also asked about the lightbulbs that they had installed in their homes before switching over to the LED bulbs in their energy kits. When installing the first LED bulb from their kits, about half of respondents in both programs reported that their original bulbs were either 60 watt or 75 watt bulbs (Figure 20). Responses were similar for the second and third LED bulb from the kit.

Figure 20: Original Lightbulb Type Before LED Replacement



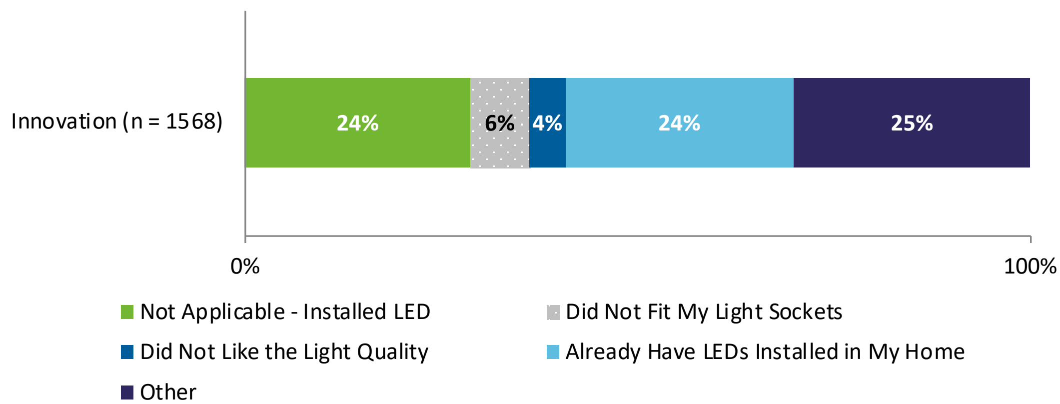
Participants in the Innovation program were asked further questions about their household lightbulb usage. On average, before participating in the program, individuals reported having approximately 23 lightbulbs in their homes. Approximately half of participants stated that they had between one and ten LED lightbulbs in their homes before the program, while 26 percent stated that they had no LED bulbs at all (Figure 21).

Figure 21: Number of LED Bulbs in Household Before Program (Innovation Participants Only)



When asked why they did not install LEDs, participants in the Innovation program most commonly responded that they either already had LEDs installed in their homes (24%) or cited other reasons (25%; Figure 22).

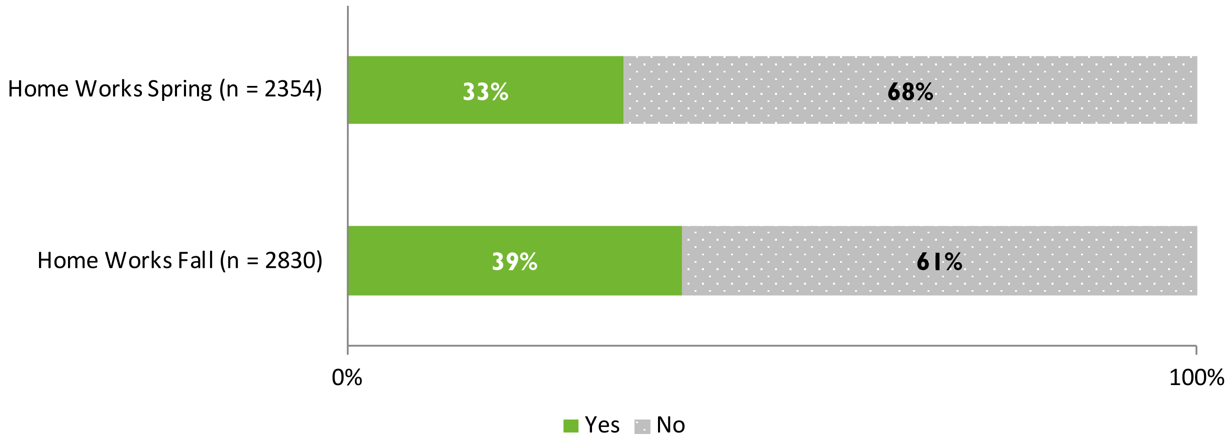
Figure 22: Reasons for Not Installing LED Bulbs (Innovation Participants Only)



Kitchen

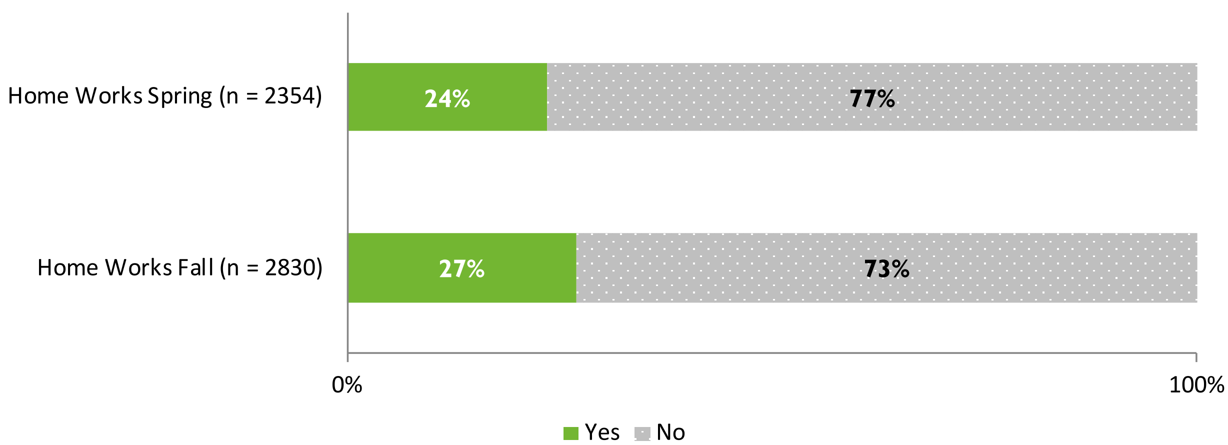
Home Works participants were asked questions about their kitchen aerators and refrigerator temperatures. Approximately one-third of respondents reported installing the kitchen aerator included in their energy kit (Figure 23).

Figure 23: Participants Who Installed the Kitchen Aerator (Home Works Participants Only)



When asked if they had raised their refrigerator temperatures after measuring their refrigerators with the kit thermometer, approximately one-fourth of participants reported that they had increased the temperature (Figure 24).

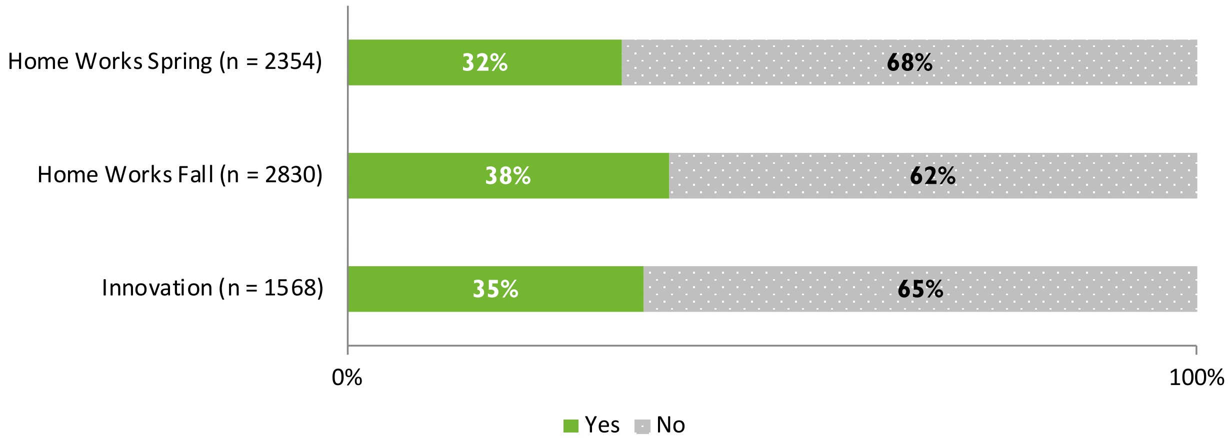
Figure 24: Increases in Refrigerator Temperatures (Home Works Participants Only)



Bathroom

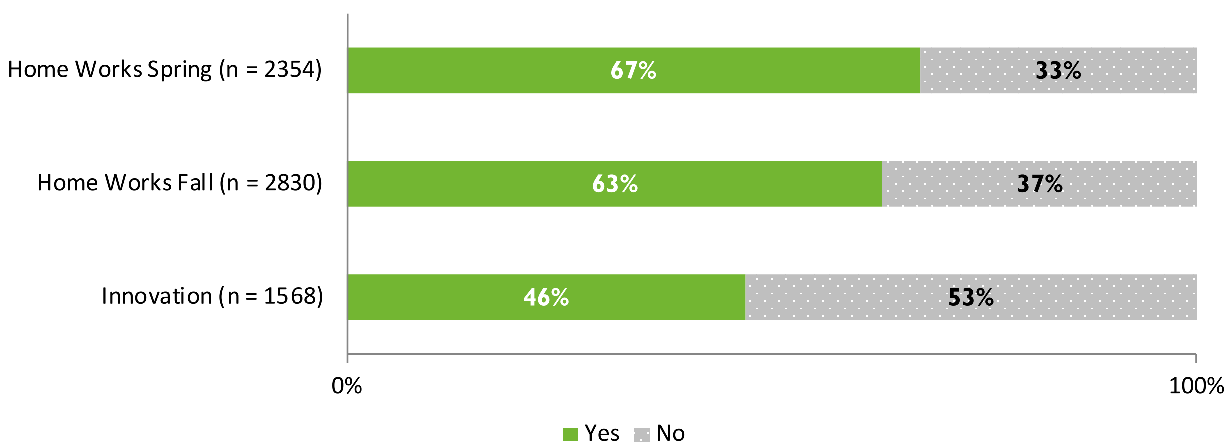
Participants in both programs were asked questions about their bathroom appliances, such as their showers and aerators. When asked if they had installed the bathroom aerator that was included in their energy kit, over one-third of participants in both programs reported performing the installation (Figure 25).

Figure 25: Installation of Bathroom Aerator from Kit



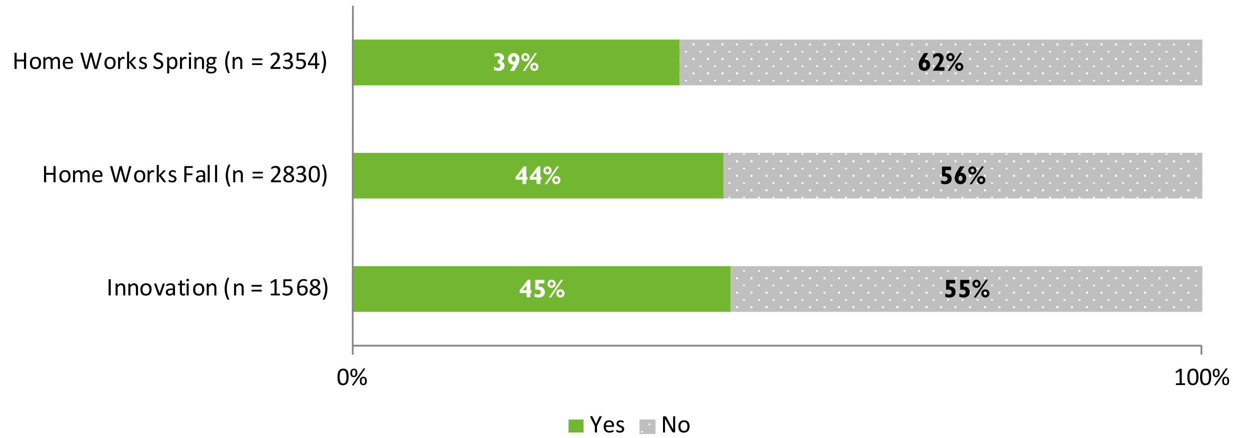
However, when asked about whether or not they used the shower timer from their kit, participants in the Home Works program were slightly more likely to report having used their shower timers (about two-thirds of participants) than the Innovation program group (about half of participants; Figure 26).

Figure 26: Percentage of Respondents Who Used the Shower Timer



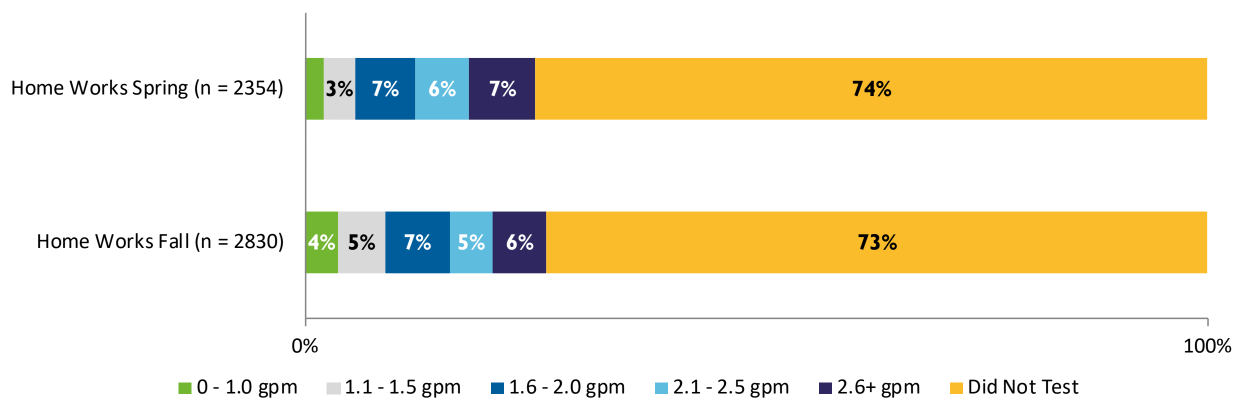
Participants were then asked whether they installed the new high efficiency shower head included in their energy kit. Slightly less than half of participants in both groups reported that they had installed the new shower head (Figure 27).

Figure 27: Percentage of Respondents Who Installed the New Shower Head



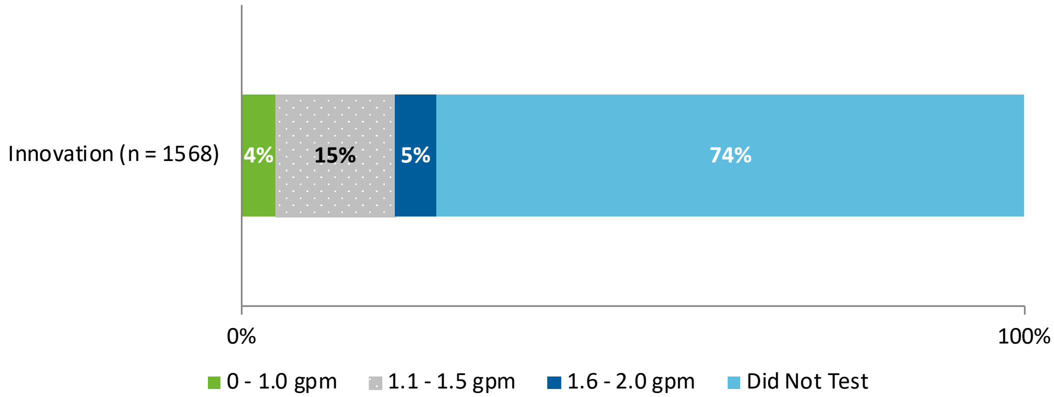
Home Works program participants were asked to measure the flow rate of their *old* shower heads, with approximately three-fourths of participants reporting that they did not test the water flow rate (Figure 28).

Figure 28: Old Shower Head Flow Rate (Home Works Participants Only)



In contrast, Innovation program participants were asked to measure the flow rate of their *new* shower heads, although approximately three-fourths of Innovation participants also did not test their water flow rate (Figure 29).

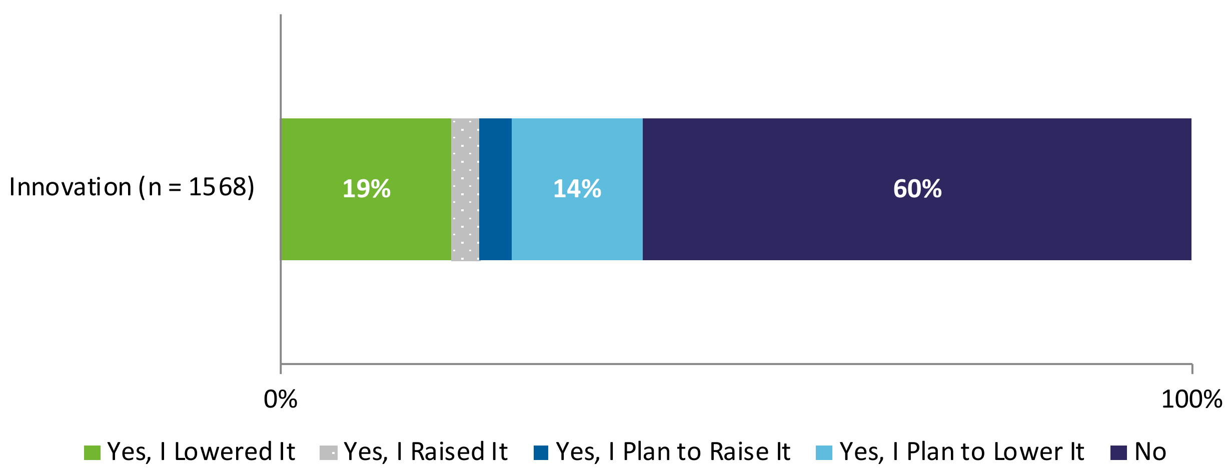
Figure 29: New Shower Head Flow Rate (Innovation Participants Only)



Water Heating

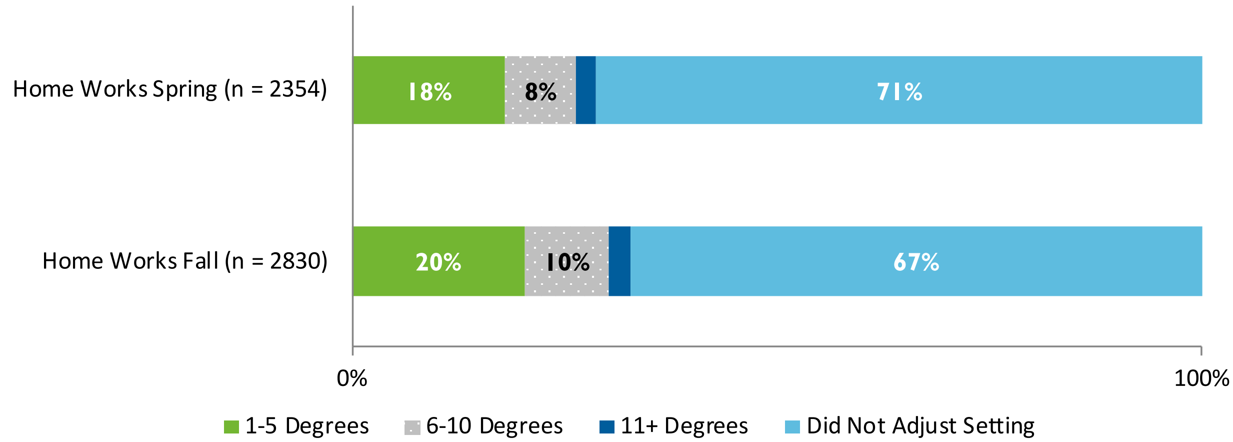
Both Home Works and Innovation program participants were asked about the settings of their water heaters. Innovation program participants were asked whether or not they had adjusted their water heater settings, with 60 percent stating that they had not changed their settings (Figure 30).

Figure 30: Adjustments to Water Heater Settings (Innovation Participants Only)



Similarly, Home Works participants were asked *how much* they had *lowered* their water heater settings. Over two-thirds of participants in both the spring and fall stated that they had not adjusted their water heater settings (Figure 31).

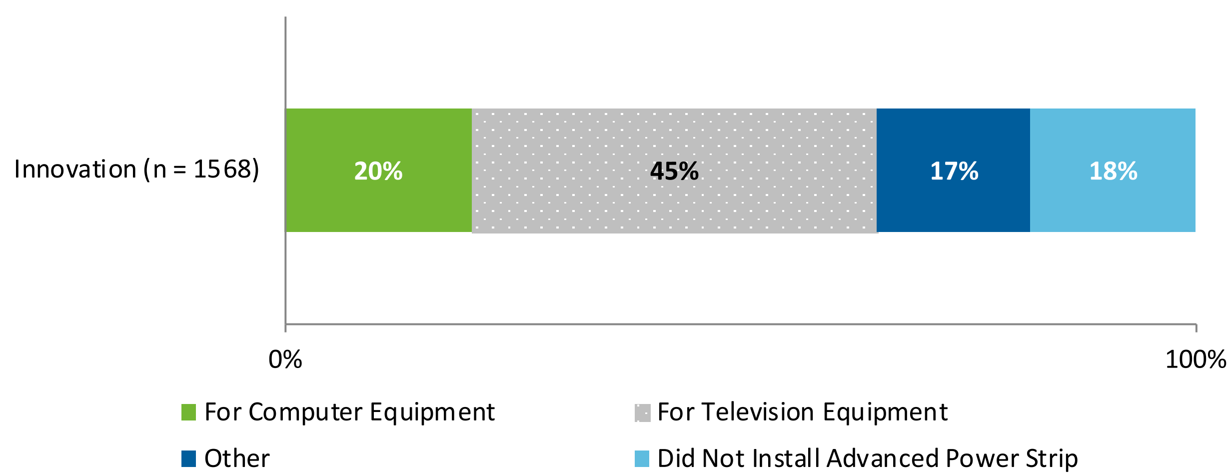
Figure 31: Decreases in Water Heater Settings (Home Works Participants Only)



Power Strip

Participants in the Innovation program were asked how they had used the advanced power strip they received during the program. Almost half of participants reported using their advanced power strip for television equipment, while 20 percent reported using their power strip for computer equipment (Figure 32).

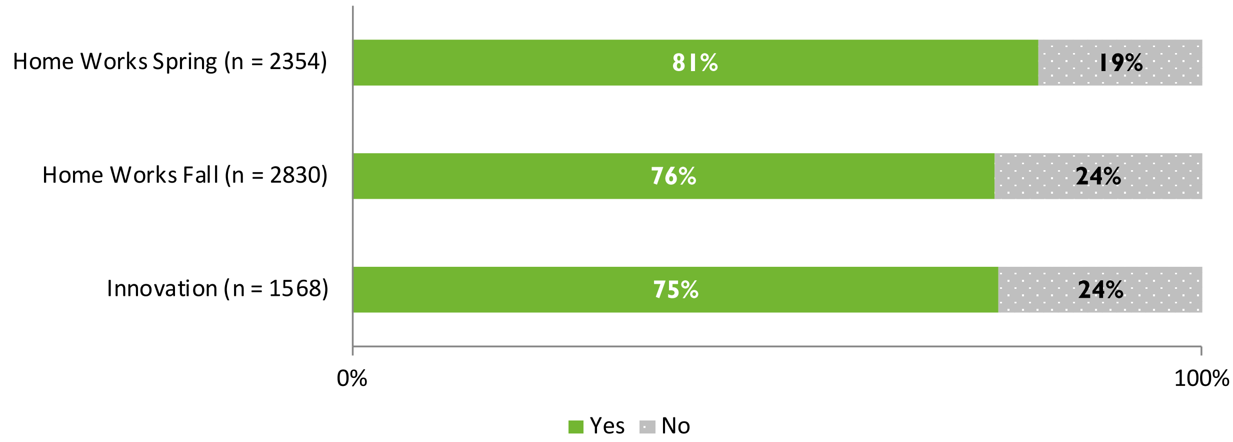
Figure 32: Usages for Advanced Power Strip (Innovation Participants Only)



Behavior Changes

Finally, participants were asked whether their participation in their respective Think Energy programs changed the way that they used energy in their homes. Across both programs, over 75 percent of participants reported that they did change the way they used energy in their homes (Figure 33).

Figure 33: Changes in Home Energy Use After Program Completion



5 Load Management as a Resource

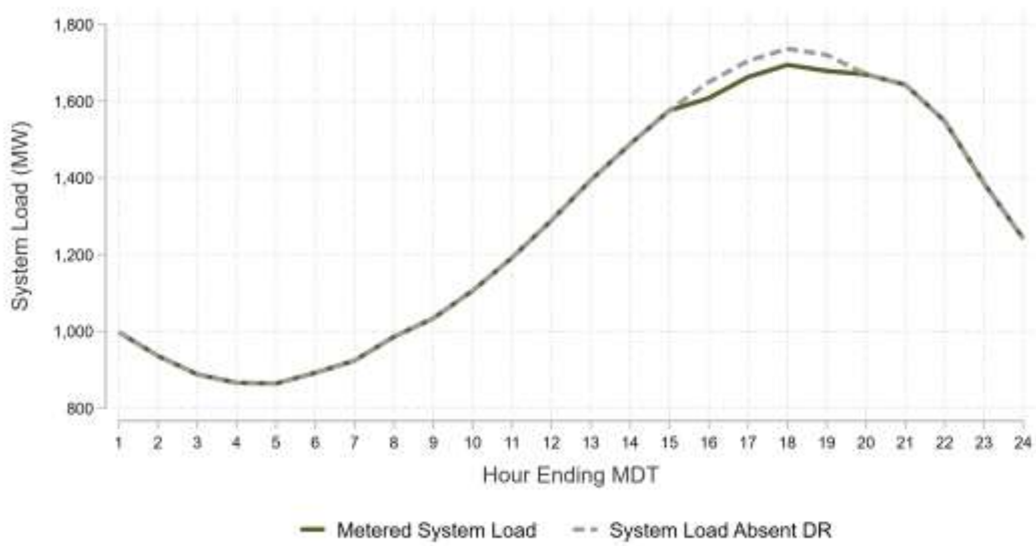
On January 31, 2018, the New Mexico Public Regulation Commission (NMPRC) issued a final order in PNM's 2017 energy efficiency case that directs Evergreen Economics, as independent program evaluator for PNM's energy efficiency and load management (LM) programs, to do the following:

In PNM's future M&V reports, the independent evaluator shall verify that load reductions from deployment of PNM's LM programs avoided or offset the need for or use of additional peaking units or power purchases or shifted demand from peak to off peak period.

The evaluation team concludes that in 2019, the load management programs served a capacity resource that avoided the need for additional supply-side peaking capacity.

Figure 34 illustrates the benefits of the load management programs on system load for a high load day in 2019. Metered retail load on PNM's system peaked at 1,695 MW on July 10, 2019, during hour ending 18:00 (Mountain Daylight Time). If we add back verified estimates of demand response performance, adjusted for line losses, the daily peak would have been 1,737 MW during hour ending 18:00 MDT. The load management programs flatten out system loads toward the top of the afternoon ramp, which reduces the amount of peaking resources needed to balance the supply and demand.

Figure 34: PNM System Load July 10, 2019



The two PNM load management—or demand response—programs relied on similar analysis methods to estimate program impacts.

PNM's demand side management portfolio includes both energy efficiency and demand response programs. While these two categories of programs both fall under the umbrella of demand side management, it is important to understand some key distinctions with respect to the nature of the resource provided. The two primary benefit streams from demand side management programs are:

- **Energy (kWh)** - the generation of electrical power over a fixed period of time. The avoided cost of energy is largely the cost of the fuel not burned in the marginal generating unit.
- **Capacity (kW)** - Capacity is the ability to provide energy when needed and assures that there will be sufficient resources to meet peak loads.

The primary objective of energy efficiency programs is to save energy. To the extent that the affected end-uses operate coincident with the system peak, energy efficiency measures will also provide capacity benefits. Demand response programs like Peak Saver and Power Saver are designed to provide capacity benefits. Their value lies in being able to reduce load quickly to balance the grid if needed. Demand response events typically result in net energy savings because the increased consumption following an event does not totally offset the reduced usage during an event. However, the distribution of benefits across resources is dominated by capacity.

Table 20 shows the energy and capacity benefits for the two demand response programs in 2019. Energy benefits amounted to less than one percent of Utility Cost Test (UCT) benefits, while capacity benefits accounted for more than 99 percent of the UCT benefits. This is very different from PNM's energy efficiency programs, where capacity accounts for less than half of UCT benefits.

Table 20: 2019 Demand Response Program Benefits

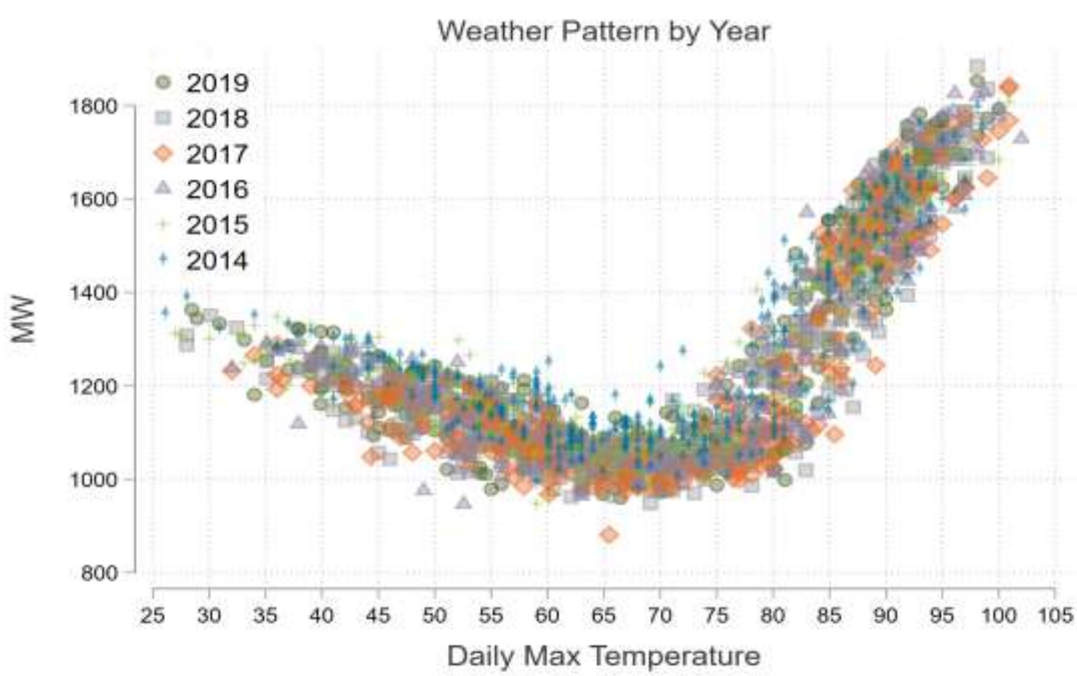
Program	Energy Benefit ($1,000)	Capacity Benefit ($1,000)	Percent Capacity
Power Saver	$3.64	$3,928.56	99.9%
Peak Saver	$6.18	$2,261.72	99.7%
Energy Efficiency Programs	$20,764.27	$17,193.49	45.3%

Another important distinction between energy efficiency and demand response is that demand response is a dispatchable resource and energy efficiency is not. When PNM supports an energy efficiency measure, the demand savings will remain present until the equipment reaches the end of its useful life. Demand response programs like Peak Saver and Power Saver are event-based resources that can be dispatched when needed. A critical thing to understand about dispatchable demand response resources is that they provide capacity benefits even if no events are called in a summer. How often demand response is dispatched and which units in the stack are displaced are energy questions which have almost no material impact on the cost effectiveness of demand response programs. Summer 2019 was not particularly extreme from a weather standpoint so the Peak Saver and Power Saver programs were dispatched less frequently than in prior summers.

To provide additional context, the evaluation team reviewed PNM's most recent Integrated Resource Plan (IRP)[16] to summarize how demand side management resources fit into resource planning.

PNM has a summer peak load forecast of approximately 1,900 MW. This does not mean that each summer, peak loads will equal 1,900 MW, because weather plays an important role in electric demand. Figure 35 illustrates this relationship using PNM system loads (2014-2019) and weather records from KABQ's weather station in Albuquerque. PNM is clearly a summer-peaking utility, with maximum summer loads that are 20 to 30 percent higher than winter loads each year.

Figure 35: Daily Maximum PNM System Load and Temperature by Year

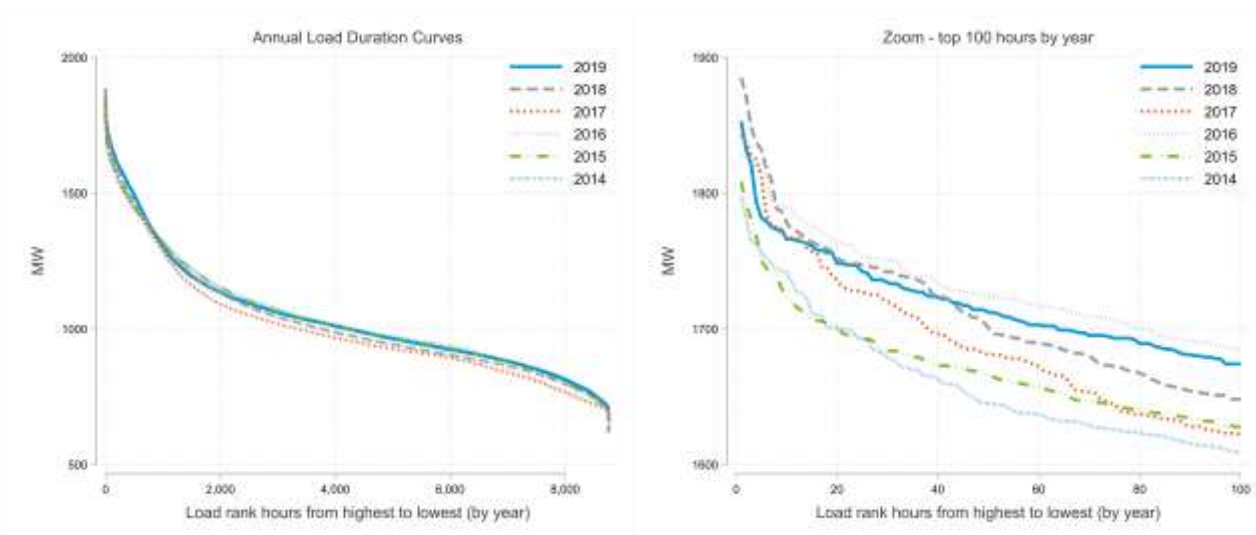


[16] PNM 2017-2036 Integrated Resource Plan. July 3, 2017. https://www.pnm.com/documents/396023/396193/PNM+2017+IRP+Final.pdf/eae4efd7-3de5-47b4-b686-1ab37641b4ed

System planners must design the system without knowing what weather conditions will be and ensure reliability even in extreme weather years. In addition to securing resources to meet forecasted demand, PNM planners maintain a reserve margin of resources above and beyond forecasted demand to ensure expected levels of reliability. In the 2017 IRP, PNM's minimum reserve margin was 13 percent. This means that although peak demand is forecast at 1,900 MW, planners need at least 2,147 MW of capacity to satisfy resource requirements. If the peak load for a summer is actually 1,900 MW and no resources experience outages or other disruptions, this means the 247 MW of capacity could go unused for the year.

Figure 36 provides annual load duration curves for the PNM system over the last six years to illustrate a key point about capacity utilization. Peak load conditions are observed in a very small number of hours. This means some capacity resources need to operate quite intermittently. The right side of Figure 36 zooms in on the top 100 hours of each year. Even within this very narrow portion of the year (1.1 percent of the hours in a year), the load duration curve has a very steep slope. In 2019, there was an 87 MW difference between the top hour and the tenth-highest load hour for the year. Four of the top six load hours in 2019 occurred on August 26th and retail load did not exceed 1800 MW on any other day.

Figure 36: Annual and Top 100 Hour Load Duration Curves 2013-2018



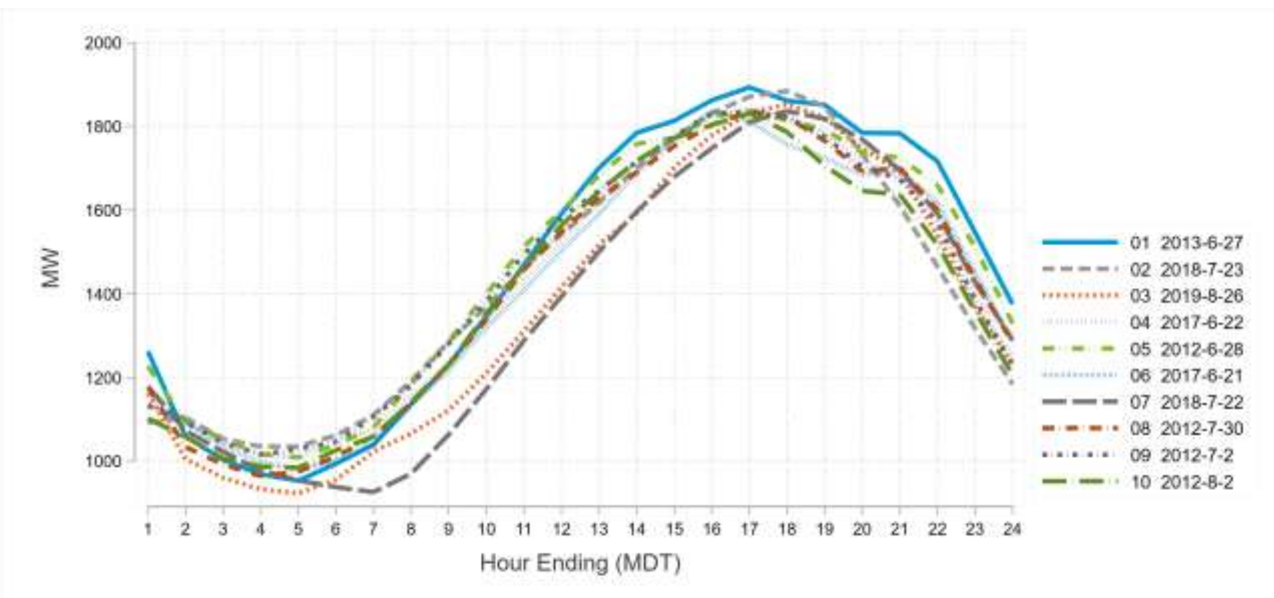
Dispatchable summer capacity resources like Peak Saver and Power Saver (which are only available in the summer) are a good fit for the PNM system because peaks occur exclusively in the summer and are focused on specific hours. From 2012 to 2017 the annual peak occurred at hour ending 17 (4:00 p.m. to 5:00 p.m.) Mountain Daylight Time (MDT) on a weekday. In 2018 and 2019, the system peaked an hour later at hour ending 18 (5:00 pm to 6:00 pm MDT).

The reserve margin requirement is above and beyond the forecasted top hour. A supply-side resource like a natural gas peaking plant built to satisfy peaks plus reserve margin would operate very infrequently—which is not a cost-effective way to operate a power plant. Demand response resources, on the other hand, work best when dispatched infrequently because it reduces fatigue of participants and limits the financial incentive the utility needs to provide.

Like most vertically integrated utilities, PNM treats energy efficiency and demand response differently in its demand forecast and resource stack. Incremental energy efficiency (because it is not dispatchable) is treated as a top-line adjustment that lowers the forecast. Demand response programs (because they are dispatchable) are listed alongside power plants as resources available to meet demand. Like traditional supply-side resources, demand response programs have a position in the dispatch stack. Although there is no fuel cost associated with demand response programs, there is a definite relationship between how often demand response participants are dispatched and the cost of the resource.

Figure 37 shows PNM's top 10 system load days of the last seven years, which includes one days from 2019. Four of the top 10 load days were in 2012.

Figure 37: Top 10 System Load Days 2012-2019



Peak Saver was not dispatched on August 26, 2019 and only the M&V groups were dispatched for Power Saver. The Evergreen team understands that demand response dispatch has a two-part trigger:

1. If the day-ahead temperature forecast is 96 degrees or higher.

2. A day-of assessment by the Power Operations and Whole Power Marketing departments to assess transmission/capacity constraints or generation issues. These groups also consider participant fatigue and will decide to not dispatch if there are no constraints.

The maximum temperature on August 26th at KABQ was 98 degrees (F) so the decision not to dispatch was likely operations-driven. The value in load management programs lies in being able to dispatch the resources *when needed*, and PNM staff are in the best position to determine when the assets are needed from an operational standpoint.

Because the capacity benefits are the dominant benefit stream for demand response programs, the primary research question for evaluation is "what kW reduction can each program be expected to provide if dispatched during system peak conditions?" This is why readers will note that the evaluation results in the Power Saver and Peak Saver impact results subchapters focus on inferences about expected, or *ex ante*, impacts at peaking conditions rather than simple averages of observed impacts during 2019 events. We analyzed the last five summers of Power Saver results to develop a time-temperature matrix and estimate the expected impact from 5:00 p.m. to 6:00 p.m. at 100 degrees Fahrenheit (F).

The avoided cost of capacity value used to monetize capacity benefits from demand side management programs is $129/kW-year. This value is consistent with projections the evaluation team has seen in other jurisdictions of the cost a new combined-cycle natural gas plant would need in order to recover its capital investment and fixed costs, given reasonable expectations about future cost recovery over its economic life. The underlying premise is that the availability of PNM's demand response programs is allowing the utility to defer or avoid the construction or purchase of additional generation capacity. Page 109 of the IRP states: "*Without the demand savings from the programs, 40 MW of additional gas peaking capacity is needed in 2018 and another 41 MW in 2020.*" This statement is consistent with our verified savings analysis of PNM's load management program performance for 2019, which estimates approximately 48 MW of load reduction capability across Power Saver and Peak Saver at the system level.

Specific details on both the Power Saver and Peak Saver programs are presented in the next two chapters.

6 Power Saver Program

Power Saver is a direct load control program offered to residential, small commercial (< 50 kW), and medium commercial (50 kW – 150 kW) PNM customers. To facilitate load control, participants must have a device attached to the exterior of their air conditioning unit. This device is capable of receiving a radio signal that will turn off the unit's compressor for an interval of time. Such signals are typically sent on the hottest weekday afternoons of the summer, with the goal being to reduce peak demand. Residential and small commercial participants receive an annual $25 incentive for their participation. Medium commercial participants receive an annual incentive of $9 per ton of refrigerated air conditioning. A residential smart thermostat component was added to the program in 2018. For this component, load curtailment is achieved via communication with the WiFi-enabled thermostat.

There were five Power Saver events during the summer 2019 demand response (DR) season, which began June 1 and ended September 30. Table 21 provides some information on these five 2019 events. All events used a 50 percent cycling strategy where curtailment is based on the runtime in the previous hour. The events on 8/19 and 8/26 were dispatched for just the Residential DCU M&V segment and the Small Commercial M&V segment. Note that the event start times and end times are in Mountain Daylight Time (MDT).

Table 21: 2019 Power Saver Event Summary

Date	Day of Week	Start Time (MDT)	End Time (MDT)	Daily High at KABQ (F)
7/10/2019	Wednesday	3:00 p.m.	7:00 p.m.	97.0
8/19/2019	Monday	2:00 p.m.	6:00 p.m.	93.9
8/26/2019	Monday	2:00 p.m.	6:00 p.m.	98.1
8/27/2019	Tuesday	3:00 p.m.	7:00 p.m.	95.0
9/4/2019	Wednesday	3:00 p.m.	7:00 p.m.	90.0

Shortly after the conclusion of the summer 2019 season, Itron provided the evaluation team with a series of datasets for the evaluation. These files included:

- For Residential DCU, Small Commercial, and Medium Commercial sites, 5-minute load data from 6/1/2019 to 9/30/2019.

- For Residential DCU and Small Commercial sites, an M&V list that provided the location type (residential or commercial), the group (control or curtailment), and/or the dates each load control device was active.
- For Medium Commercial sites, an M&V list that provided the dates each load control device was active.
- For the Two Way Smart Thermostat group, 5-minute runtime data from 6/1/2019 to 9/30/2019.

The evaluation team also received Itron's Power Saver impact evaluation report, which detailed the methods Itron employed in calculating customer baselines (CBLs) for the four different participant classes. A CBL is an estimate of what participant loads would have been absent the DR event dispatch. By customer class, the report also showed the load impact, which is the difference between the CBL and the metered load, for each 5-minute interval of each curtailment day. The key steps in the verified savings analysis were:

1. For each customer class, reproduce the performance estimates calculated by Itron using the contractually-agreed upon CBL method.
2. Modify the CBL methodology and produce *ex post* estimates of what the per-device impact was during the 2019 DR season.
3. Where possible, leverage additional historical data from 2015-2018 to produce *ex ante* estimates of what the per-device impact at peaking conditions (3:00 p.m. at 100°F) will be in future summers.
4. Scale the per-device estimates by the number of active program devices to calculate the aggregate load impacts (MW) of the Power Saver program.

Table 22 and Table 23 summarize our findings for the residential and commercial segments, respectively. The main driver in the difference between Itron and Evergreen load reduction estimates is that Itron commonly summarized impacts with the maximum (e.g., the largest 5-minute impact in a one-hour interval is the impact for that hour), whereas the evaluation team summarized impacts with an average. Multiplying our per-device reduction estimates by the number of devices in each class (shown in Table 22) leads to a 2019 average total estimated load reduction of approximately 21.9 MW, 0.4 MW, 2.4 MW, and 0.8 MW for the Residential DCU, Two Way Smart Thermostat, Small Commercial, and Medium Commercial segments, respectively. In aggregate, the average 2019 performance is 25.5 MW. This is approximately 75 percent of Itron's estimate (34.1 MW). After making an online adjustment for the thermostat group (85%) and an operability adjustment (86%) for the other three segments, the aggregate Evergreen-calculated impacts for 2019 are 21.9 MW (compared to 29.3 MW from Itron after adjustment).

The evaluation team used Power Saver results from 2015-2019 to estimate the load relief capability under extreme conditions. We estimate the program is capable of delivering 32.7 MW of load reduction under planning conditions of 100°F between 5:00 p.m. and 6:00 p.m. MDT, of which 29.4 MW comes from the Residential DCU segment, 0.5 MW comes from the Two-Way Smart Thermostat segment, and 1.8 MW and 1.0 MW come from small and medium commercial customers, respectively. Factoring in the operability/online adjustments, the aggregate program can provide 28.1 MW of load relief.

Table 22: Power Saver Impacts - Residential

			Residential DCU		Smart Thermostats	
		Unit	Measured	Adjusted	Measured	Adjusted
Number of Devices Installed		#	41,376	41,376	384	384
Itron	5-year Rolling Average kW Factor	kW / device[17]	0.82		0.68	
Itron	5-year Rolling Average kW Factor	Total MW	33.93		0.26	
Itron	2019 Load Reduction Estimate	kW / device	0.69	0.59	0.80	0.68
Itron	2019 Load Reduction Estimate	Total MW	28.55	24.55	0.31	0.26
Evergreen	2019 Load Reduction Estimate	kW / device	0.53	0.46	1.02	0.87
Evergreen	2019 Load Reduction Estimate	Total MW	21.93	18.86	0.39	0.33
Evergreen	*Ex Ante* Load Reduction Estimate[18]	kW / device	0.71	0.61	1.36	1.16
Evergreen	*Ex Ante* Load Reduction Estimate[18]	Total MW	29.38	25.26	0.52	0.44
Evergreen	2019 Energy Savings	kWh / device	2.43	2.09	6.55	5.57
Evergreen	2019 Energy Savings	Total MWh	100.7	86.66	2.52	2.14

[17] 2019 kW factors include a rolling average per-device result for 2015-2019. The 2018 Residential DCU kW factor has an 85 percent operability adjustment applied, and the 2019 Residential DCU kW factor has an 86 percent operability adjustment applied. The 86 percent operability percentage was calculated as 85 percent multiplied by the number of DCU sites that have not been visited in the last two years plus 95 percent multiplied by the number of DCU sites that were visited in the last two years. 2019 Two-Way Smart Thermostats have an 85 percent offline (not operability) adjustment applied.

[18] *Ex ante* program capability is reported in the 5 p.m. – 6 p.m. MDT hour at 100°F.

Table 23: Power Saver Impacts - Commercial

		Unit	Small Commercial		Medium Commercial	
			Measured	Adjusted	Measured	Adjusted
Number of Devices Installed		#	3,443	3,443	2,636	2,636
Itron	5-year Rolling Average kW Factor	kW / device[19]	1.38		0.72	
		Total MW	4.75		1.90	
	2019 Load Reduction Estimate	kW / device	1.21	1.04	0.40	0.35
		Total MW	4.17	3.58	1.07	0.92
Evergreen	2019 Load Reduction Estimate	kW / device	0.69	0.59	0.30	0.26
		Total MW	2.38	2.04	0.79	0.68
	Ex Ante Load Reduction Estimate	kW / device	0.52	0.45	0.39	0.34
		Total MW	1.79	1.54	1.03	0.88
	2019 Energy Savings	kWh / device	9.16	7.88	4.70	4.04
		Total MWh	31.54	27.12	12.39	10.65

A detailed discussion of the impact estimation methods and results for each Power Saver customer class group is included in Appendix C.

6.1 Power Saver Conclusions and Recommendations

After our review of the 2019 Power Saver program, we offer the following conclusions and recommendations:

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[19] 2019 kW factors include a rolling average per-device result for 2015-2019. The 2019 Small Commercial and Medium Commercial segments have an 86 percent operability adjustment applied. The 86 percent operability percentage was calculated as 85 percent multiplied by the number of DCU sites that have not been visited in the last two years plus 95 percent multiplied by the number of DCU sites that were visited in the last two years.

- *Ex post* impacts provide a helpful look at program performance, but for planning purposes, a consistent, weather-normalized value should be used.
    - **Recommendation:** The *ex ante* program impacts from 5:00 p.m. to 6:00 p.m. MDT at 100°F, de-rated for operability, should be used for reporting, cost-effectiveness, and planning.
- The Itron contract definition of capacity performance is upwardly biased by capturing favorable noise along with the program impact.
    - **Recommendation:** If there is a chance to review the terms, collapse to the hourly mean rather than the maximum.
- For the Two-Way Smart Thermostat segment, there are significant differences in the load shapes for the M&V group and the curtailment group.
    - **Recommendation:** Use an alternative impact estimation method for this group. One option would be to use a method similar to the Small Commercial and Medium Commercial segments (high 3-of-5 baseline calculated in aggregate). The estimated baselines line up well with the actual loads during pre-event hours. Other possible options include using an alternating control group, using regression, or using a difference-in-differences approach.

7 Peak Saver Program

PNM offers the Peak Saver program to non-residential customers with peak load contributions of at least 50 kW. The program compensates participants for reducing electric load upon dispatch during periods of high system load. Peak Saver was implemented by Enbala in 2019, which managed the enrollment, dispatch, and settlement with participating customers. During the summer 2019 demand response season, there were 92 participating facilities and three demand response (DR) events. These events are summarized in Table 24.

Table 24: 2019 Peak Saver Event Summary

Date	Weekday	Start Time (MDT)	End Time (MDT)	Daily High at KABQ (F)
07/10/2019	Wednesday	3:00 p.m.	7:00 p.m.	97
08/27/2019	Tuesday	3:00 p.m.	7:00 p.m.	94
09/04/2019	Wednesday	3:00 p.m.	7:00 p.m.	90

After the 2019 DR season concluded, Enbala provided the evaluation team with one-minute interval load data for each site in the Peak Saver population, as well as some workbooks with the performance metrics (10-minute capacity, average participant capacity, participant event capacity, and energy delivered) for each site/event combination. The interval data spanned a period from June 1 to September 30.

The one-minute interval load data also included a field with load impacts calculated using a customer baseline (CBL) method detailed in the contract between PNM and Enbala. A CBL is an estimate of what participant loads would have been absent the DR event dispatch. Load impacts are the difference between the CBL and the metered load during the event. The relevant CBLs were also in the one-minute load data.

With these data sources, the evaluation team completed our verified savings analysis. The three key steps in the analysis were to:

1. Reproduce the performance estimates calculated by Enbala using the contractually-agreed upon CBL method;
2. Assess the accuracy of the contract CBL method by examining its ability to predict loads on non-event weekdays; and
3. Modify the CBL methodology to reduce bias and calculate verified impacts for each event.

The findings from our analysis are described below, with additional technical detail provided in Appendix D.

Based on our review of the CBL methodology used to generate Enbala's baselines and impact estimates, the evaluation team calculated these values (and the performance metrics they feed into) using an adjusted CBL methodology:

- The adjustment factor is symmetric, meaning it can increase or decrease baselines, rather than only serving to increase baselines;
- The adjustment factor is capped at 20 percent rather than uncapped;
- The adjustment factor is only applied to sites that (1) have weather sensitive loads, (2) do not have solar power, and (3) do not pre-pump or pre-cool prior to demand response events;
- For sites that meet (1) and (2) above but not (3), an additive adjustment factor based on weather was applied rather than an adjustment factor based on pre-event load; and
- The 3-of-5 baseline days are selected based on average load during the event window rather than the maximum 15-minute kW reading.

Regarding weather sensitive loads, the evaluation team estimated weather sensitivity at each site by assessing the relationship between load and temperature during common event hours (2:00 p.m.–7:00 p.m., which includes the adjustment window) on non-event, non-holiday weekdays during the summer of 2019. Sites were considered to be weather sensitive if (1) the correlation between temperature and load was positive and (2) temperature was found to be a statistically significant predictor of load. In total, 52 of the 92 sites met these criteria.

7.1 Performance Metrics

After calculating adjusted baselines and adjusted impacts, the evaluation team calculated participant performance metrics in a manner identical to the manner in which Enbala did so with one exception: we did not zero out negative performances as a rule. However, we did zero out negative performances in cases where the program implementer had documentation showing a site informed them that the site would not be participating in the upcoming event.

The results of the 2019 Peak Saver Demand Response evaluation are shown in Table 25. For comparison, the savings produced by the program implementer are shown in Table 26. Our findings indicate the Peak Saver program is approximately a 17 MW capacity resource. On average, the verified capacity performance estimates using the Evergreen methodology are 56 percent of the values calculated by Enbala using the settlement CBL. The majority of the difference can be attributed to one site. Without that site, the verified capacity performance estimates using the Evergreen methodology are 85 percent of the settlement values.

Table 25: Evaluated Performance Summary by Event

Event Date	10-Minute Capacity Performance (kW)	Average Capacity Performance (kW)	Verified Capacity Performance (kW)	Energy Performance During Event Hours (kWh)
07/10/2019	14,416	12,953	13,539	51,180
08/27/2019	15,186	14,091	14,529	54,999
09/04/2019	22,777	18,981	20,499	74,570
Average	**17,460**	**15,342**	**16,189**	**60,250**

Table 26: Performance Summary – Program Implementer

Event Date	10-Minute Capacity Performance (kW)	Average Capacity Performance (kW)	Verified Capacity Performance (kW)	Energy Performance During Event Hours (kWh)
07/10/2019	29,864	28,257	28,900	113,057
08/27/2019	29,532	33,343	31,819	131,677
09/04/2019	31,862	21,334	25,545	85,139
Average	**30,419**	**27,645**	**28,754**	**109,958**

Table 27 presents daily energy savings. This is the aggregate difference between energy use on an event day and the baseline for all hours following the beginning of the event (including the event hours). Comparing the capacity performance, energy savings during the event, and the daily energy savings helps illustrate the extent to which event load was shifted to other hours. On average, aggregate energy used decreased by 63.8 MWh on event days. One would expect daily energy savings to be less than event energy savings due to snapback. This was not the case for Peak Saver in 2019, as several of the large customers saved energy in the post-event hours (i.e., their actual load was less than their baseline). The table also shows how these numbers change if the two largest sites (in terms of demand) are removed. These two sites swing the results by about 21 MWh for each event.

Table 27: Daily Energy Savings – Event Hours and Post-Event Hours

Event Date	Daily Energy Impact (kWh)	Daily Energy Impact (kWh) – Without Two Largest Sites
07/10/2019	59,793	37,781
08/27/2019	49,455	31,507
09/04/2019	82,014	58,189
Average	**63,754**	**42,493**

7.2 Comparing Performance and Commitments

This section compares DR nominations with verified performance metrics (as calculated by the evaluation team). The metric our team reviewed was the percent of the nomination achieved, calculated as follows:

$$Percent\ of\ Nomination\ Achieved = 100\% * \frac{Verified\ Reduction}{Nominated\ Reduction}$$

Figure 38 shows the distribution of these percentages. For each participant, unique percentages were calculated for each event. Instances where actual reductions do not exceed nominated reductions result in percentages that are less than 100 percent, and vice-versa. The majority of the distribution falls below 100 percent, implying that most sites did not achieve their nominated load reduction on most event days.

Figure 38: Distribution of Percent Differences

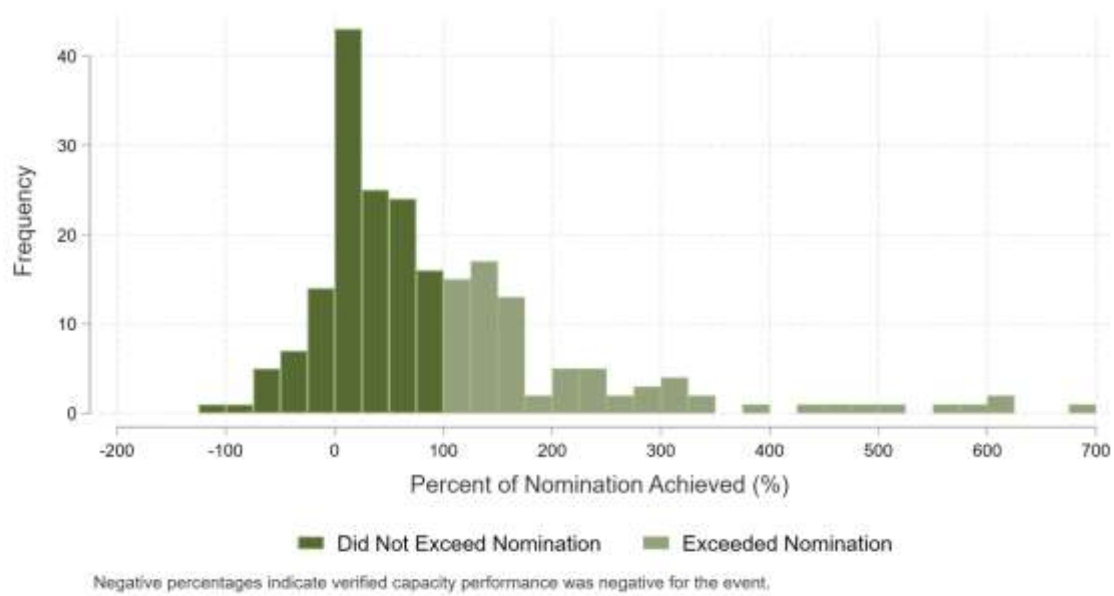


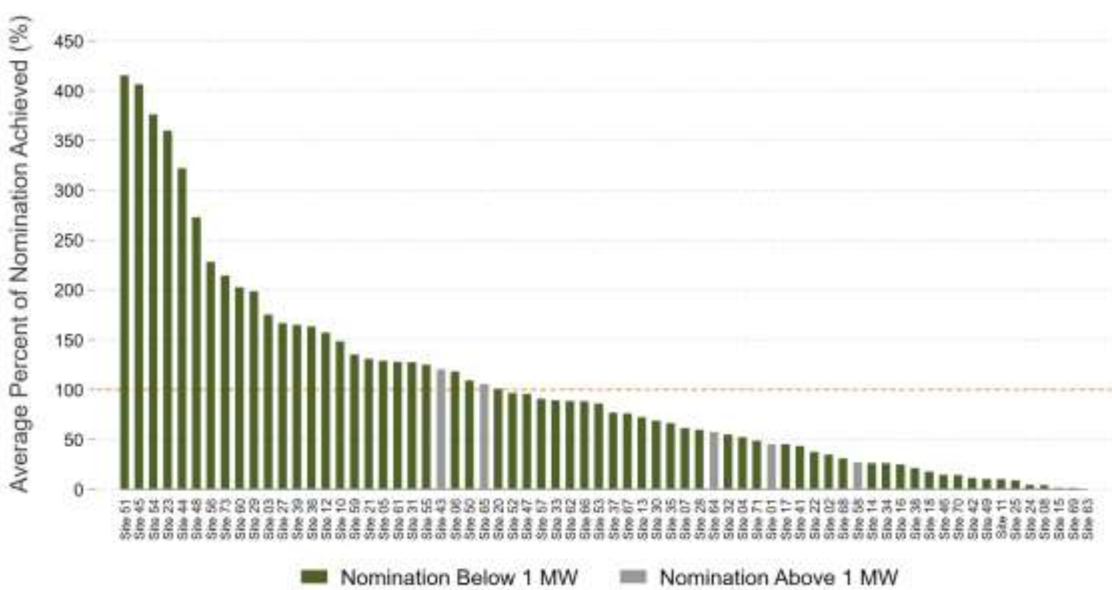
Table 28 groups participants based on how their verified reductions compared to their nominated reductions. Of the 73 participants, 27 exceeded their nomination on average.[20] Another 40 participants – accounting for 75 percent of the total nominations –did not exceed their nomination but did provide demand reductions. Figure 39 shows, on average, what percentage of their nomination each site achieved. The five participants with negative verified reductions are not included in the figure. None of these five sites have solar PV and three of them are schools.

Table 28: Comparing Performance and Nominations

Result	Frequency	Aggregate Nomination (kW)[1]
Did Not Exceed Nomination	40	18,675
Exceeded Nomination	27	5,955
Negative Performance	5	370
Nomination of 0 kW	1	0
Total	**73**	**25,000**

[1] Nominations from August 2019 are shown.

Figure 39: Average Performance by Site



[20] Recall that sites are aggregated to the participant level. Some participants had multiple sites.

7.3 Peak Saver Conclusions and Recommendations

After our review of the 2019 Peak Saver program, the evaluation has the following recommendations:

- **Recommendation:** Make the multiplicative adjustment symmetric rather than asymmetric. As per the assessment of CBL accuracy, using an asymmetric adjustment results in an upwards bias in the baseline. Biasing the baseline inherently biases the performance metrics. The bias is greatly reduced when using a symmetric adjustment.
- **Recommendation:** Add a cap to the multiplicative adjustment factor. Otherwise, baselines are apt to approach unrealistic levels.
- **Recommendation:** Examine load data for solar patterns or pre-pumping/pre-cooling on event days. Pre-pumping/pre-cooling on event days is fine, but sites that do so should not receive the adjustment factor (or the adjustment factor should be based on weather rather than load). For sites with solar, consider using a smaller adjustment factor cap, using an additive adjustment, or removing the adjustment factor altogether.
- **Recommendation:** Compare DR nominations to the average demand on typical summer afternoons. If any nominations seem too high, update them. (Note that nominations for some sites do change throughout the summer.)
- **Recommendation:** PNM should also consider collecting all meter channels for sites with solar PV. This would allow the CBL to fully capture the load shape of sites that are net exporters during key times of day. It is possible that these sites reduced load and thus became larger exporters than they would have been on a non-event day, but the available data do not allow for a measurement. Also, an additive adjustment may work better than a multiplicative one for sites whose load can cross zero during the event period or adjustment window.
- **Recommendation:** When metered load is higher than the baseline, performance estimates should be recorded as negative values and not zeroed out.

8 Cost Effectiveness Summary

Earlier chapters presented the UCT cost effectiveness results for those programs evaluated in 2019. This chapter presents a summary of the cost effectiveness calculations for all of the PY2019 PNM programs.

As discussed previously, in order to do the UCT calculation, the evaluation team obtained the following from PNM:

- Avoided cost of energy (costs per kWh over a 20+ year time horizon);
- Avoided cost of capacity (estimated cost of adding a kW/year of generation, transmission, and distribution to the system);
- Avoided cost of CO2 (estimated monetary cost of CO2 per kWh generated);
- Avoided transmission and distribution costs;
- Discount rate;
- Line loss factor; and
- Program costs (all expenditures associated with program delivery).

Additional considerations for the UCT as applied to the PNM programs:

- PNM does not quantify the avoided cost of transmission and distribution.
- PNM provided a levelized avoided cost of capacity, to which the discount rate was not applied further.
- The NMPRC allows for the benefits of low-income programs to be boosted by 20 percent to account for utility system economic benefits. PNM estimates the following proportions of low-income customers participate in their programs:
    - 100 percent of Low Income Home Energy Checkup
    - 54 percent of Commercial Comprehensive - Multifamily
    - 100 percent of Easy Savings
    - 100 percent of Energy Smart
    - 40 percent of Home Works
- Program costs were broken into the following categories:
    - Administration
    - Promotion
    - Measurement & Verification
    - Rebates
    - Third-Party Costs
    - Market Transformation

The results of the UCT for all PY2019 programs based on net realized savings are shown below in Table 29. All programs except Power Saver and Peak Saver had a UCT of greater than 1.00. Overall, the PY2019 portfolio was found to have a UCT ratio of 1.85.

Table 29: PY2019 Cost Effectiveness

Program	Utility Cost Test (UCT)
Commercial Comprehensive	2.07
Residential Lighting	5.37
Home Works	2.18
Energy Smart	1.14
Residential Comprehensive	1.12
Easy Savings	3.08
New Home Construction	2.34
Power Saver	0.85
Peak Saver	0.94
Overall Portfolio	**1.85**