Evaluation of the 2020 Public Service Company of New Mexico Energy Efficiency and Demand Response Programs

Final Report

April 6, 2021

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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 2020 (PY2020).

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 PY2020, the following PNM programs were evaluated:

- Commercial Comprehensive
- Residential Comprehensive
- New Home Construction
- Energy Smart
- Power Saver
- Peak Saver

[1] NMSA §§ 62-17-1 *et seq* (SB 644). Per the New Mexico Public Regulation Commission Rule 1 SEP 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 2020 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 PY2020 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. Unlike past year, there were no site visits conducted in 2020 due to the Covid pandemic.. 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 Comprehensive. This is a prescriptive program serving PNM's residential customers and is made up of three sub-programs: Home Energy Checkup (including low-income households), Residential Cooling and Pool Pumps, and Refrigerator Recycling. The Home Energy Checkup sub-program includes a home energy assessment and the installation of low-cost measures in addition to available equipment rebates. The impact evaluation for the Residential Comprehensive program included a deemed savings review and participant survey. The participant survey was also used for the process evaluation that assessed how well the program is operating.

New Home Construction. This program was re-launched by PNM in 2017 after the Energy Star New Homes program was discontinued in 2014. There are two paths offered by the

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

program: The Performance path, which encourages a whole home approach to efficiency, and the Prescriptive path, which provides incentives for individual equipment upgrades. The impact evaluation included desk reviews for Performance projects, and a deemed savings review for Prescriptive measures. Builder interviews were used to estimate free ridership as part of the net impact analysis.

Energy Smart (Low Income). The Energy Smart program provides weatherization services and other efficiency upgrades to low-income households in PNM territory. Measures are prescriptive in nature and include insulation, duct sealing, water heater tank and pipe insulation, low-flow showerheads and aerators, and efficient lighting. A deemed savings review was conducted to complete the impact evaluation for this program.

Power Saver and Peak Saver. PNM had two demand response programs in PY2020. 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 PY2020 evaluation methods.

Table 1: Summary of PY2020 Evaluation Methods by Program

Program	Deemed Savings Review	Participant Survey / Interviews	Engineering Desk Reviews	Site Visits	Billing Regression
Commercial Comprehensive	◆	◆	◆		
Residential Comprehensive	◆	◆			
New Home Construction	◆	◆	◆		
Energy Smart	◆				
Power Saver (Res & Small/Med Commercial)					◆
Peak Saver (Large Commercial & Industrial)					◆

The results of the PY2020 impact evaluation are shown in Table 2 (kWh) and Table 3 (kW), with the programs evaluated in 2020 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: PY2020 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	191	30,689,939	0.9851	30,233,928	0.8605	26,017,504
Midstream	43	859,728	0.8511	731,689	0.8605	629,648
Quick Saver	244	9,163,751	0.9352	8,569,897	1.0000	8,569,897
Building Tune-Up	31	1,158,260	0.9369	1,085,206	0.8605	933,863
New Construction	36	4,326,786	1.1217	4,853,406	0.8605	4,176,550
Multifamily	38	2,442,561	1.5291	3,735,001	0.8605	3,214,118
Residential Lighting	1,383,725	40,455,478	1.0000	40,455,478	0.6800	27,509,725
Home Works	12,553	2,576,280	1.0000	2,576,280	1.0000	2,576,280
Energy Smart	160	274,669	0.9829	269,972	1.0000	269,972
Residential Comprehensive						
Home Energy Checkup	572	375,856	1.0000	375,856	0.9799	368,290
Home Energy Checkup - LI	498	400,390	1.0000	400,390	0.9799	392,330
Refrigerator Recycling	5,996	6,530,364	1.0000	6,530,364	0.5489	3,584,713
Cooling	2,866	5,049,113	0.9639	4,866,840	0.6625	3,224,427
Easy Savings	13,481	3,004,915	1.0000	3,004,915	1.0000	3,004,915
New Home Construction	1,362	2,559,525	1.0000	2,559,591	0.7300	1,868,502
Customer Self-Direct	0	0	0.0000	0	0.0000	0
Power Saver	50,577	370,803	0.7555	280,142	1.0000	280,142
Peak Saver	130	709,170	0.7820	554,550	1.0000	554,550
Total	**1,472,503**	**110,947,590**		**111,083,506**		**87,175,427**

Table 3: PY2020 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	191	3,565	1.0283	3,666	0.8605	3,154
Midstream	43	501	0.5050	253	0.8605	218
Quick Saver	244	2,138	0.3542	757	1.0000	757
Building Tune-Up	31	-	-	-	0.8605	-
New Construction	36	874	1.1497	1,004	0.8605	864
Multifamily	38	481	0.8381	403	0.8605	347
Residential Lighting	1,383,725	7,908	1.0000	7,908	0.6800	5,377
Home Works	12,553	144	1.0000	144	1.0000	144
Energy Smart	160	41	1.0000	41	1.0000	41
Residential Comprehensive						
Home Energy Checkup	572	47	1.0000	47	0.9799	46
Home Energy Checkup - LI	498	58	1.0000	58	0.9799	57
Refrigerator Recycling	5,996	1,535	1.0000	1,535	0.5489	843
Cooling	2,866	3,495	0.9639	3,368	0.6625	2,232
Easy Savings	13,481	183	1.0000	183	1.0000	183
New Home Construction	1,362	1,006	1.0298	1,036	0.7300	757
Customer Self-Direct	0	0	0.0000	0	0.0000	0
Power Saver	50,577	41,070	0.7555	31,028	1.0000	31,028
Peak Saver	130	18,175	0.7092	12,890	1.0000	12,890
Total	**1,472,503**	**81,221**		**64,323**		**58,939**

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: PY2020 Savings Summary – Lifetime kWh

Program	Expected Gross kWh Lifetime Savings	Realized Gross kWh Lifetime Savings	Realized Net kWh Lifetime Savings
Commercial Comprehensive			
Retrofit Rebate	325,313,358	320,479,638	275,785,547
Midstream	9,113,118	7,755,908	6,674,269
Quick Saver	97,135,762	90,840,912	90,840,912
Building Tune-Up	12,277,561	11,503,183	9,898,949
New Construction	45,863,929	51,446,102	44,271,429
Multifamily	25,891,151	39,591,015	34,069,652
Residential Lighting	455,181,001	455,181,001	309,523,081
Home Works	28,780,216	28,780,216	28,780,216
Energy Smart	4,436,063	4,360,206	4,360,206
Residential Comprehensive			
Home Energy Checkup	3,363,911	3,363,911	3,296,195
Home Energy Checkup - LI	3,583,492	3,583,492	3,511,356
Refrigerator Recycling	32,110,056	32,110,056	17,626,173
Cooling	75,380,852	72,659,603	48,139,167
Easy Savings	39,664,877	39,664,877	39,664,877
New Home Construction	44,284,259	44,285,401	32,328,343
Power Saver	370,803	280,142	280,142
Peak Saver	709,170	554,550	554,550
Total	**1,203,459,578**	**1,206,440,211**	**949,605,063**

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. Overall, the portfolio had a UCT of 2.31 for PY2020 and therefore was cost effective.

Table 5: PY2020 Cost Effectiveness

Program	Utility Cost Test (UCT)
Res Comp – Refrigerator Recycling	1.10
Res Comp – Cooling & Pool Pumps	3.58
Res Comp – Home Energy Checkup	0.25
Res Comp – Home Energy Checkup LI	0.42
Residential Lighting	6.51
Comm Comprehensive	2.32
Comm Comprehensive - Multifamily	1.40
Easy Savings	1.99
Energy Smart (MFA)	1.24
New Home Construction	2.99
PNM Home Works	2.15
PNM Power Saver	0.93
PNM Peak Saver	0.91
Overall Portfolio	**2.31**

[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
Note that, at the request of PNM, we made some slight adjustments to the UCT calculation so that evaluation report would be consistent with PNM's internal cost effectiveness calculations. These changes were primarily related to rounding EUL values and changing the timing for discounting future costs and benefits, and resulted in a small increase in the portfolio UCT from 2.28 to 2.31.

The impact evaluation—which included engineering desk reviews for a sample of Commercial Comprehensive and New Homes projects, a review of deemed savings values for the other programs, and statistical models for the Power Saver and Peak Saver programs—resulted in relatively high realized gross savings, particularly for kWh. 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 (especially lights assumed to run from dusk to dawn), and differences in HVAC baseline parameters.

The process evaluation activities included customer surveys for the Commercial Comprehensive and Residential Comprehensive programs, and in-depth interviews with a small number of builders for the New Homes program. Across all these surveys and interviews, we found very high levels of satisfaction with PNM's 2020 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 in 2020. 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.

The *ex ante* 2020 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 44 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	191	30,689,939	3,565
Midstream	43	859,728	501
Quick Saver	244	9,163,751	2,138
Building Tune-Up	31	1,158,260	-
New Construction	36	4,326,786	874
Multifamily	38	2,442,561	481
Total	**583**	**48,641,025**	**7,559**

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 90/7 for the Commercial Comprehensive program overall. The larger sub-programs Retrofit Rebate and Quick Saver were among the highest precision levels at 85/4 and 80/11, respectively.

Table 7: Commercial Comprehensive Desk Review Sample

Sub-Program	Measure Group	Stratum	Count	Average kWh	Total kWh Savings	% of Savings	Current Sample
Retrofit Rebate	Custom	Certainty	1	5,000,000	5,000,000	10.4%	0
		1	24	91,398	2,193,548	4.6%	16
	HVAC	Certainty	2	1,671,000	3,342,000	6.9%	2
		1	17	38,369	652,265	1.4%	4
	Lighting	1	4	1,165,405	4,661,621	9.7%	3
		2	13	460,674	5,988,768	12.4%	3
		3	39	146,483	5,712,827	11.9%	3
		4	83	31,547	2,618,418	5.4%	3
	Other	1	5	20,183	100,917	0.2%	3
Quick Saver		1	8	306,648	2,453,187	5.1%	3
		2	20	123,803	2,476,058	5.1%	2
		3	53	41,782	2,214,429	4.6%	2
		4	163	12,393	2,020,079	4.2%	2
Building Tune-Up		1	7	60,943	426,600	0.9%	4
		2	9	49,233	443,094	0.9%	6
		3	14	20,612	288,563	0.6%	5
Midstream		1	2	199,144	398,287	0.8%	1
		2	4	72,188	288,751	0.6%	2
		3	33	5,991	197,708	0.4%	5
Multifamily		1	7	185,473	1,298,311	2.7%	3
		2	30	38,142	1,144,248	2.4%	3
New Construction		1	6	328,597	1,971,580	4.1%	4
		2	30	78,507	2,355,209	4.9%	3
Total			**574***	**441,240**	**48,246,468**	**100%**	**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.

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 Midstream and Quick Saver projects, where adjustments to demand savings ranged from 50 to 65 percent. These adjustments were primarily due to the misapplication of lighting operating hour assumptions, where dusk-to-dawn fixtures were erroneously assumed to be operating during coincident peak periods. In these cases the kW savings were set to zero. Adjustments were made to the other sub-programs in those cases where the savings calculations did not match the New Mexico TRM or the PNM work papers for these measures. 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 how the resulting engineering adjustments were used to calculated realized savings. For the Commercial Comprehensive program overall, these adjustments resulted in engineering adjustment factors of 1.0117 for kWh and 0.8047 for kW.

Table 8: PY2020 Commercial Comprehensive Gross kWh Impact Summary

Sub-Program	# of Projects	Expected Gross kWh Savings	Engineering Adjustment Factor	Realized Gross kWh Savings
Retrofit Rebate	191	30,689,939	0.9851	30,233,928
Midstream	43	859,728	0.8511	731,689
Quick Saver	244	9,163,751	0.9352	8,569,897
Building Tune-Up	31	1,158,260	0.9369	1,085,206
New Construction	36	4,326,786	1.1217	4,853,406
Multifamily	38	2,442,561	1.5291	3,735,001
Total	**583**	**48,641,025**	**1.0117**	**49,209,127**

Table 9: PY2020 Commercial Comprehensive Gross kW Impact Summary

Sub-Program	# of Projects	Expected Gross kW Savings	Engineering Adjustment Factor	Realized Gross kW Savings
Retrofit Rebate	191	3,565	1.0283	3,666
Midstream	43	501	0.5050	253
Quick Saver	244	2,138	0.3542	757
Building Tune-Up	31	-	-	-
New Construction	36	874	1.1497	1,004
Multifamily	38	481	0.8381	403
Total	**583**	**7,559**	**0.8047**	**6,083**

A summary of the individual desk review findings for each of the 90 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).[5] 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.

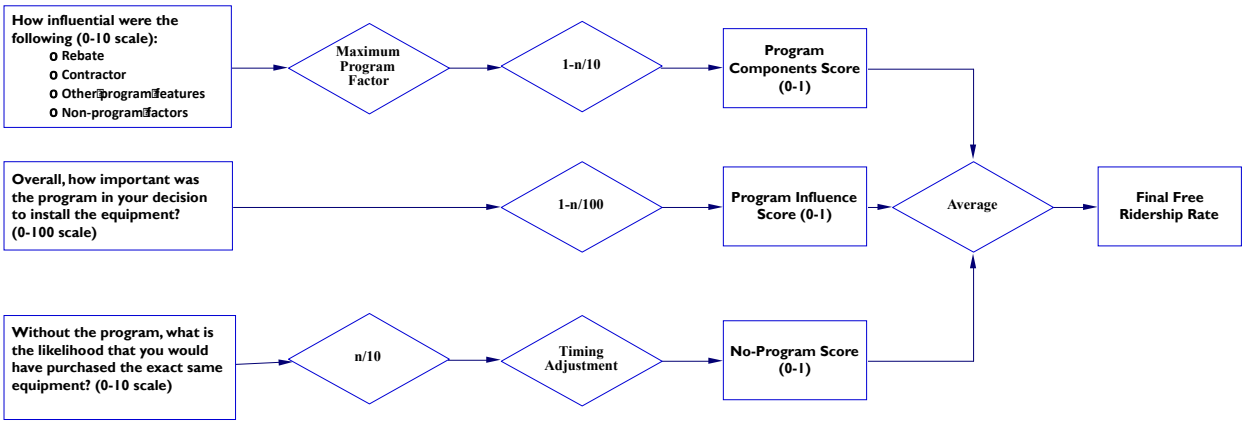
Each component was assessed using survey responses that rated the influence of various factors on the respondent's equipment choice. Since opposing biases potentially affect the main components, the No-Program Component typically indicates higher free ridership than the Program Component/Influence questions. Therefore, combining these opposing influences helps mitigate the potential biases. This framework also relies on multiple

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

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:

$$\text{Net Realized Savings} = (\text{Net-to-Gross Ratio})*(\text{Gross Realized Savings})$$

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 is 0.8605. While the survey sample was mostly Retrofit Rebate customers, there were also a few customers from the New Construction and Multifamily programs and so the same NTG ratio was applied to these programs, as well as to the Building Tune-Up program. This resulted in an increase in the NTG ratio for these latter three sub-programs relative their original *ex ante* values. For Quick Saver, an NTG ratio of 1.00 was applied, due to the direct install design of this sub-program.

Table 10 and Table 11 summarize the PY2020 net impacts for the Commercial Comprehensive program using the NTG ratios described above. Net realized savings for the program overall are 43,541,580 kWh, and net realized demand savings are 5,340 kW.

Table 10: PY2020 Commercial Comprehensive Net kWh Impact Summary

Sub-Program	# of Projects	Realized Gross kWh Savings	NTG Ratio	Realized Net kWh Savings
Retrofit Rebate	191	30,233,928	0.8605	26,017,504
Midstream	43	731,689	0.8605	629,648
Quick Saver	244	8,569,897	1.0000	8,569,897
Building Tune-Up	31	1,085,206	0.8605	933,863
New Construction	36	4,853,406	0.8605	4,176,550
Multifamily	38	3,735,001	0.8605	3,214,118
Total	**583**	**49,209,127**	**0.8848**	**43,541,580**

Table 11: PY2020 Commercial Comprehensive Net kW Impact Summary

Sub-Program	# of Projects	Realized Gross kW Savings	NTG Ratio	Realized Net kW Savings
Retrofit Rebate	191	3,666	0.8605	3,154
Midstream	43	253	0.8605	218
Quick Saver	244	757	1.0000	757
Building Tune-Up	31	-	0.8605	-
New Construction	36	1,004	0.8605	864
Multifamily	38	403	0.8605	347
Total	**583**	**6,083**	**0.8779**	**5,340**

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.[6]

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).

[6] 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

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 PY2020 impact evaluation for Commercial Comprehensive were used in the final cost effectiveness calculations.

For the 2020 Commercial Comprehensive program, the UCT value was 2.21.

1.5 Quick Saver and Retrofit Rebate Participant Surveys

A participant phone survey was fielded in late 2020 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, 100 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	89	40	27
Quick Saver	124	60	69
New Construction	12	0	2
Multifamily	8	0	2
Total	**233**	**100**	**100**

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

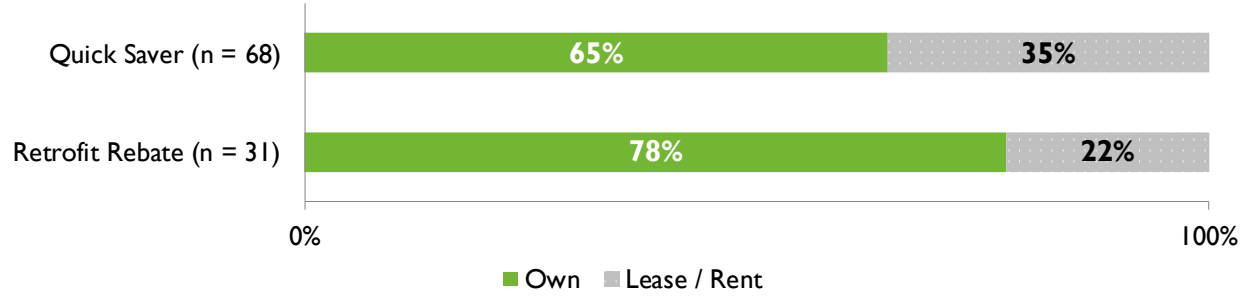
The following sections report results on company demographics, sources of program awareness, motivations for participation, and program satisfaction.

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. Figure 2 shows that 65 percent of Quick Saver sub-program participants owned their building, which is somewhat expected, as direct install programs typically target customers that rent their spaces. Additionally, 78 percent of Retrofit Rebate sub-program participants reported that they owned their building.

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 Retrofit Rebate customers are more likely to get rebates, with 83 percent occupying buildings of 50,000 square feet or more. Additionally, 24 percent of Retrofit Rebate participants reported having more than 100 full-time employees and 26 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 (68 percent) occupying buildings of less than 10,000 square feet. In addition, seven percent of Quick Saver participants reported having more than 100 full-time employees.

Figure 3: Quick Saver and Retrofit Rebate Participant Building Size

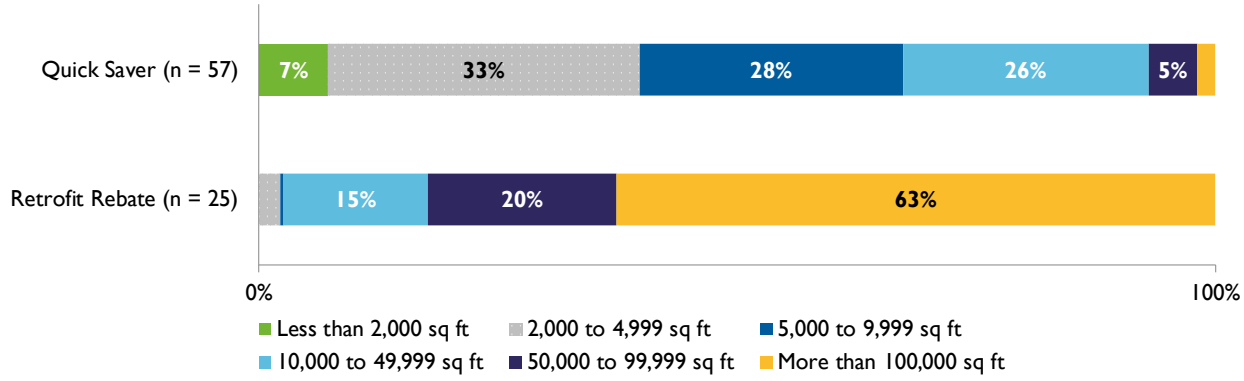


Figure 4: Quick Saver and Retrofit Rebate Participant Number of Employees

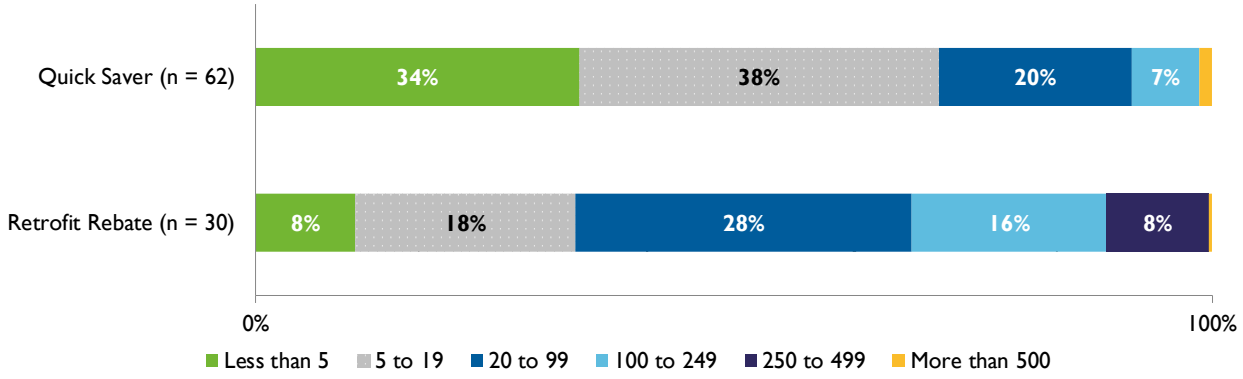
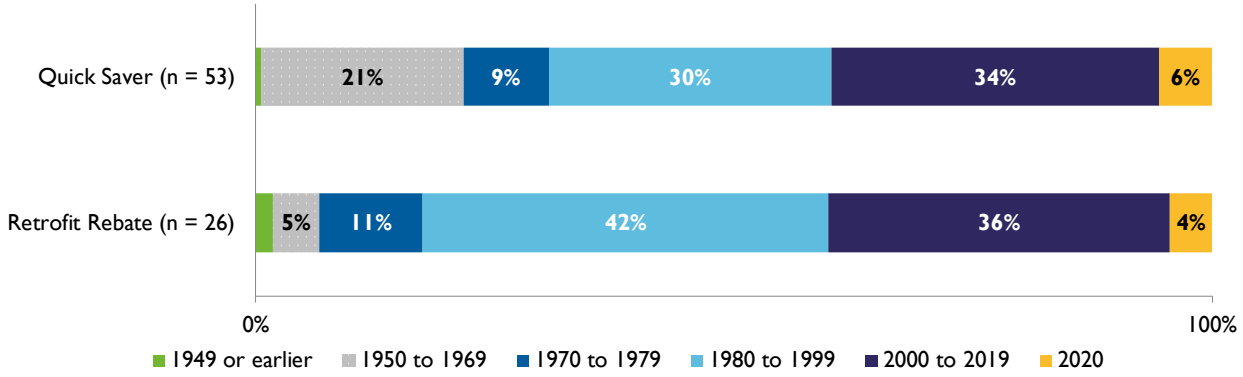


Figure 5 shows that the majority (42 percent) of Retrofit Rebate participants' buildings were built between 1980 and 1999 compared to 30 percent of Quick Saver participants' buildings. Both programs had roughly 40 percent of participants' buildings constructed after 2000, suggesting that both sub-programs could do 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, the most frequently reported channels for Retrofit Rebate participants were contractors/distributors (44 percent) and through previous participation in a PNM program (43 percent). Quick Saver participants most frequently reported contractors/distributors (38 percent) and word of mouth (26 percent) as their initial sources of awareness.

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 (38 percent), while Quick Saver sub-program participants found the PNM website (50 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

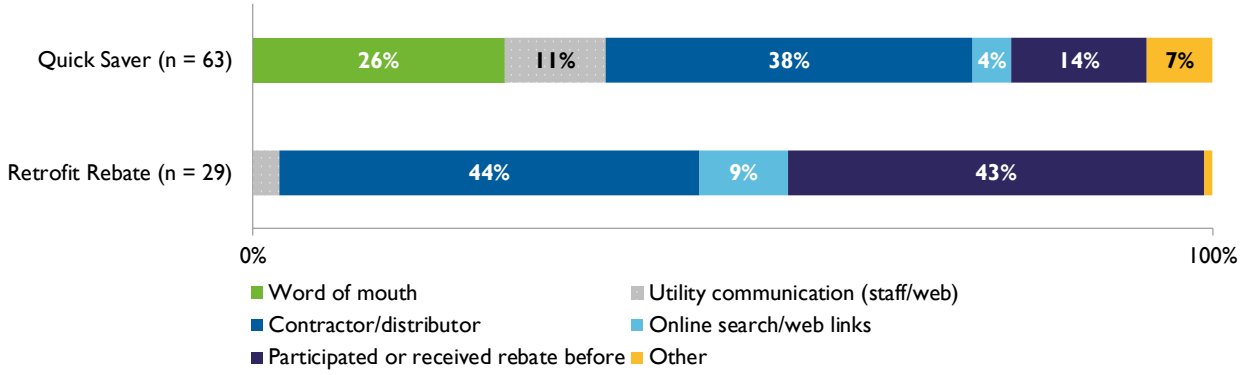
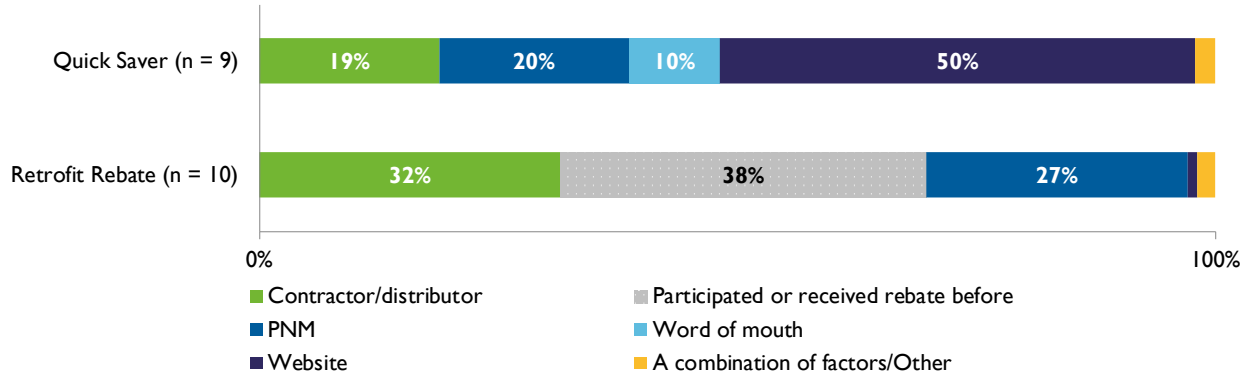


Figure 7: Most Useful Source of Awareness



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.

For Retrofit Rebate customers, receiving the rebate was the most influential factor, with 78 percent of individuals indicating it was extremely important in their decision to participate. Other factors that followed were reducing energy bills (76 percent) and improving air quality (68 percent).

For Quick Saver customers, reducing energy bills was the most important factor, with 80 percent of respondents indicating that it was extremely important. Other factors that followed were upgrading older equipment (56 percent) and contractor recommendations (43 percent).

While improving comfort was observed to be one of the least important factors for both Retrofit Rebate participants (50 percent) and Quick Saver participants (34 percent), Quick Saver participants indicated that reducing business environmental impacts (27 percent) was the least important factor in their decision to participate in the program.

Figure 8: Retrofit Rebate Motivations for Participation (n=31)

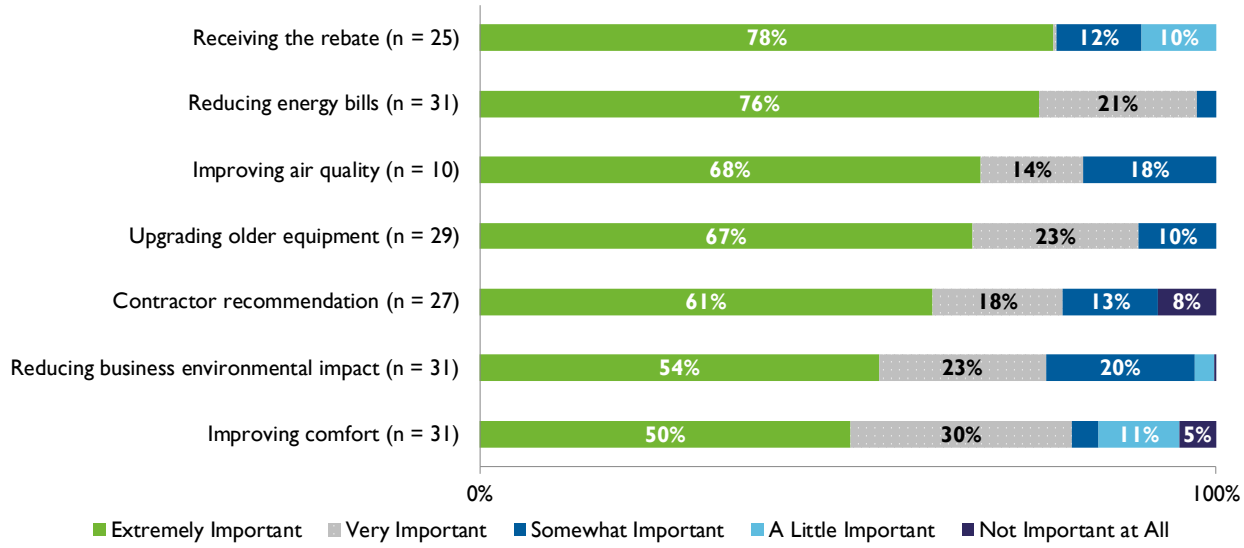
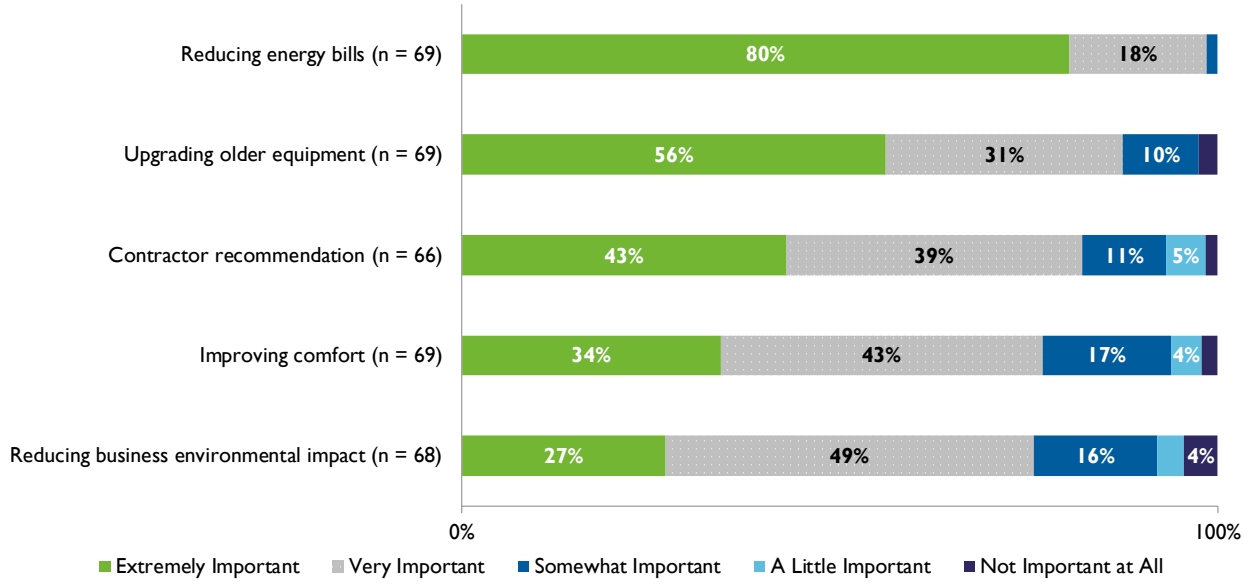


Figure 9: Quick Saver Motivations for Participation (n=69)



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.[7] As shown in Figure 10 below, the majority of Retrofit Rebate participants rated all eight program factors as extremely important (ratings of 8 to 10) or very important (6 or 7) in their decision to determine how energy efficient their

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

project would be. Previous participation in a PNM program was the highest-rated program factor.

Figure 10: Retrofit Rebate Importance of Program Factors (n=31)

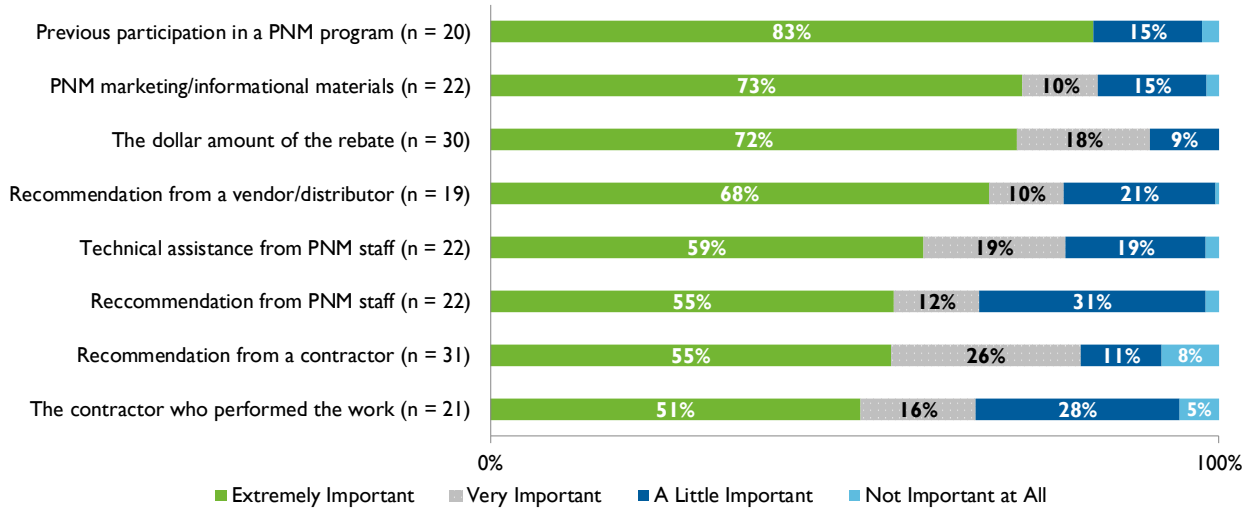
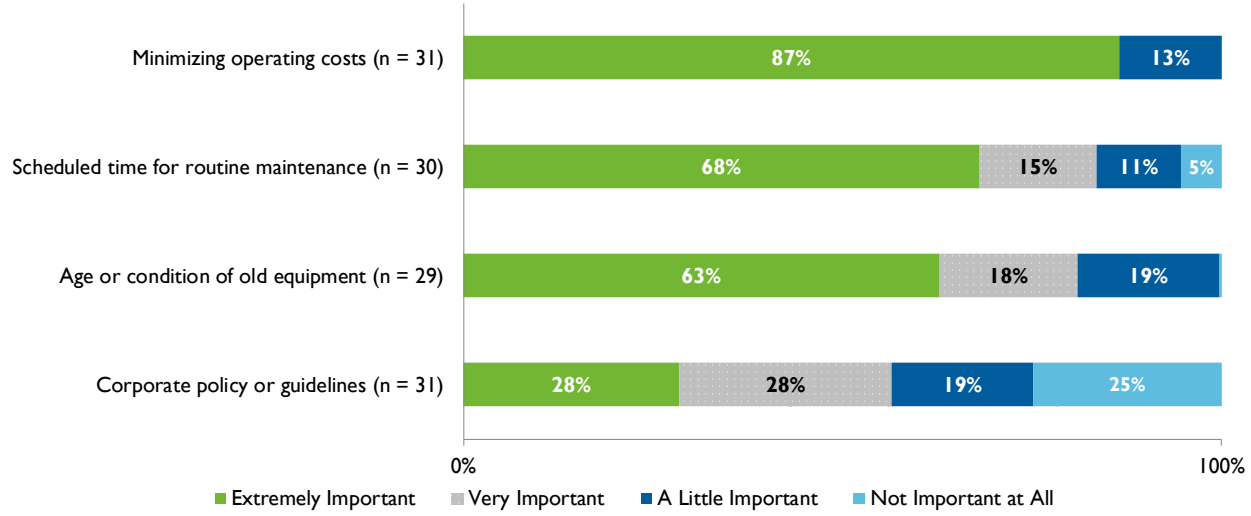


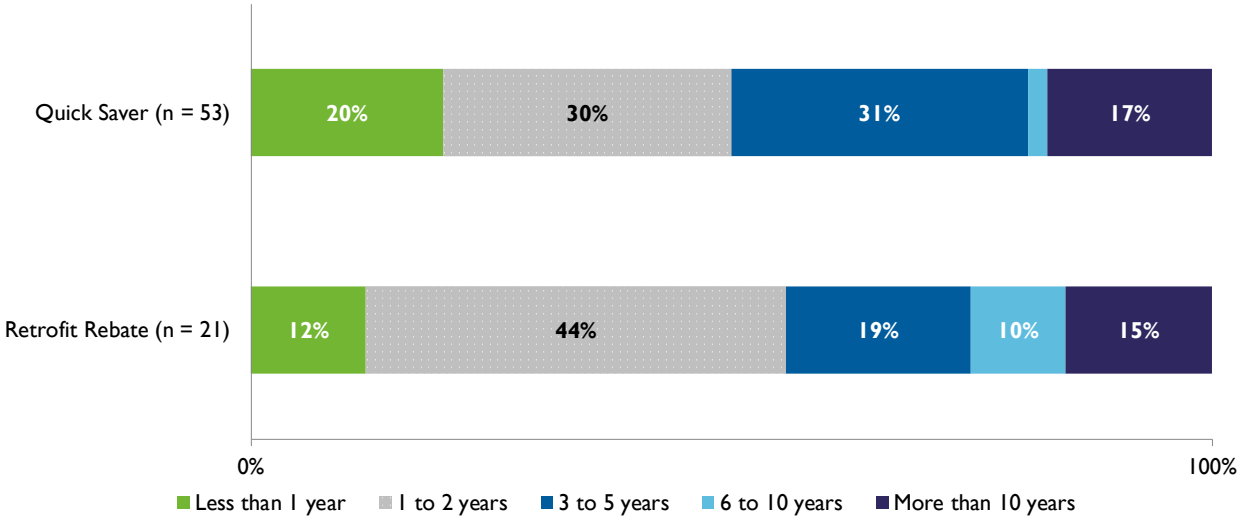
Figure 11 shows that the majority of Retrofit Rebate participants rated three of the four non-program factors as extremely important (ratings of 8 to 10) on the decision to determine how energy efficient their project would be. The minimization of operating costs and scheduled time for routine maintenance were the most influential non-program factors in the decision regarding efficiency level of the equipment, with 87 percent and 68 percent of participants reporting it as extremely important respectively. Corporate policy or guidelines were reported as the least influential non-program factor, with 28 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 50 percent of Quick Saver participants believed that their equipment would have lasted less than three years. Similarly, the majority of Retrofit Rebate participants (56 percent) reported that their equipment would have lasted between one to two years. This suggests that the program could do more to target customers with functioning equipment, rather than those whose equipment is not working and would need to be replaced anyway (i.e., potential free riders).

Figure 12: Participant Equipment Remaining Life



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

Figure 13 and Figure 14 below summarize the satisfaction levels for both the Quick Saver and Retrofit Rebate participants. Overall, participants expressed high levels of satisfaction, with the majority of participants reporting ratings of "very satisfied" for all eleven program components.

Retrofit Rebate program participants were most satisfied with the overall quality of the installation (100 percent), the rebate program overall (97 percent), and the interactions with PNM (96 percent). Similarly, Quick Saver participants were most satisfied with the overall quality of the installation (97 percent), the rebate program overall (91 percent), and the contractor who installed the equipment (90 percent).

Figure 13: Retrofit Rebate Program Satisfaction (n=31)

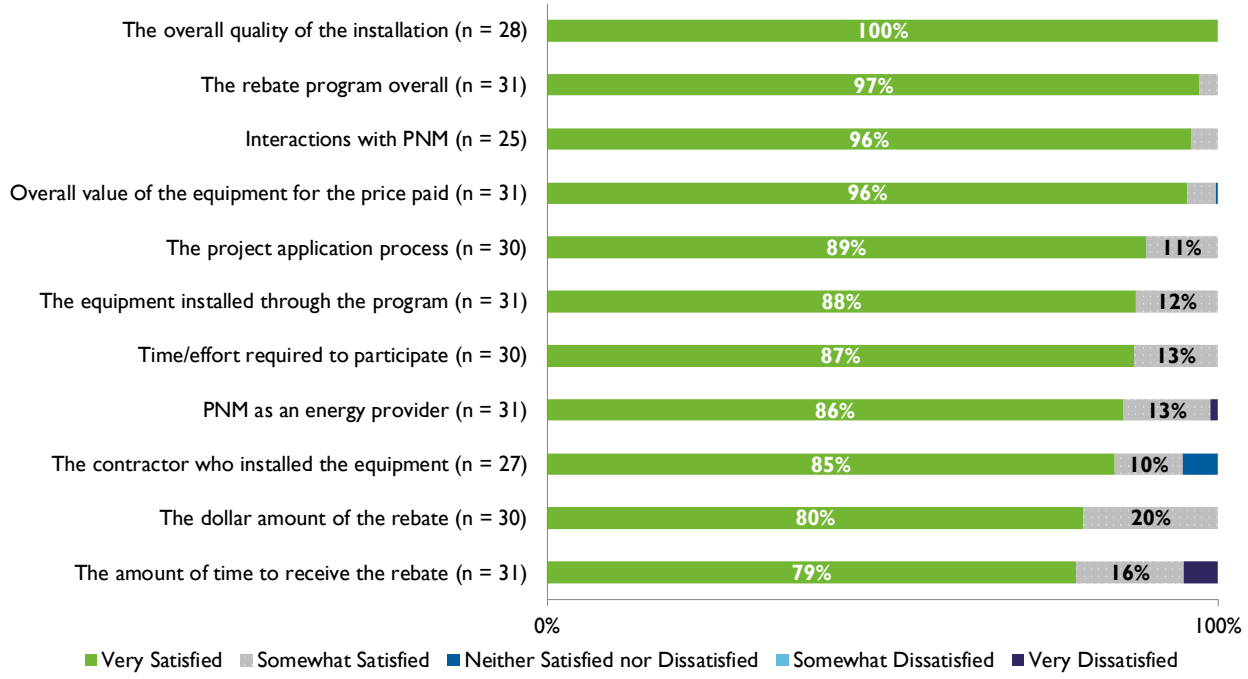
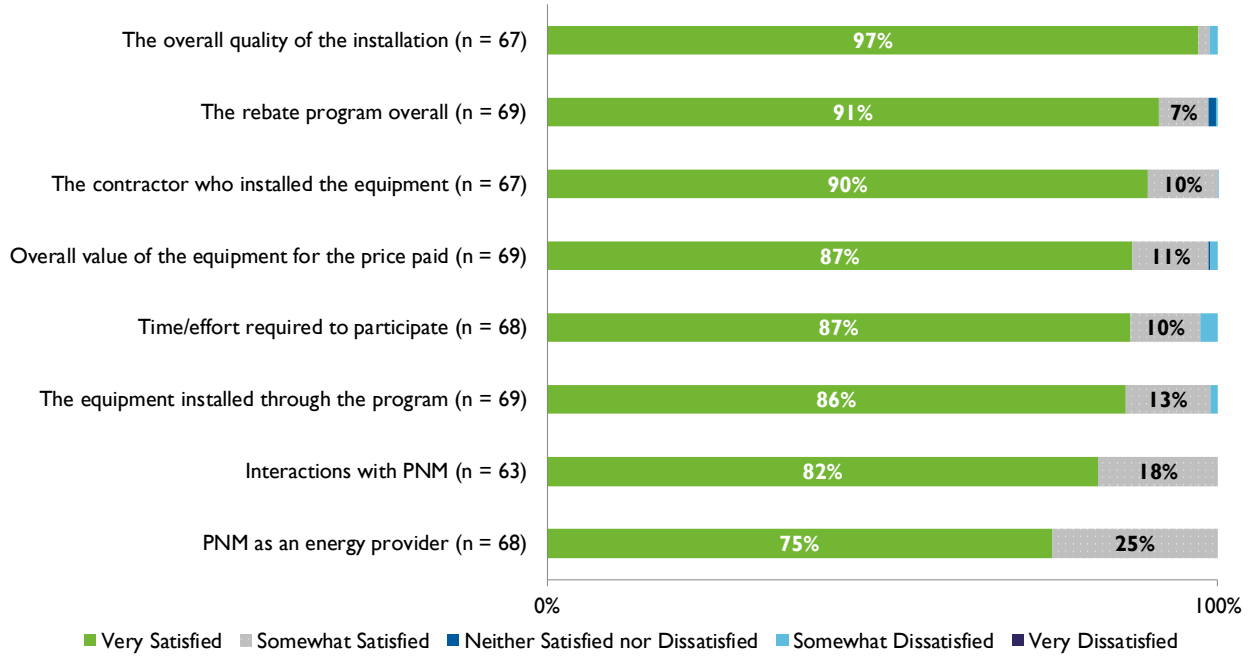


Figure 14: Retrofit Rebate Program Satisfaction (n=69)



1.6 Commercial Comprehensive Conclusions and Recommendations

Impact evaluation activities for the Commercial Comprehensive program included engineering desk reviews for a sample of the Building Tune-Up, Direct Install, Midstream, Multifamily, New Construction, and Retrofit Rebate sub-programs. Based on these desk reviews, an engineering adjustment factor of 0.9995 was found for kWh savings, and 0.7395 was found 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 2019 PNM Workpapers and New Mexico TRM 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 *ex ante* and *ex post* 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 was not able to reproduce the *ex ante* peak demand savings for several prescriptive high efficiency motor and prescriptive VSD projects using the PNM workpapers.
    - Using assumption, 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 *ex ante* and *ex post* 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 Workpapers, such as averaging deemed values, for prescriptive projects.
- The evaluation team was not able to replicate the *ex ante* HVAC savings for several projects throughout the evaluated sub-programs using the supplied project documentation and PNM workpapers.
    - Using assumptions, algorithms, baseline values provided in the PNM Workpaper 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.

- The evaluation team was not able to identify the discrepancy in the *ex ante* and *ex post* savings without additional documentation of the project-specific calculations performed by PNM.
- **Recommendation:** Provide algorithm inputs that PNM used to calculate the *ex ante* savings for the HVAC projects throughout the sub-programs.

- The evaluation team adjusted the lighting hours of use for multiple Direct Install (Quick Saver) projects to align with either the customer reported hours or the listed building type when customer reported hours were not available.
  - It is unclear what hours PNM used to calculate the savings for some of the lighting projects in the Direct Install (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 Workpapers. It is not clear what annual hours of use were used to calculate the savings for some of the Direct Install (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 workpapers.
  - **Recommendation:** Use 4,192 hours per year for lights that operate on a dusk-to-dawn schedule as noted in the PNM workpapers.
- The evaluation team found Direct Install (Quick Saver) 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.
- Several New Construction lighting projects used a different baseline lighting power density (LPD) than the building type LPDs listed in the PNM workpapers and NM TRM to calculate the *ex ante* savings.
  - The evaluation team found several instances of *ex ante* savings calculations utilizing lower baseline LPDs for interior and exterior spaces than those listed in the PNM workpapers and the TRM.
  - We updated the *ex post* savings calculation with the interior and exterior baseline LPD values for the applicable building types. This change led to an overall increase in claimed savings for all the sampled New Construction projects.

- The evaluation team used hours of operation, HVAC interactive factors and coincidence factors as listed in the PNM workpaper. The *ex ante* savings calculation and application did not provide information regarding hours of operation, HVAC interactive factors and coincidence factors.
- **Recommendation:** Provide rationale for using a custom calculated baseline LPD. Otherwise, reference the baseline LPD values listed in the PNM workpapers or NM TRM for the applicable building type.

- The evaluation team identified multiple Building Tune-Up projects with *ex ante* building area (square feet) values that appear to be rough estimates or rounded estimates. It was often unclear if the utility account information provided was for the specific building(s) or was a master-meter account for entire facility/campus.
  - There were 15 Building Operator Certificates projects evaluated during PY2020. The same customer completed five different projects at five different locations, and representatives from each site were certified. Other customers also had multiple projects at different locations.
  - When possible, the evaluation team used the algorithms and assumptions (building type) listed in the PNM Workpapers 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 Workpapers for applicable measures and provide clear reported areas (square feet) which reflects the entire building or conditioned areas.
  - **Recommendation:** Consider adding a section in the application that encourages applicants to submit list of measures that the building operator is planning to implement after their training.
- The supplied information for the Midstream sub-program did not include any application files, *ex ante* savings calculations, or other documentation. All of the program data were supplied in an Excel workbook.
  - All Midstream projects were included in a single Excel workbook summary table, where each row is a different measure. The summary table shows only values (no formulas) for a fairly limited number of parameters related to the facility location, installed equipment, and energy savings.
  - **Recommendation**: Provide copies of invoices, savings calculations (or an explanation of how the savings values in the Excel summary table are generated), and any other documentation related to equipment involved in the measures for the evaluation teams' review.
- The evaluation team found that PNM did not claim any *ex ante* energy or peak demand savings for high-efficiency ice machine measures listed in the Midstream tracking data.

- The Excel summary table shows equipment quantities (as well as incentive amounts) associated with distributors, but energy savings are shown as 0 kWh and 0 kW.
- PNM workpapers contain the methodology and deemed values for energy savings per ice machine, but they appear to not have been used for *ex ante* calculations.
- **Recommendation**: Provide additional context and detail regarding the high-efficiency ice machine measure, including how and when savings will be calculated for the measure. Utilize PNM workpapers as the source for savings values for this measure.

2 Residential Comprehensive Program

2.1 Residential Comprehensive Gross Impacts

The *ex ante* 2020 impacts are summarized in Table 13 for each Residential Comprehensive sub-program. In total, the Residential Comprehensive program accounted for 11 percent of energy impacts in PNM's overall portfolio.

Table 13: Residential Comprehensive Savings Summary

Sub-Program	# of Projects	Expected Gross kWh Savings	Expected Gross kW Savings
Home Energy Checkup	1,070	776,246	105
Refrigerator Recycling	5,996	6,530,364	1,282
Cooling and Pool Pumps	2,866	5,049,113	3,495
Total	**9,932**	**12,355,723**	**4,881**

The gross impact evaluation of the Residential Comprehensive program consisted of a deemed savings review of per-unit savings values for each of the three sub-programs. We compared PNM documentation on the source, calculations, and input assumptions of savings values to determine whether they were correct and appropriate.

For the Home Energy Checkup and Refrigerator Recycling sub-programs, we were able to confirm the source of savings, calculations, and input assumptions for the majority of measures. For measures where we did not have enough information on the input assumptions to replicate the calculations, we confirmed that the per-unit values were within a reasonable range for the type of measure. In the future, we recommend that PNM clearly and consistently document the source of deemed savings, formulas used to calculate deemed savings, and all input assumptions for those calculations in order to facilitate evaluator review of savings values. The engineering adjustment factor for both the Home Energy Checkup and Refrigerator Recycling sub-programs was 1.00.

For the Residential Comprehensive Cooling sub-program, a slight engineering adjustment was made to account for the lack of lack of baseline efficiency documentation in the program tracking data. The evaluation team used a baseline assumption based on the heating and cooling capacity of the units. This resulted in slight adjustment (0.9639) to the original gross impact values.

Table 14 and Table 15 show the results of the deemed savings reviews and how the resulting engineering adjustments were used to calculated realized savings. For the Residential Comprehensive program overall, these adjustments resulted in an engineering adjustment factor of 0.9838 for kWh and 0.9742 for kW.

Table 14: PY2020 Residential Comprehensive Gross kWh Impact Summary

Sub-Program	# of Projects	Expected Gross kWh Savings	Engineering Adjustment Factor	Realized Gross kWh Savings
Home Energy Checkup	1,070	776,246	1.0000	776,246
Refrigerator Recycling	5,996	6,530,364	1.0000	6,530,364
Cooling and Pool Pumps	2,866	5,049,113	0.9639	4,866,840
Total	**9,932**	**12,355,723**	**0.9838**	**12,173,450**

Table 15: PY2020 Residential Comprehensive Gross kW Impact Summary

Sub-Program	# of Projects	Expected Gross kW Savings	Engineering Adjustment Factor	Realized Gross kW Savings
Home Energy Checkup	1,070	105	1.0000	105
Refrigerator Recycling	5,996	1,535	1.0000	1,535
Cooling and Pool Pumps	2,866	3,495	0.9639	3,368
Total	**9,932**	**4,881**	**0.9742**	**4,755**

2.2 Residential Comprehensive Net Impacts

Net impacts for the Residential Comprehensive program were calculated using NTG ratios from the participant phone survey, using a similar self-report scoring algorithm described above for the Commercial Comprehensive program. Customers were asked to assess the influence that various program actions (e.g., rebate) had on their decision to purchase or install the energy efficient measure. They were also asked the likelihood that they would have done the same action if the PNM program had not been available. The scores from these two questions were average to obtain the estimated free ridership for each sub-program. The resulting NTG ratios ranged from 0.5489 for Refrigerator Recycling to 0.9799 for Home Energy Checkup.

Table 16 and Table 17 summarize the PY2020 net impacts for the Residential Comprehensive program using the NTG ratios described above. Net realized savings for the program overall are 7,569,783 kWh, and net realized demand savings are 3,039 kW.

Table 16: PY2020 Residential Comprehensive Net kWh Impact Summary

Sub-Program	# of Projects	Realized Gross kWh Savings	NTG Ratio	Realized Net kWh Savings
Home Energy Checkup	1,070	776,246	0.9799	760,643
Refrigerator Recycling	5,996	6,530,364	0.5489	3,584,713
Cooling and Pool Pumps	2,866	4,866,840	0.6625	3,224,427
Total	**9,932**	**12,173,450**	**0.6218**	**7,569,783**

Table 17: PY2020 Residential Comprehensive Net kW Impact Summary

Sub-Program	# of Projects	Realized Gross kW Savings	NTG Ratio	Realized Net kW Savings
Home Energy Checkup	1,070	105	0.9799	103
Refrigerator Recycling	5,996	1,535	0.5489	843
Cooling and Pool Pumps	2,866	3,368	0.6625	2,232
Total	**9,932**	**4,755**	**0.6389**	**3,039**

2.3 Participant Phone Surveys

As part of the process evaluation, the evaluation team conducted telephone surveys with 40 residential customers that received rebates through the PNM Residential Comprehensive Cooling and Pool Pumps sub-program. The surveys were completed in January and February 2021 and ranged from 15 to 20 minutes in length.

The participant survey was designed to cover the following topics:

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

- Additional process evaluation topics.

PNM provided program participation data on the Residential Comprehensive participant projects, which allowed us to select a sample for surveys. The evaluation team randomly selected and recruited program participants based on whether they had valid contact information and received a rebate through the Cooling and Pool Pumps sub-program.

Table 18: Residential Comprehensive Phone Survey Sample

Sub-Program	Count of Customers with Valid Contact Info	Target # of Completes	Completed Surveys
Cooling & Pool Pumps	179	40	40
Refrigerator Recycling	458	40	40
Home Energy Checkup	589	40	40
Total	**1,226**	**120**	**120**

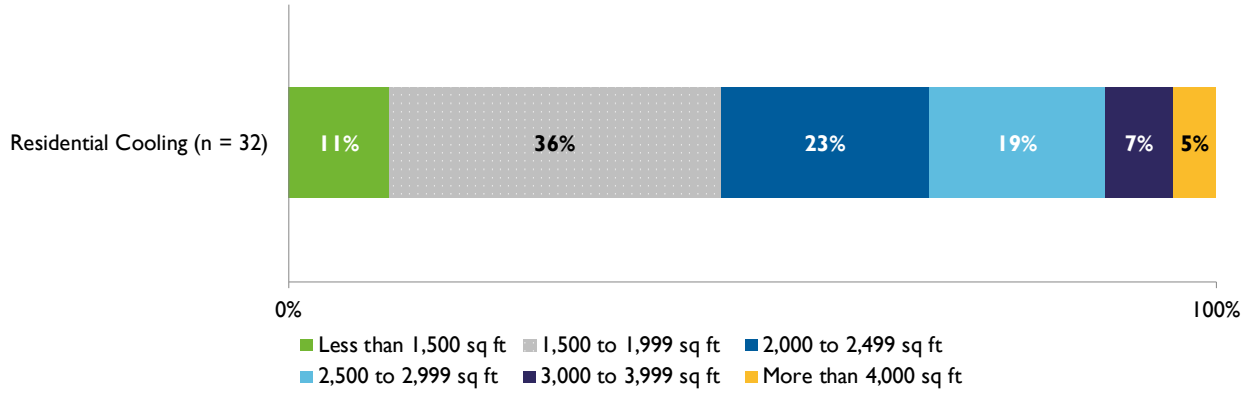
The following subchapters include data covering demographics, sources of program awareness, motivations for participation, and program satisfaction amongst survey participants.

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.

2.3.1 Residential Cooling Survey Results

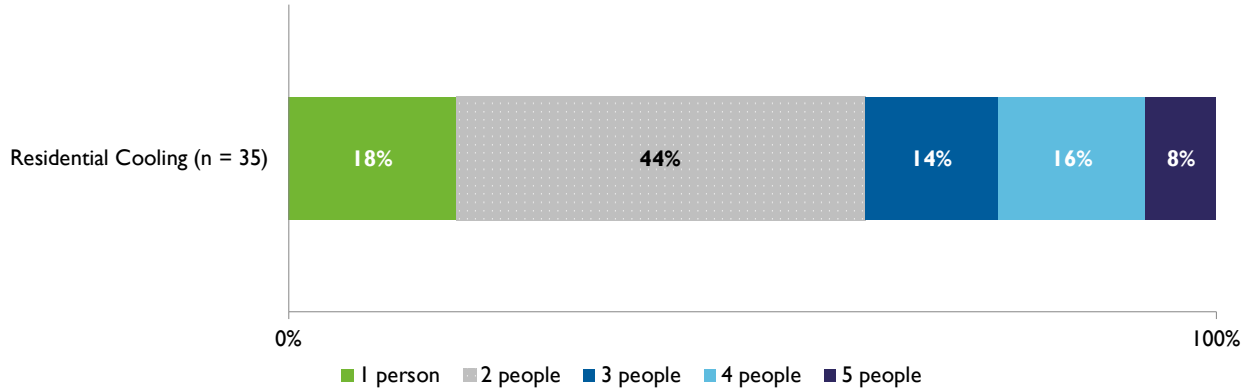
All 40 participants reported owning the homes in which their cooling equipment or pool pumps were installed. Figure 15 presents the home sizes of respondents, who reported an even distribution of household square footage. For example, while 36 percent of respondents reported home sizes between 1,500 and 1,999 square feet, there was a small percentage of participants with large homes (over 4,000 square feet).

Figure 15: Residential Cooling Respondent Home Size (n=32)



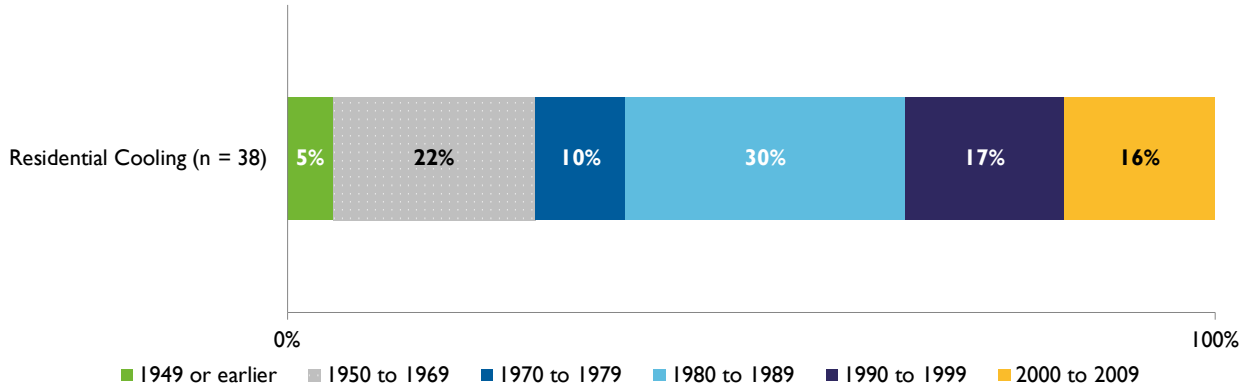
Similarly, participants reported an even distribution of household member sizes. As shown in Figure 16, while 44 percent of respondents reported household sizes of two people, other participants reported larger household sizes. However, of the participants surveyed, there were no household sizes larger than five people.

Figure 16: Residential Cooling Respondent Household Size (n=35)



As shown in Figure 17, a large portion (67 percent) of participants reported that their home was built sometime before 1989. This suggests that the programs are doing a good job at targeting older homes, where the potential for significant energy savings is the greatest.

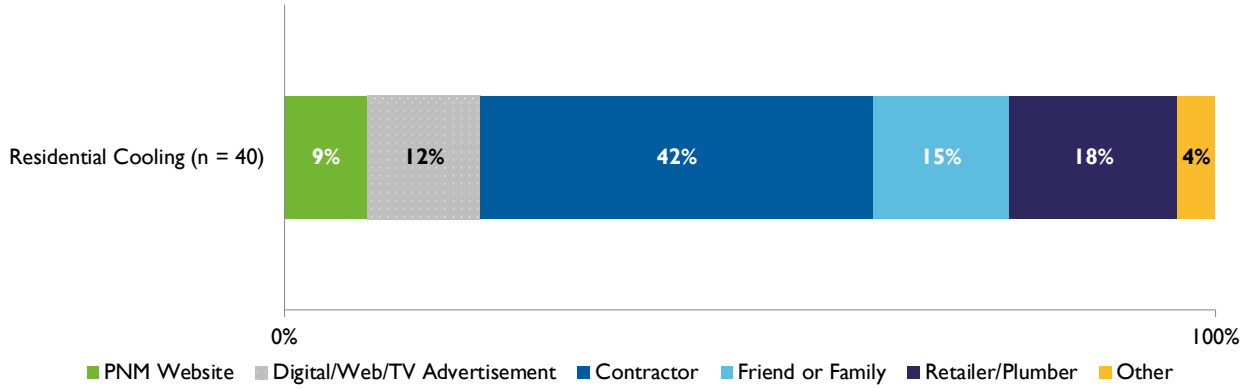
Figure 17: Residential Cooling Participant Home Age (n=38)



Source of Awareness

Respondents became aware of the program rebates/assistance through a variety of channels, including retailers, contractors, the PNM website, and friends and family. As shown in Figure 18, 42 percent of respondents initially became aware of the program through a contractor. The next most common methods of discovering the rebate program were through a retailer or plumber (18 percent) and through friends and family (15 percent).

Figure 18: Residential Cooling Initial Sources of Awareness (n=40)



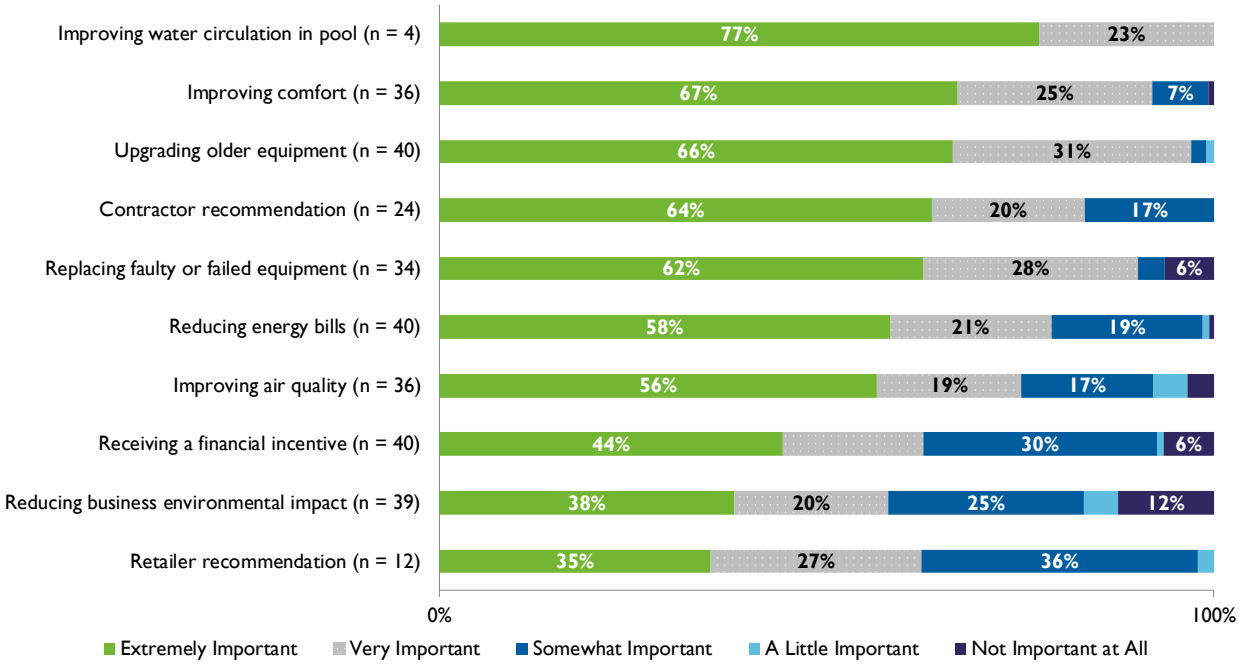
Motivations for Participation

Respondents were then asked to rate a variety of factors that might have influenced their decision to participate in the incentive program (Figure 19). Across both cooling equipment and pool pumps, participants most commonly mentioned the need or desire to upgrade older equipment as one of the most important factors in their decision to participate in the rebate program (66 percent).

Additionally, pool pump participants indicated that improving water circulation in their pools was an extremely important factor (77 percent). Similarly, cooling participants

indicated that comfort in their home was an extremely important factor in their decision to participate in the program (67 percent).

Figure 19: Residential Cooling Motivations for Participation (n=40)

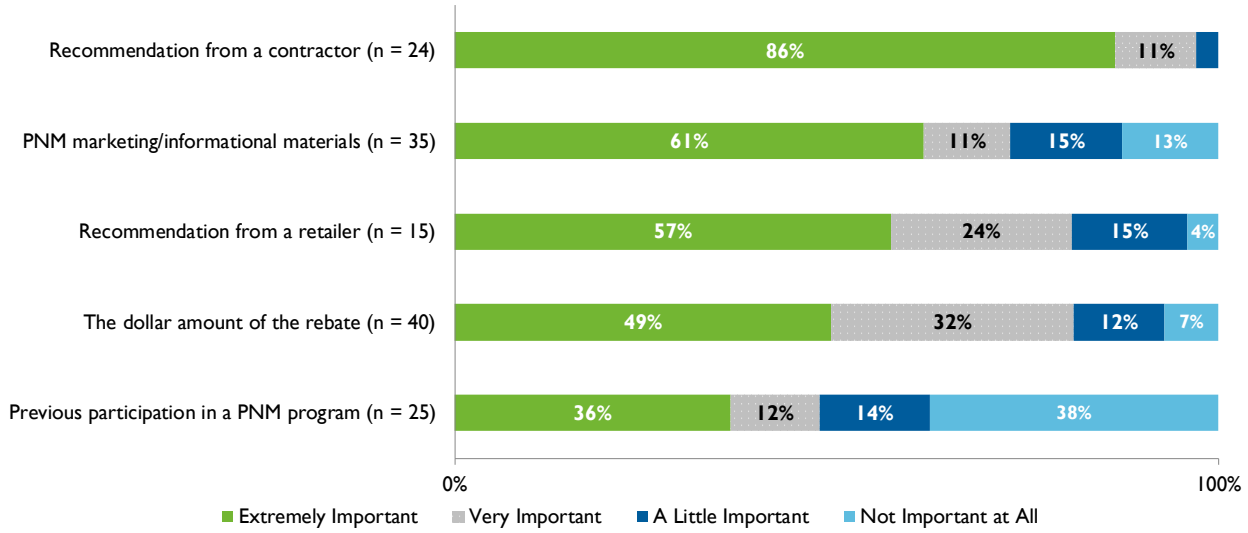


In addition to motivations for participating, survey respondents were given a list of potential program factors that may have influenced their decision about how energy efficient their equipment would be and were then asked to rate their influence on a 0 to 10 scale.[8]

As shown in Figure 20, the majority of participants (86 percent) rated the contractor recommendation as "extremely important" (ratings of 8 to 10) in their decision to make the efficiency upgrade, followed by PNM marketing and informational materials (61 percent) and recommendations from a retailer (57 percent).

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

Figure 20: Residential Cooling Influence of Program Factors (n=40)



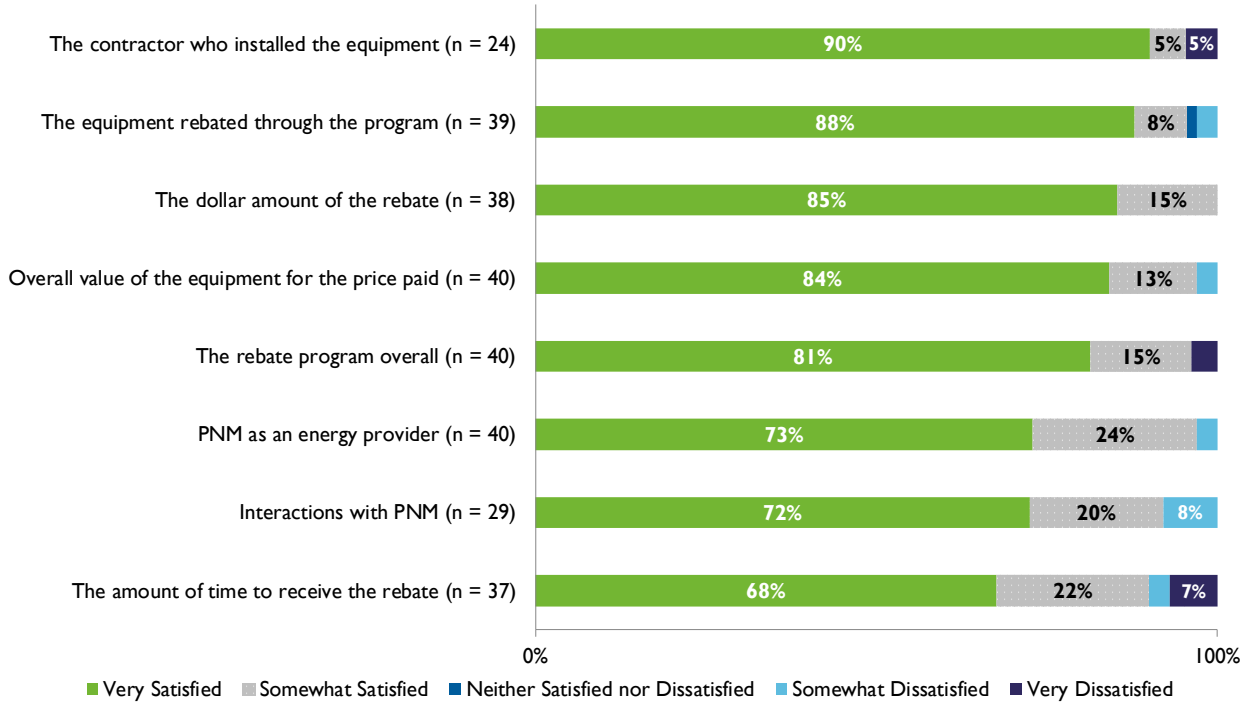
Participant Satisfaction

Survey respondents evaluated their satisfaction with various components of the Cooling and Pool Pumps sub-program, and more broadly PNM as an energy provider, 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 rebated equipment
- The installation contractor
- 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

Figure 21 summarizes the satisfaction levels for Cooling and Pool Pumps participants. Overall, surveyed program participants expressed high levels of satisfaction with all Cooling and Pool Pumps sub-program components, with the majority reporting being "very satisfied." Participants were most satisfied with the contractor who installed their equipment (90 percent), the equipment rebated through the program (88 percent), and the dollar amount of the rebate (85 percent). Finally, participants who gave a low rating to the amount of time taken to receive their rebate stated that they had not yet received their rebate.

Figure 21: Cooling Participant Program Satisfaction (n=40)



2.3.2 Refrigerator Recycling Survey Results

The same phone survey was administered to a sample of 40 customers that participated in PNM's Refrigerator Recycling program, and the following charts present highlights of their responses.

Household Demographics

There was a wide distribution of home sizes, but the majority fell in the 1,500 to 2,500 square foot range (Figure 22). The most common home vintage range was 1980-1999 (44%), with 39 percent built prior to 1980 (Figure 23). As with the Cooling participants, the vast majority of the Refrigerator Recycling participants (90%) own their home (chart not shown).

Figure 22: Participant Home Size

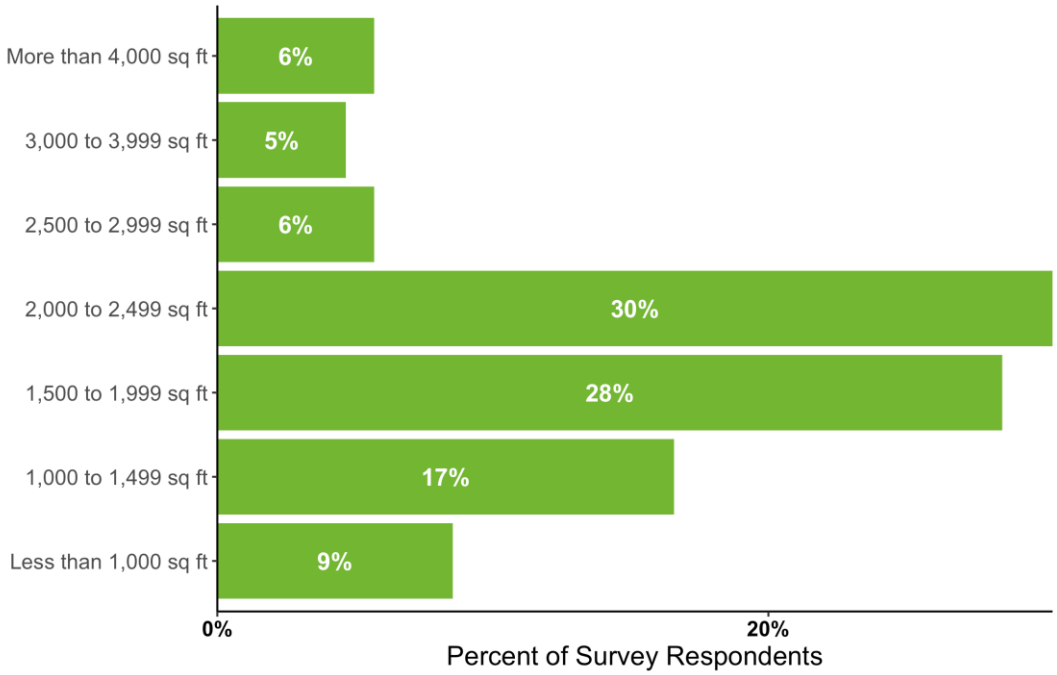
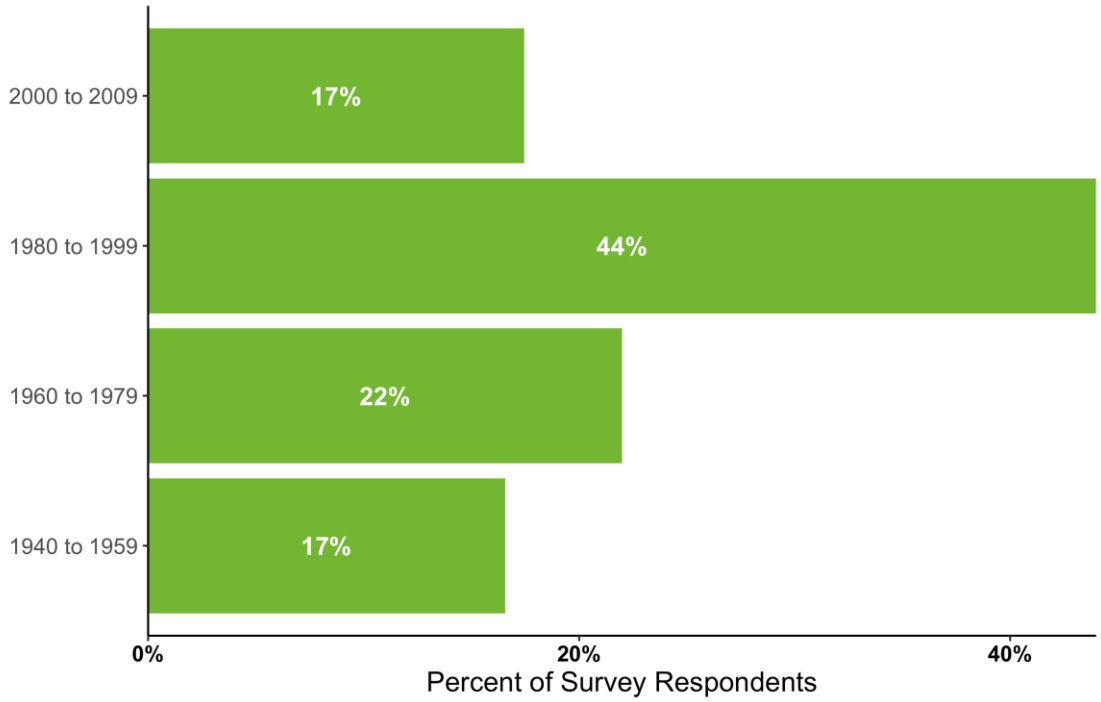


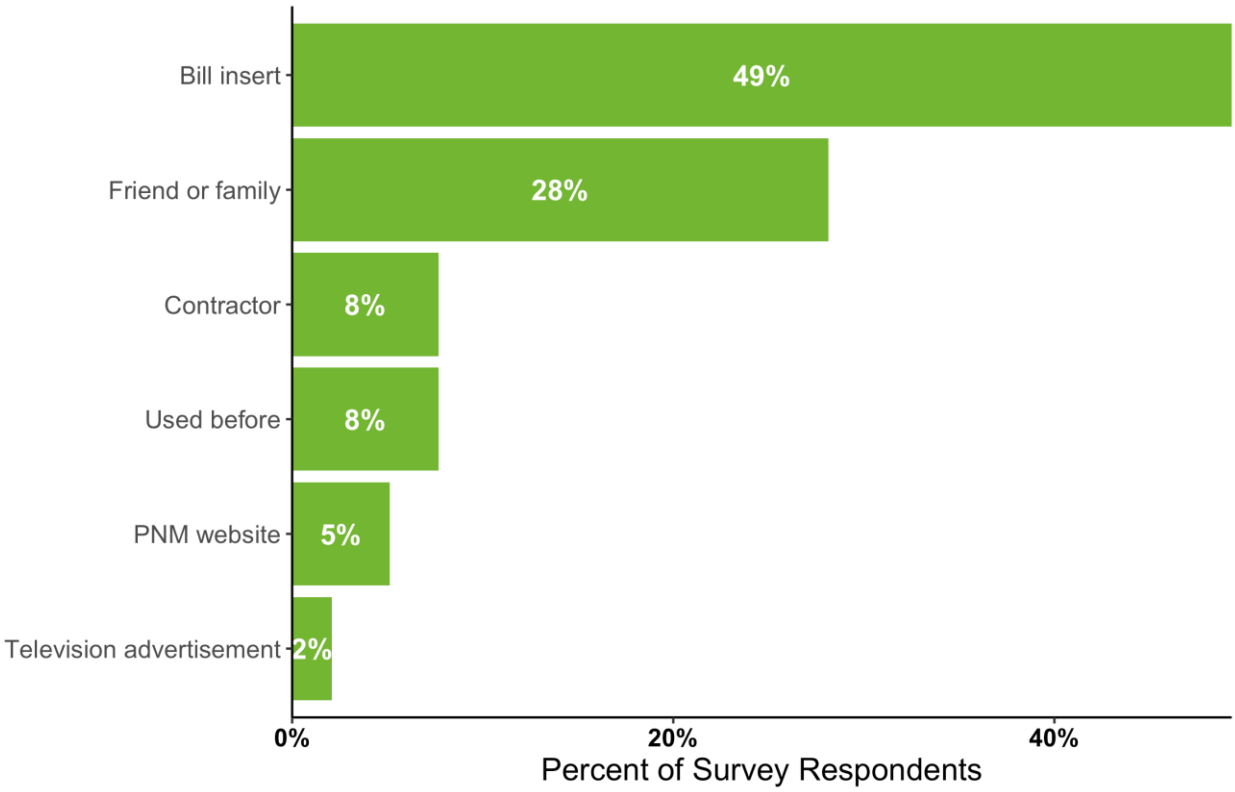
Figure 23: Home Age



Source of Awareness

For customers looking to recycle appliances, the PNM bill insert was the common source of awareness (49%), which differs from many of the other PNM programs where contractors are also a primary source of awareness. With the cooling participants, for example, 42 percent cited their contractor as the primary source of awareness.

Figure 24: Participant Source of Awareness



Motivations for Participation

For appliance recycling programs, participation is often motivated by factors that are more related to upgrading equipment than with saving energy. This is borne out in the results shown Figure 25, although reducing the environmental impact and energy costs are still rated as important.

As shown in Figure 26, the influence of PNM program factors is also lower than what we have seen in other programs, which is consistent with the higher level of free ridership estimated for Refrigerator Recycling program.

Figure 25: Motivations for Participation

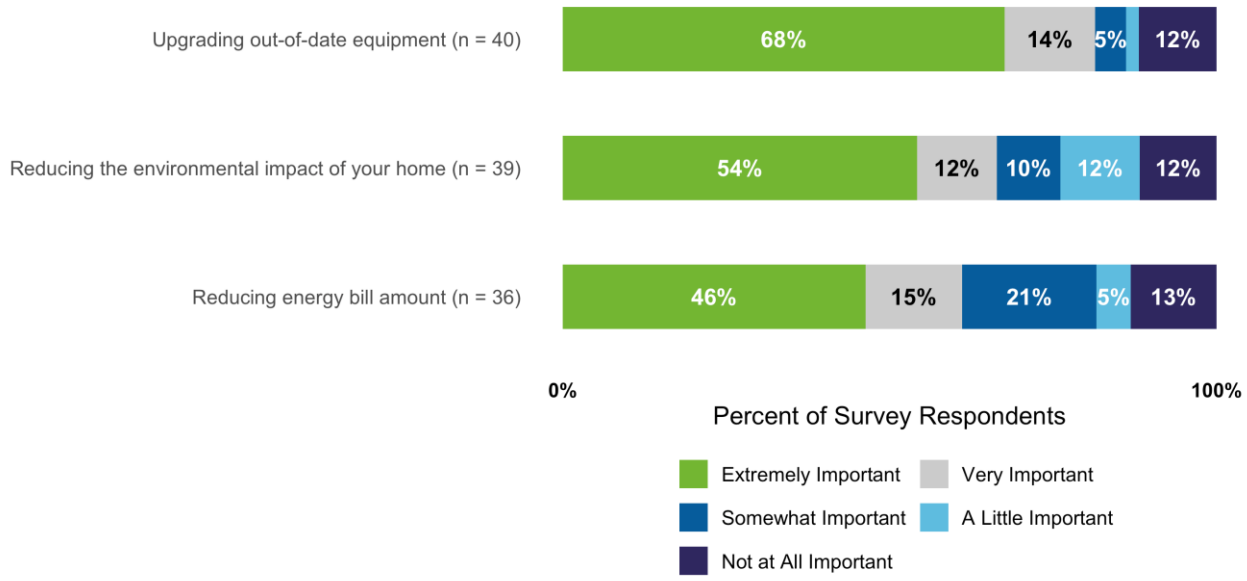
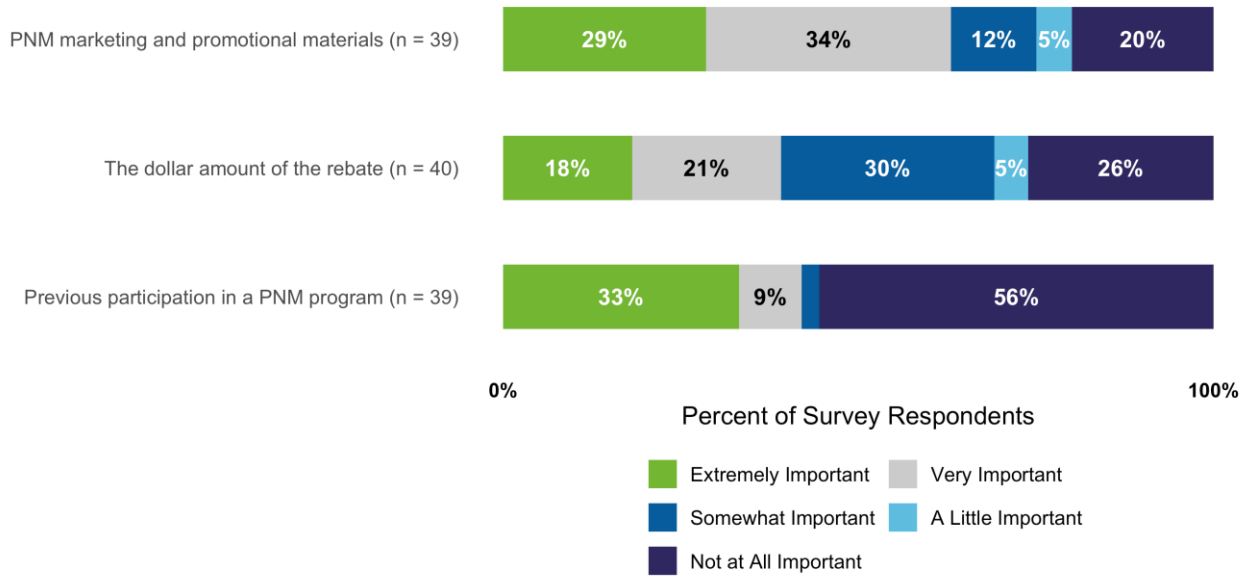


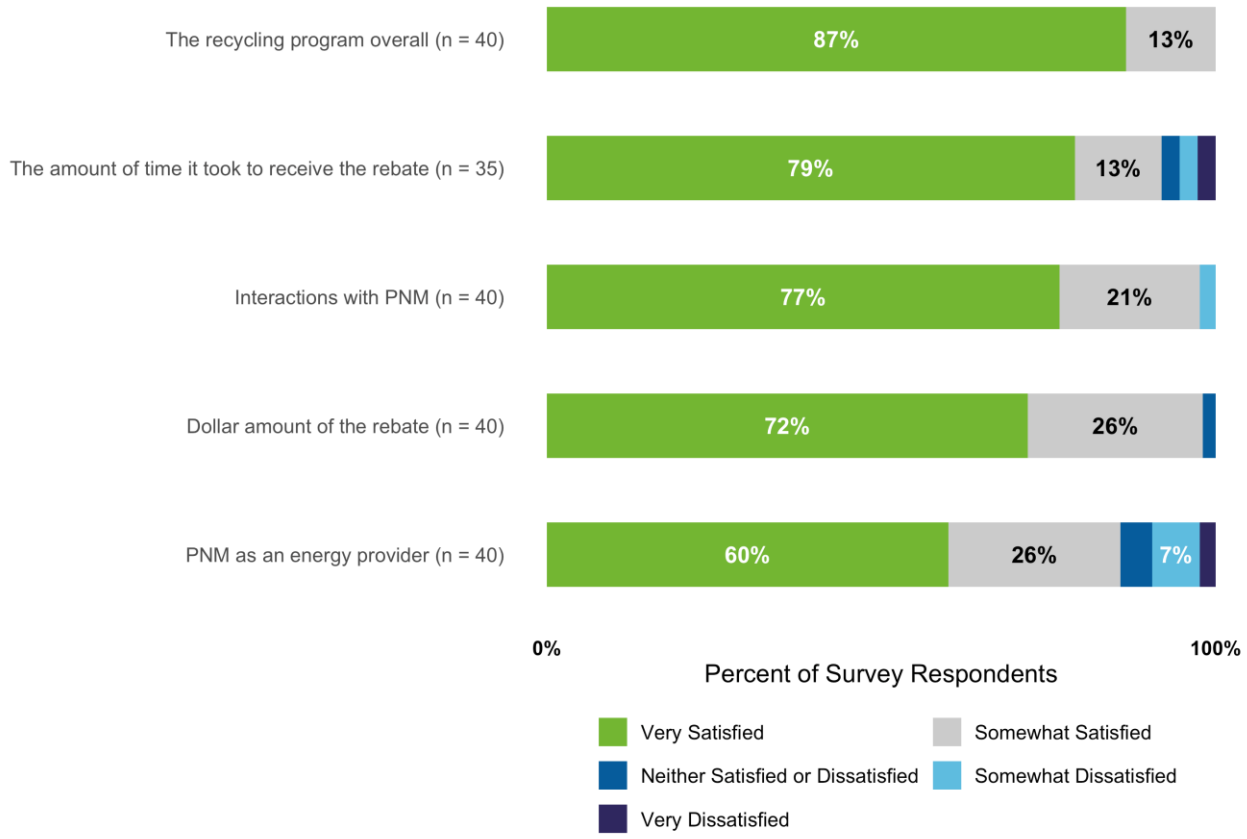
Figure 26: Influence of Program Factors



Participant Satisfaction

As we have seen with the other programs, customers in the Refrigerator Recycling program are generally very satisfied with their participation experience (Figure 27).

Figure 27: Program Satisfaction



Likelihood of Recycling without Program

The final two questions relate to what customers would have done if the Refrigerator Recycling program had not been available. Most of the participants (65%) report that they would have been very likely or extremely likely to recycling their equipment even without the program. Most would have done so within 12 months without the program, indicating that the program was not significantly accelerating these replacements. These responses were used as part of the free ridership calculation discussed in the net impacts for this sub-program.

Figure 28: Likelihood of Recycling Same Equipment if PNM Rebate Program Not Available

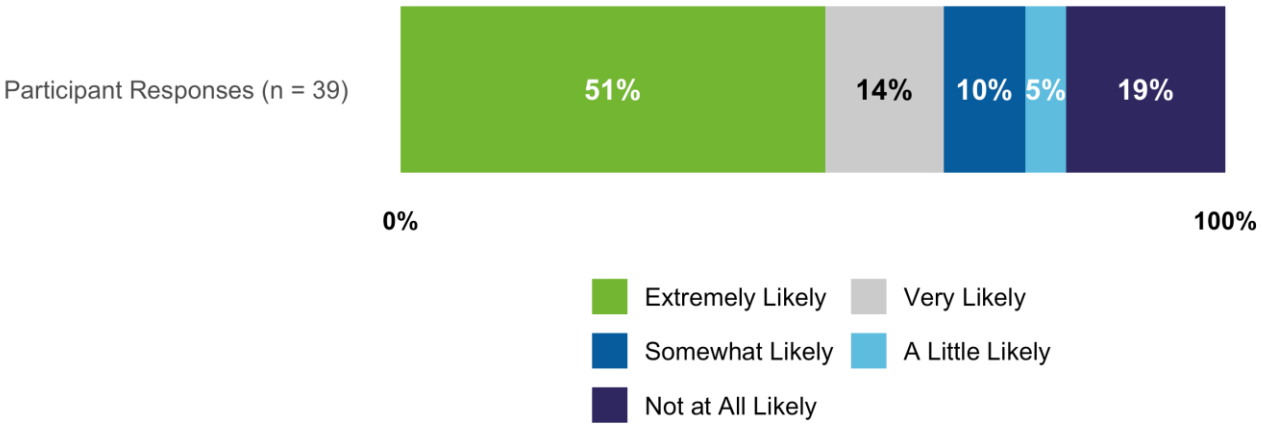
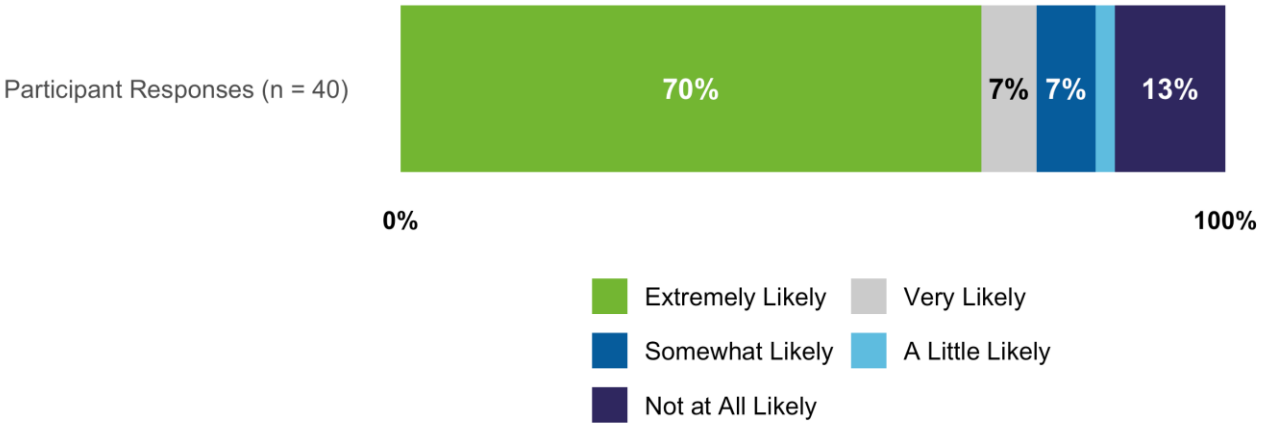


Figure 29: Likelihood of Recycling within 12 Months if the PNM Rebate Program Not Available



2.3.3 Home Energy Checkup Survey Results

Finally, the same phone survey was used for a sample of 40 participants from the Home Energy Checkup program.

Participants had somewhat smaller homes than in the other sub-programs surveyed, with almost half the respondents in the 1,500 to 1,999 square foot range (Figure 30). These homes also tend to be newer, with 35 percent built between 2000 and 2009, and 11 percent built since 2010 (Figure 31).

Figure 30: Participant Home Size

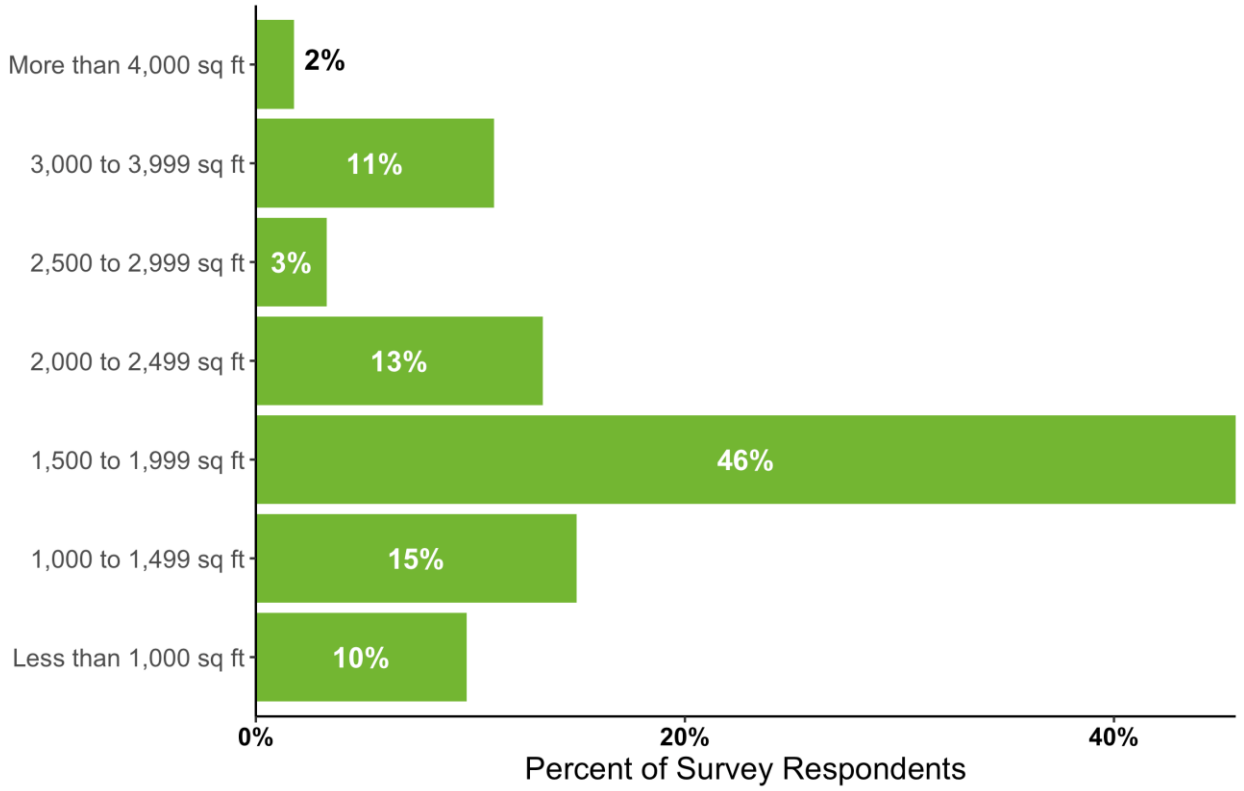
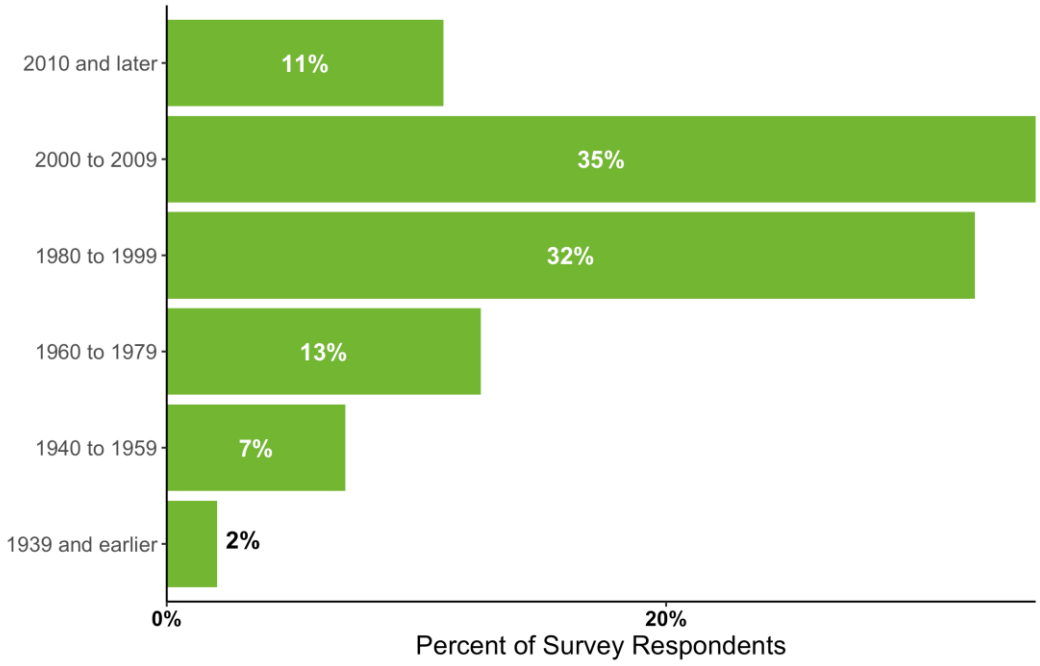


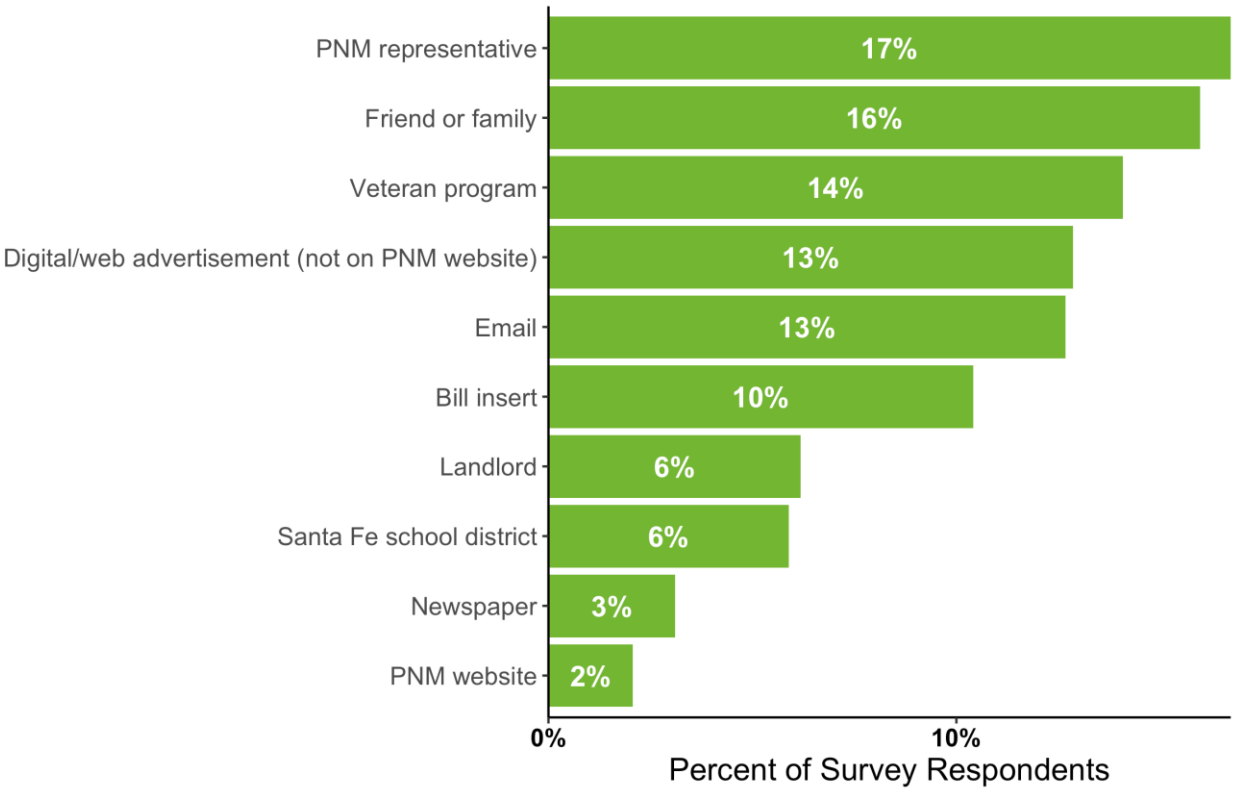
Figure 31: Home Vintage



Source of Awareness

Sources of awareness for this program are more diverse than the other sub-programs, with PNM representative ranking the highest at 17 percent. Notable other sources include Veteran program (14%), web advertising other than from PNM (13%), and the Santa Fe school district (6%).

Figure 32: Participant Source of Awareness



Motivations for Participation

As shown in Figure 33, the biggest driver of participation was the desire to save money on energy bills, with 93 percent indicating that this was extremely important in their participation decision. This result is not surprising given that this program has a greater focus on customer education and does not provide rebates for large equipment purchases like the other sub-programs. Participants rated virtually all of the program-related factors as either very important or extremely important (Figure 34).

Figure 33: Motivations for Participation

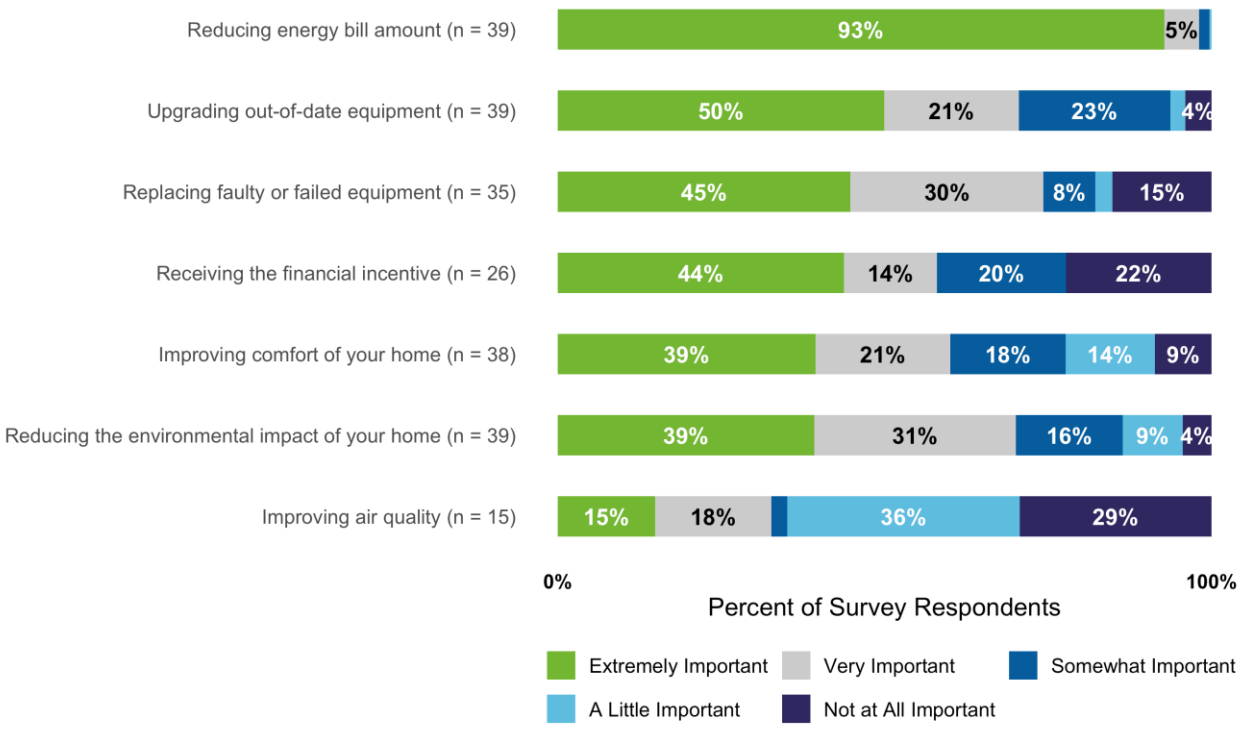
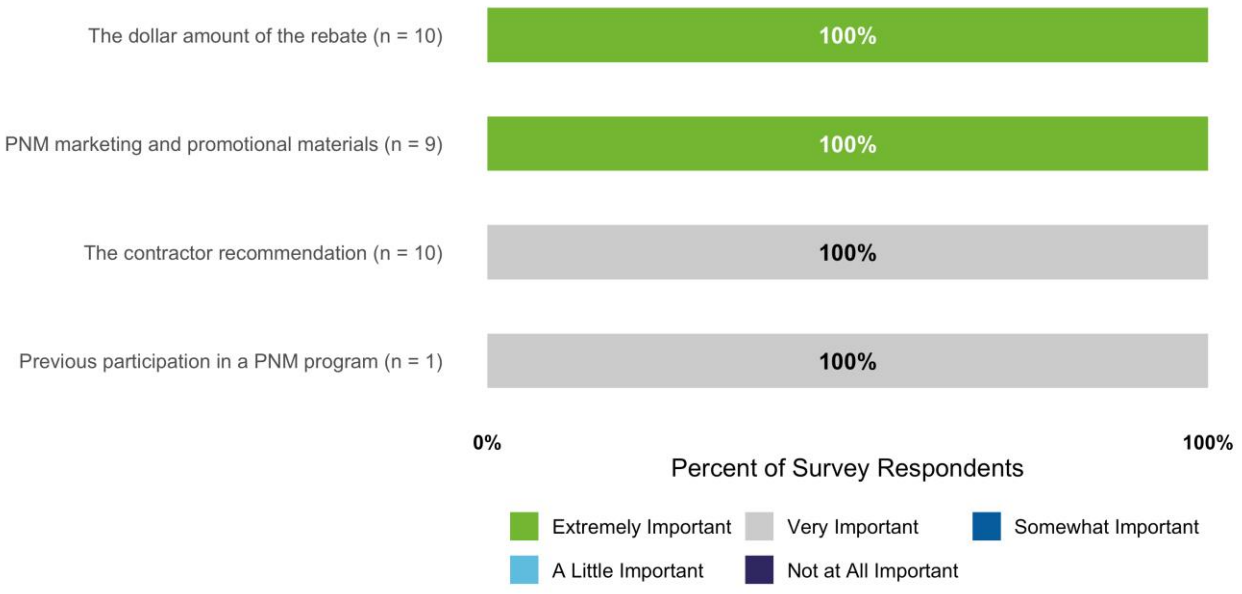


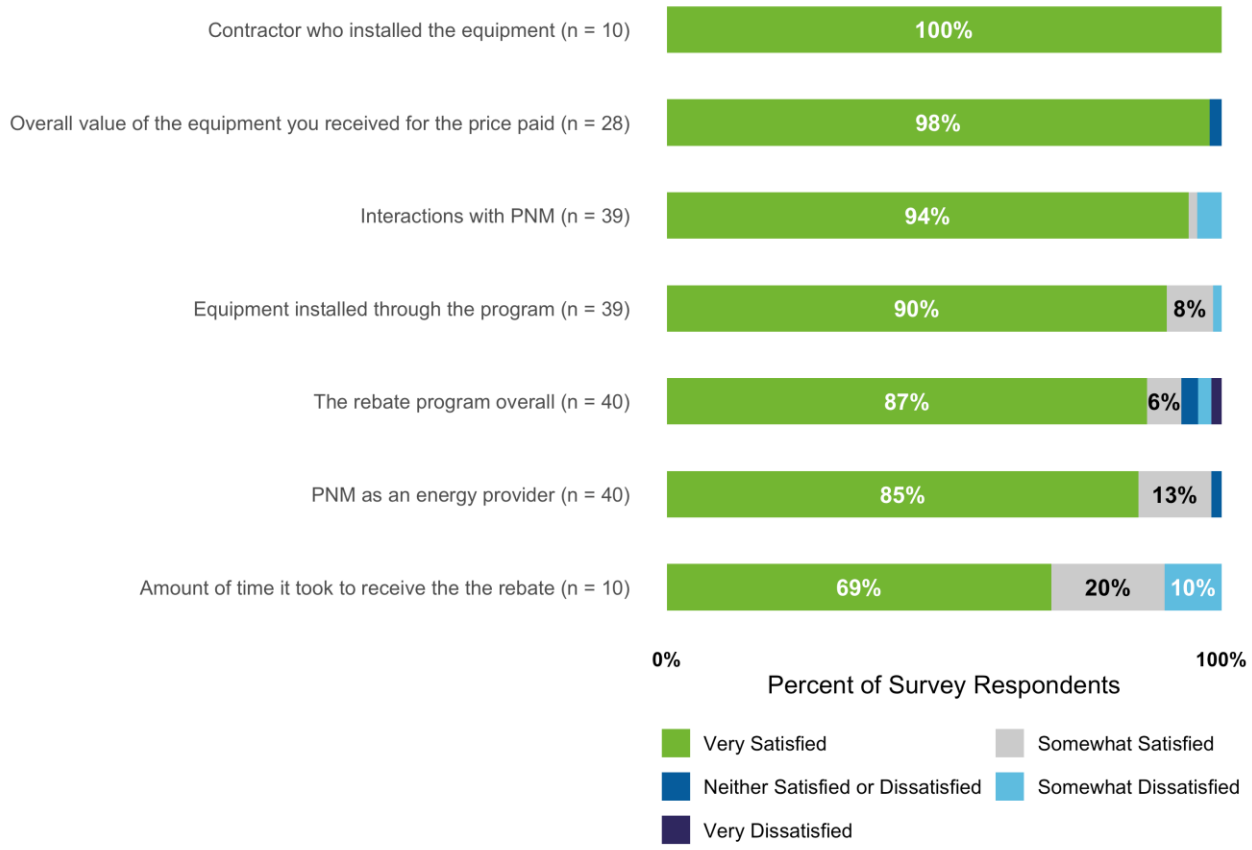
Figure 34: Influence of Program Factors



Participant Satisfaction

Finally, as we have observed for all of PNM's programs surveyed in PY2020, participants in the Home Energy Checkup program reported very high levels of satisfaction.

Figure 35: Program Satisfaction



2.4 Residential Comprehensive Program Conclusions and Recommendations

The gross impact evaluation of the Residential Comprehensive program consisted of a deemed savings review of per-unit savings values for each of the three sub-programs. We compared PNM documentation on the source, calculations, and input assumptions of savings values to determine whether they were correct and appropriate. Based on our review, the deemed savings values used by PNM are generally in line with those recommended in the New Mexico TRM.

For the Home Energy Checkup and Refrigerator Recycling sub-programs, we were able to confirm the source of savings, calculations, and input assumptions for the majority of measures. For measures where we did not have enough information on the input

assumptions to replicate the calculations, we confirmed that the per-unit values were within a reasonable range for the type of measure. However, specific details on the calculations or exact source of savings would be preferred.

The realization rate for the Residential Comprehensive Cooling sub-program is not equal to 1.00 due to the lack of baseline efficiency information in the program tracking data. The evaluation team instead used a baseline assumption based on the heating and cooling capacity of the units. This resulted in slight adjustment to the original gross impact values. If the baseline efficiency rating was included in the program tracking data, the sub-program realization rate would likely be equal to 100 percent.

- **Recommendation:** Include information on baseline efficiency assumptions in the savings calculations for measures in the Residential Comprehensive Cooling sub-program.

3 New Home Construction

The *ex ante* PY2020 impacts are summarized in Table 19 for the New Home Construction program. In total, the New Home Construction program accounted for about two percent of energy impacts in PNM's overall portfolio.

Table 19: New Home Construction Savings Summary

Program	# of Projects	Expected Gross kWh Savings	Expected Gross kW Savings
New Home Construction	1,362	2,559,525	1,006

The gross impact evaluation activities included engineering desk reviews of a sample of both Performance and prescriptive projects and a deemed savings review of prescriptive projects. For the desk reviews, the sample was stratified based on total energy savings for each Performance and prescriptive project. The resulting sample achieved a relative precision of 90/1 overall for Performance and prescriptive New Home Construction projects. The final sample design is shown in Table 20.

Table 20: New Home Construction Desk Review Sample

Project Type	Stratum	Count	Average kWh	Total kWh Savings	% of Savings	Final Sample
Performance	1	248	3,180	788,532	30.81%	3
Performance	2	348	2,165	753,363	29.43%	3
Performance	3	477	1,579	753,298	29.43%	3
Prescriptive	1	71	1,316	93,408	3.65%	3
Prescriptive	2	95	900	85,462	3.34%	3
Prescriptive	3	123	695	85,462	3.34%	3
Total		**1,362**	**1,639**	**2,559,525**	**100%**	**18**

As discussed previously, gross realized impacts for the New Home Construction program were determined by performing engineering desk reviews on the sample of Performance and prescriptive projects and a deemed savings review for prescriptive projects.

For prescriptive projects, the evaluation team found multiple measures that existed in both the New Mexico TRM and the PNM Workpapers, and the savings calculation approaches sometimes differed across sources. In these cases, we examined both sources but defaulted to the methodology and algorithm inputs in the PNM Workpapers. Some of the other incentivized measures existed only in the PNM Workpapers, 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.

Table 21 and Table 22 show the summary results of the desk reviews and deemed savings review and how the resulting engineering adjustments were used to calculate realized savings. For the New Home Construction program overall, these adjustments result in an engineering adjustment factor of 1.0000 for kWh and 1.0226 for kW.

Table 21: PY2020 New Home Construction Gross kWh Impact Summary

Program	# of Projects	Expected Gross kWh Savings	Engineering Adjustment Factor	Realized Gross kWh Savings
New Home Construction	1,362	2,559,525	1.0000	2,559,591

Table 22: PY2020 New Home Construction Gross kW Impact Summary

Program	# of Projects	Expected Gross kW Savings	Engineering Adjustment Factor	Realized Gross kW Savings
New Home Construction	1,362	1,006	1.0298	1,036

3.1 New Home Construction Net Impacts

Net impacts for the New Home Construction program were calculated using the combined results of the builder interviews from the PY2020 and PY2018 evaluations. The evaluation team conducted interviews with participating home builders and asked them a series of questions to determine how the program has influenced their home building practices and decisions to include efficient equipment and envelope measures for these homes.

Respondents commonly indicated that the rebates offered by PNM were very influential in their ability to build energy efficient homes; however, responses to the question of whether or not builders would still be building to the same specs in absence of the

program were not consistent with these findings. The evaluation team believes that the question was misinterpreted and not reflective of what responding builders meant, resulting in higher free ridership scores. Therefore, for the purpose of this analysis, this question was removed from the free ridership calculation. We believe that the NTG ratio of 0.73 is a reasonable estimate of the impacts of the program on builders' decisions to incorporate efficient options into their homes.

Table 23: PY2020 New Home Construction Net kWh Impact Summary

Program	# of Projects	Realized Gross kWh Savings	NTG Ratio	Realized Net kWh Savings
New Home Construction	1,362	2,559,591	0.7300	1,868,502

Table 24: PY2020 New Home Construction Net kW Impact Summary

Program	# of Projects	Realized Gross kW Savings	NTG Ratio	Realized Net kW Savings
New Home Construction	1,362	1,039	0.7300	757

3.2 New Home Construction Builder Interviews

The evaluation team conducted telephone interviews with builders who participated in the New Home Construction program. Due to the low response rate for PY2020, the evaluation team combined the results from the evaluation of the PY2018 New Homes builder interviews for the purpose of this analysis. Between PY2018 and PY2020, the evaluation team conducted a total of 15 interviews with participating home builders across the three New Mexico utilities that offer a New Homes program: PNM, El Paso Electric, and New Mexico Gas Company. Of these 15 home builders, 12 had received rebates from PNM for efficiency upgrades through the New Home Construction program.

The interviews focused on the following topics:

- Project context and background;
- Role and influence of the PNM New Home Construction program; and
- Program satisfaction.

Participants were categorized into three groups based on the number of projects completed through all of the New Mexico utilities' New Homes programs from 2018 through 2020: lightly active (1 to 12 projects), moderately active (13 to 100 projects), and

highly active (more than 100 projects). The evaluation team interviewed eight moderately active firms, six lightly active, and one highly active firm. While respondents had varying levels of interaction with the New Home Construction program directly, all 15 were familiar with the eligible projects and played a significant role in their business's participation in the program.

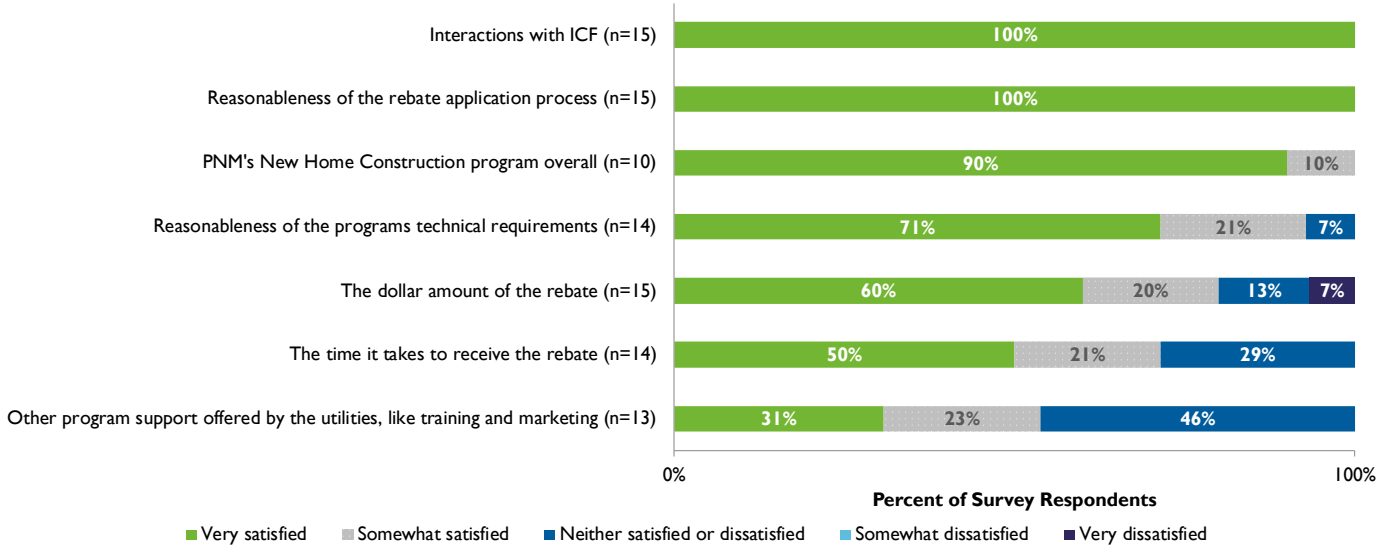
Program Satisfaction

New Home Construction interviewees were asked a series of questions to quantify their level of satisfaction with various components of the program using a 1 to 5-point scale, where 1 meant "very dissatisfied" and 5 meant "very satisfied".

Satisfaction with the New Home Construction program was high in PY2018 and continued to stay high in PY2020. As shown in Figure 36, all 15 interviewees reported being "very satisfied" with their interactions with ICF and the reasonableness of the rebate application process. In addition, participating builders had high praise for the PNM New Home Construction program overall, with 100 percent being "very" or "somewhat satisfied."

Further, respondents were mostly satisfied with the reasonableness of the program technical requirements but one of the highly active firms brought up a concern, stating "we have [the firm] heard whisperings that the program requirements are going to continue to creep up. We understand that they will increase each year but there is talks [internally] that they are getting to be too high. If they continue to increase the requirements at this rate, my company will not be able to continue to use it if we can't justify the extra costs to get to the new efficiency level."

Figure 36: New Home Construction Program Builder Satisfaction



4 Energy Smart

PNM's Energy Smart program provides weatherization services and other efficiency upgrades to low-income households in PNM territory. Measures are prescriptive in nature and include insulation, duct sealing, water heater tank and pipe insulation, low-flow showerheads and aerators, and efficient lighting. To evaluate the impacts of the Energy Smart program, the evaluation team conducted a deemed savings review of the energy saving measures provided by the program.

In the deemed savings review, we attempted to confirm the source of savings cited by PNM and/or replicate the per-unit savings values if savings were based on an algorithm from the New Mexico TRM. We were unable to match the *ex ante* savings values for faucet aerators and low flow showerheads in the program tracking data, and so we substituted in the deemed savings values from the New Mexico TRM. This resulted in an engineering adjustment factor of 0.9829 overall for the entire program, which was applied to the kWh savings to calculate realized gross savings.

The NTG ratio for the Energy Smart program is stipulated at 1.00, and as a result the net realized savings are equal to the gross verified savings of 269,972 kWh and 41 kW.

5 Load Management as a Resource

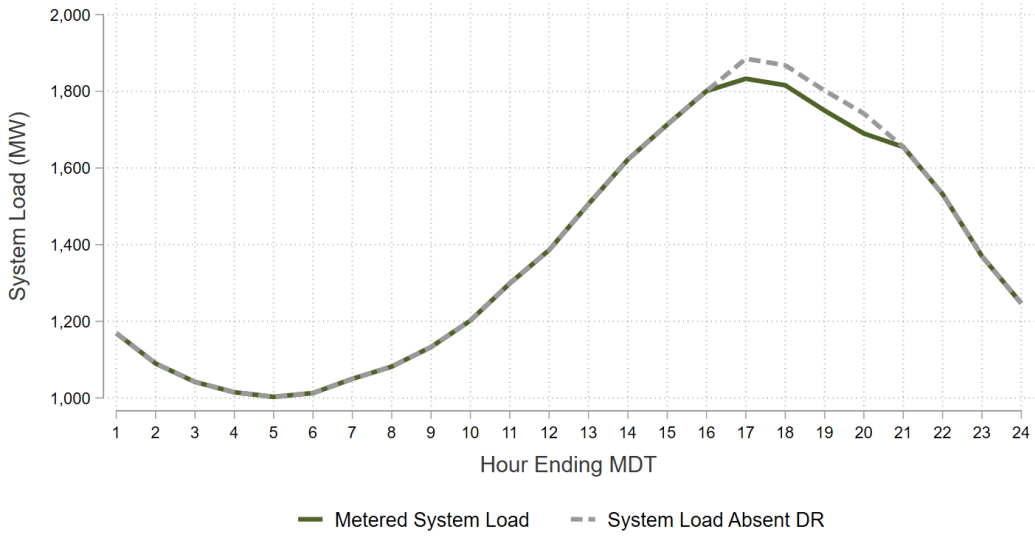
On January 31, 2018, the New Mexico Public Regulation Commission (NMPRC) issued a final order in PNM's 2017 energy efficiency case that directs Evergreen Economics, as independent program evaluator for PNM's energy efficiency and load management (LM) programs, to do the following:

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 2020, the load management programs served a capacity resource that avoided the need for additional supply-side peaking capacity.

Figure 37 illustrates the benefits of the load management programs on system load for a high load DR event day in 2020. Metered retail load on PNM's system peaked at 1,833 MW on August 20, 2020, 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 1,885 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 37: PNM System Load August 20, 2020



The two PNM load management—or demand response—programs relied on similar analysis methods to estimate program impacts. Additional detail on the analysis methods used for both programs are included as appendices to this report.

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 25 shows the energy and capacity benefits for the two demand response programs in 2020. 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 25: 2020 Demand Response Program Benefits

Program	Energy Benefit ($1,000)	Capacity Benefit ($1,000)	Percent Capacity
Power Saver	$10.41	$4,334.83	99.8%
Peak Saver	$20.61	$1,800.82	98.9%
Energy Efficiency Programs	$27,277.51	$23,128.15	45.9%

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 have almost no material impact on the cost effectiveness of demand response programs. In summer 2020, both demand response programs were dispatched ten times.

To provide additional context, the evaluation team reviewed PNM's most recent Integrated Resource Plan (IRP)[9] 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 38 illustrates this relationship using PNM system loads (2015-2020) 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.

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 2020 IRP, PNM proposed a minimum reserve margin of 18 percent, an increase from the prior 13 percent. This means that although peak demand is forecast at 1,900 MW, planners need at least 2,242 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 342 MW of capacity could go unused for the year.

[9] PNM 2020-2040 Integrated Resource Plan. https://www.pnmforwardtogether.com/assets/uploads/PNM-2020-IRP-FULL-PLAN-NEW-COVER.pdf

Figure 38: Daily Maximum PNM System Load and Temperature by Year

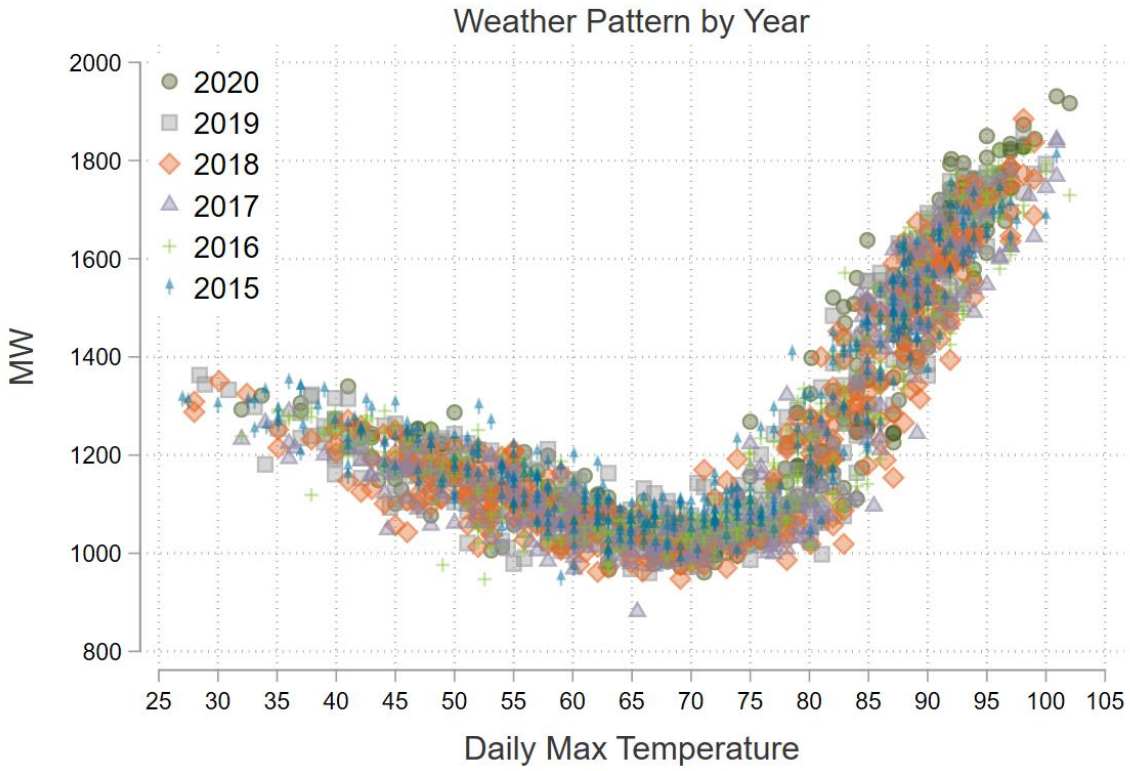
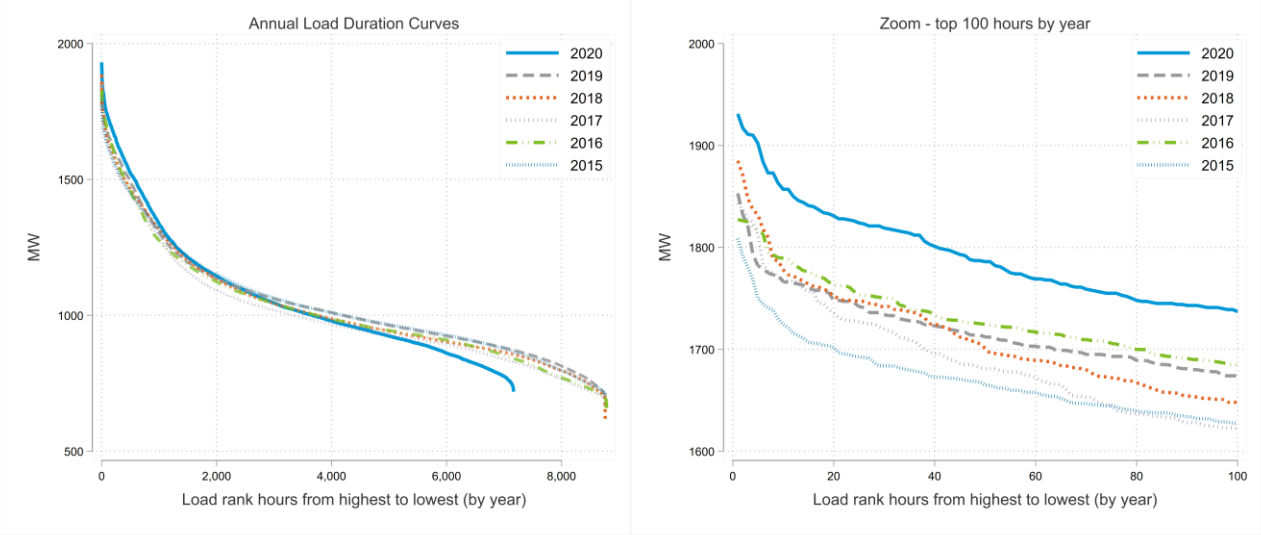


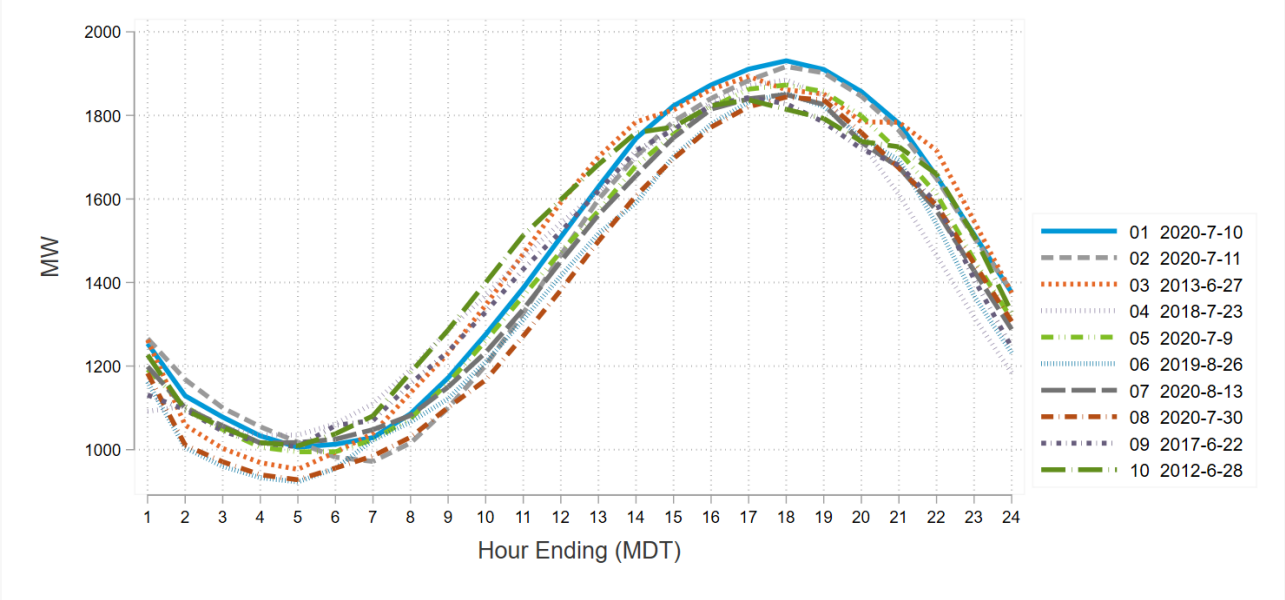
Figure 39 provides annual load duration curves for the PNM system over the last six years to illustrate a key point about capacity utilization. Peak load conditions are observed in a very small number of hours. This means some capacity resources need to operate quite intermittently. The right side of Figure 39 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 2020, there was a 58 MW difference between the top hour and the tenth-highest load hour for the year. The twelve highest load hours occurred on three days (July 9, July 10, and July 11), and retail load did not exceed 1850 MW on any other day.

Figure 39: 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) can be a good fit for the PNM system because peaks occur exclusively in the summer and are focused on specific afternoon and early evening hours. **Error! Reference source not found.** shows PNM's top 10 system load days of the last eight y ears. The top two load days, and five of the top eight load days, were in 2020. 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, 2019, and 2020, the system peaked one hour later at hour ending 18 (5:00 pm to 6:00 pm MDT).

Figure 40: Top 10 System Load Days 2012-2020



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. The Peak Saver and Power Saver programs, however, also have several limitations, as described in the PNM 2020 IRP. Specifically, demand response programs can only be dispatched for several hours at a time (events have historically been four hours in duration) and either Peak Saver nor Power Saver can be called on weekends. In addition, page 112 of the 2020 IRP indicates that the effective load carrying capacity (ELCC) of demand response programs is expected to decrease as additional DR capacity is deployed within the PNM service territory.

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) lowers the energy and demand 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.

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 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. The maximum temperature on July 10th at KABQ was 101 degrees (F) so the decision not to dispatch was likely operations-driven. The temperature on July 11th was 102 degrees but occurred on a Saturday, and so demand response programs were not able to be called on this day. Demand response programs were called for a total of ten events in June, July, and August during the summer of 2020.

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 2020 events. We analyzed the last six 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). Our verified savings analysis of PNM's load management program performance estimates approximately 48 MW of load reduction capability across Power Saver and Peak Saver at the system level.

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.[10] 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. Indeed, page 110 of the 2017 IRP stated: "*Without the demand savings from the programs, 40 MW of additional gas peaking capacity is needed in 2018 and another 41 MW in 2020.*"[11] This statement is consistent with our 2020 verified savings analysis.

Looking forward, the current Power Saver and Peak Saver programs are governed by a five-year contract that expires in 2023, with the option for extension. The 2020 IRP considered extensions of both programs beyond 2023, but ultimately did not select either program for extension in its two preferred plans. The 2020 IRP did, however, opt to extend the relatively new DR programs enacted with the retirement of the San Juan Generating Station. In the near term, however, both the Power Saver and Peak Saver programs will continue to provide load reduction capability during summer peak periods.

Specific details on the Power Saver and Peak Saver programs are presented in the following two sections.

[10] In a low-carbon planning environment such as that conducted by PNM for the 2020 IRP in accordance with the New Mexico Energy Transition Act, an energy storage device or combustion turbine may be more appropriate alternative sources of generation capacity.
[11] PNM 2017 Integrated Resource Plan.
https://www.pnm.com/documents/396023/396193/PNM+2017+IRP+Final.pdf/eae4efd7-3de5-47b4-b686-1ab37641b4ed?t=1498845724233

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 and a residential bring your own thermostat ("BYOT") program was added in 2020. For these components, load curtailment is achieved via communication with the WiFi-enabled thermostat.

There were ten Power Saver events during the summer 2020 demand response (DR) season, which began June 1st and ended September 30th. Table 26 provides some information on these ten 2020 events. All events used a 50 percent cycling strategy where curtailment is based on the runtime in the previous hour. Note that the event start times and end times are in Mountain Daylight Time (MDT).

The realized gross energy savings is 280,142 kWh and the realized gross demand savings is 31,028 kW.

Table 26: 2020 Power Saver Event Summary

Date	Day of Week	Start Time (MDT)	End Time (MDT)	Daily High at KABQ (F)
6/4/2020	Thursday	3:00 PM	7:00 PM	95
6/25/2020	Thursday	3:00 PM	7:00 PM	94
7/6/2020	Monday	3:00 PM	7:00 PM	97
7/13/2020	Monday	3:00 PM	7:00 PM	95
7/14/2020	Tuesday	3:00 PM	7:00 PM	93
7/29/2020	Wednesday	3:00 PM	7:00 PM	94
8/14/2020	Friday	3:00 PM	7:00 PM	96
8/18/2020	Tuesday	4:00 PM	8:00 PM	92
8/19/2020	Wednesday	4:00 PM	8:00 PM	95
8/20/2020	Thursday	4:00 PM	8:00 PM	98

Shortly after the conclusion of the summer 2020 season, Itron provided the Evergreen 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 6/1/2020 to 9/30/2020
- 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 and BYOT groups, 5-minute runtime data from 6/1/2020 to 9/30/2020

The Evergreen team also received Itron's Power Saver impact evaluation report, which detailed the methods Itron employed in calculating customer baselines (CBLs) for the five different DR program offerings. A CBL is an estimate of what participant loads would have been absent the DR event dispatch. For each DR program offering, 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 Evergreen verified savings analysis were:

1) For each DR program offering, 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 2020 DR season.
3) Where possible, leverage additional historical data from 2015 - 2019 to produce ex ante estimates of what the per-device impact at peaking conditions (5-6 PM 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 reduction capability (MW) of the Power Saver program.

Table 27 and Table 28 summarize our findings for 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 Evergreen team summarized impacts with an average. Multiplying our per-device reduction estimates by the number of devices in each class (shown in Table 27) leads to a 2020 average total estimated load reduction of approximately 22.8 MW, 1.0 MW, 0.1 MW, 2.6 MW, and 1.7 MW for the Residential DCU, Two-Way Smart Thermostat, BYOT, Small Commercial, and Medium Commercial segments respectively. In aggregate, the average 2020 performance is 28.2 MW. This is approximately 75% of Itron's estimate for the 2020 season (38.8 MW). After making an online adjustment for the thermostat groups of (87%

for Two-Way Smart Thermostats and 85% for BYOT) and an operability adjustment for the other three segments (87%), the aggregate Evergreen-calculated impacts for 2020 are 24.5 MW (compared to 33.8 MW from Itron after adjustment).

The Evergreen team used Power Saver results from 2015-2020 to estimate the load relief capability under extreme conditions. We estimate the program is capable of delivering 35.7 MW of load reduction under planning conditions of 100°F between 5:00 PM and 6:00 PM MDT, of which 31.1 MW comes from the Residential DCU segment, 1.2 MW comes from the Two-Way Smart Thermostat segment, 0.1 MW comes from the BYOT segment, and 2.1 MW and 1.1 MW come from the Small and Medium Commercial segments, respectively. Factoring in the operability/online adjustments, the aggregate program can provide 31.0 MW of load relief.

Table 27: High Level Results – Residential

		Unit	Residential DCU		Two-Way Smart Thermostats		BYOT Smart Thermostats	
			Measured	Adjusted	Measured	Adjusted	Measured	Adjusted
Number of Devices Installed		#	42,640	42,640	636	636	142	142
Itron	5-year Rolling Average kW Factor	kW / device[12]	0.77		1.28		1.50	
		Total MW	32.66		0.81		0.21	
	2020 Load Reduction Estimate	kW / device	0.74	0.64	2.06	1.79	1.76	1.53
		Total MW	31.55	27.45	1.31	1.14	0.25	0.22
Evergreen	2020 Load Reduction Estimate	kW / device	0.54	0.47	1.63	1.41	0.86	0.73
		Total MW	22.81	19.85	1.03	0.90	0.12	0.10
	Ex Ante Load Reduction Estimate[13]	kW / device	0.73	0.64	1.93	1.68	0.77	0.65
		Total MW	31.13	27.08	1.23	1.07	0.11	0.09
	2020 Energy Savings	kWh / device	0.44	0.38	4.79	4.17	2.19	1.86
		Total MWh	187.59	163.20	30.47	26.51	3.11	2.65

[12] 2020 kW factors include a rolling average per-device result for 2016-2020. 2018 Residential DCU kW factor has an 85% operability adjustment applied. 2020 Residential DCU kW factors have an 87% operability adjustment applied. The 87% operability percentage was calculated as 85% multiplied by the number of DCU sites that have not been visited in the last two years plus 95% multiplied by the number of DCU sites that were visited in the last two years. 2020 Two-Way Smart Thermostats have an 87% offline (not operability) adjustment applied. The 2020 BYOT have an 85% offline (not operability) adjustment applied.

[13] Ex ante program capability is reported in the 5 PM – 6 PM MDT hour at 100°F.

Table 28: High Level Results – Commercial

		Unit	Small Commercial		Medium Commercial	
			Measured	Adjusted	Measured	Adjusted
Number of Devices Installed (Number of Locations)		#	4,194	4,194	2,965 (400)	2,965 (400)
Itron	5-year Rolling Average kW Factor	kW / device[14]	1.24		0.68	
		Total MW	5.22		2.01	
	2020 Load Reduction Estimate	kW / device	0.66	0.57	0.99	0.86
		Total MW	2.77	2.41	2.94	2.55
Evergreen	2020 Load Reduction Estimate	kW / device	0.61	0.53	0.56	0.49
		Total MW	2.56	2.23	1.65	1.44
	Ex Ante Load Reduction Estimate	kW / device	0.49	0.43	0.39	0.34
		Total MW	2.06	1.79	1.15	1.00
	2020 Energy Savings	kWh / device	1.13	0.98	1.80	1.57
		Total MWh	47.39	41.23	53.52	46.56

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 2020 Power Saver program, the Evergreen team offers the following recommendations:

[14] 2020 kW factors include a rolling average per-device result for 2016-2020. 2020 Small Commercial and Medium Commercial have an 87% operability adjustment applied. The 87% operability percentage was calculated as 85% multiplied by the number of DCU sites that have not been visited in the last two years plus 95% 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. The Evergreen team recommends that ex ante program impacts from 5:00 PM to 6:00 PM MDT at 100°F, de-rated for operability, 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. If there is a chance to review the terms, we recommend collapsing to the hourly mean rather than the maximum.
- The connected load assumption used to convert air conditioner runtime to electric demand is high given the average air conditioner size. It is also higher than the assumed value in the smart thermostat protocol of the New Mexico TRM. Currently the BYOT and Two-Way thermostat offerings represent a small fraction of the Power Saver resource capability, but as they grow it will be important to base the load impact calculations on sound assumptions. The Evergreen team recommends Itron transition to a connected load in the 3.0-3.5 kW range for 2021.

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 2020, who managed the enrollment, dispatch, and settlement with participating customers. During the summer 2020 demand response season, there were 130 participating facilities and ten demand response events. These events are summarized in Table 29.

Table 29: 2020 Peak Saver Event Summary

Date	Weekday	Participants	Start Time (MDT)	End Time (MDT)	Daily High at KABQ (F)
06/04/2020	Thursday	92	3:00 PM	7:00 PM	95
06/25/2020	Thursday	93	3:00 PM	7:00 PM	94
07/06/2020	Monday	130	3:00 PM	7:00 PM	97
07/13/2020	Monday	130	3:00 PM	7:00 PM	97
07/14/2020	Tuesday	130	3:00 PM	7:00 PM	93
07/29/2020	Wednesday	130	3:00 PM	7:00 PM	94
08/14/2020	Friday	130	3:00 PM	7:00 PM	96
08/18/2020	Tuesday	130	4:00 PM	8:00 PM	92
08/19/2020	Wednesday	130	4:00 PM	8:00 PM	95
08/20/2020	Thursday	130	4:00 PM	8:00 PM	98

After the 2020 demand response (DR) season concluded, Enbala provided the Evergreen 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 May 20 to August 20. The May days were included in the data to facilitate the baseline calculation for the June 4th event. 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 Evergreen team completed our verified savings analysis. The three key steps in the analysis were:

5) Reproduce the performance estimates calculated by Enbala using the contractually-agreed upon CBL method;
6) Assess the accuracy of the contract CBL method by examining its ability to predict loads on non-event weekdays; and
7) Modify the CBL methodology to reduce bias and calculate verified impacts for each event.
8) Summarize average performance and discuss key drivers.

7.1 Validation of Settlement Calculations

The settlement calculations called for a "high 3-of-5" baseline with an uncapped, asymmetric day-of adjustment. The high 3-of-5 days were determined as follows:

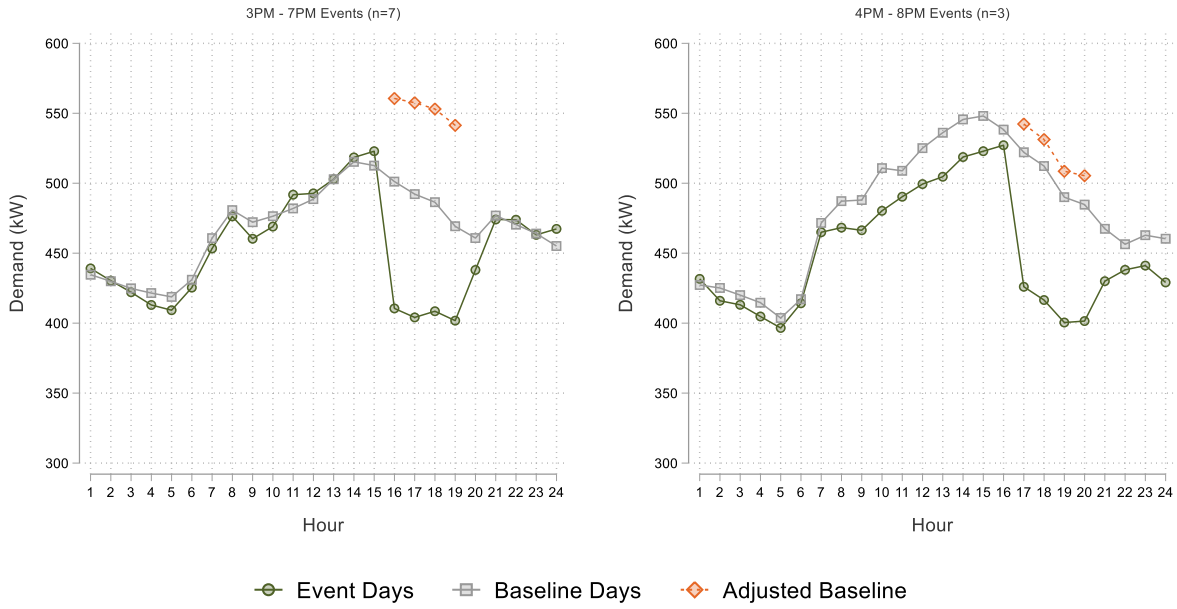
- Select the five non-holiday, non-event weekdays that immediately precede the event; and
- Out of those five days, pick the three days with the highest average demand during the hours in which the event occurred.

In the case of a tie, the day that is closer to the event day was selected as a baseline day. (This tie-breaking procedure was not laid out formally; rather, we discovered it when recreating Enbala's calculations.)

Our team was able to replicate nearly all of the settlement baselines. Across all sites and event hours, the average settlement baseline was 556.19 kW and the average Evergreen baseline was 556.18 kW. Any differences between the settlement baseline and our team's baseline were small, typically under a 0.1% difference with a couple of larger differences (between 1% and 6%). In the instances where differences were noted, there were gaps in the one-minute interval data on the baseline days. Differences in how this missing data was handled may explain the differences in the baselines.

Figure 41 shows average hourly event day loads across the full population, average hourly loads on the high 3-of-5 baseline days, and also average hourly baselines for the two different event intervals. Of the ten event days, seven had an event interval spanning from 3:00 PM to 7:00 PM (left panel). The other three events were from 4:00 PM to 8:00 PM (right panel).

Figure 41: Peak Saver Loads and Baselines



After verifying that the baselines were calculated correctly, our team moved onto the performance metric calculations. The relevant performance metrics are:

- **10-Minute Participant Capacity Performance –** The difference between the CBL and the lowest actual electrical demand measured by a one-minute interval reading between eight and ten minutes after the start of an event.
- **Average Participant Capacity Performance –** The average difference between the CBL and the participant's actual electric demand beginning ten minutes after the initiation of the event.
- **Participant Event Capacity Performance –** Weighted average of 10-Minute Participant Capacity Performance (40% weight) and Average Participant Capacity Performance (60% weight).
- **Energy Delivered –** The difference (in kWh) between the adjusted CBL and the metered load summed across all DR event hours.

Using the settlement baselines, all performance calculations were replicated without problem, with a small caveat on the energy delivered metric. For a couple of sites, there were minor differences between the settlement calculation and our team's calculation. Upon looking further into these differences, they may also be attributable to missing one-minute interval data for the site and day combinations. Per the settlement baselines, Table 30 shows portfolio performance metrics by date.

Table 30: Peak Saver Performance Metrics by Date

Date	10-Minute Participant Capacity (kW)	Average Participant Capacity (kW)	Participant Event Capacity Performance (kW)	Energy Delivered (kWh)
06/04/2020	22,365	25,620	24,318	100,524
06/25/2020	26,369	24,511	25,254	97,751
07/06/2020	19,319	18,475	18,813	73,562
07/13/2020	19,623	17,831	18,548	71,022
07/14/2020	16,556	17,714	17,251	70,286
07/29/2020	21,936	16,563	18,712	67,368
08/14/2020	14,182	12,404	13,115	49,450
08/18/2020	18,024	15,463	16,487	61,766
08/19/2020	14,858	15,111	15,010	60,124
08/20/2020	14,944	14,397	14,616	57,314
Average	**18,818**	**17,809**	**18,212**	**70,917**

7.2 Peak Saver Conclusions and Recommendations

Through investigating the impact of the COVID-19 pandemic on the 2020 demand response season, it is clear that both the reference loads and the demand reductions were affected by state-wide restrictions. The fluctuation in reference load between June and July follows a pattern similar to that in other states. While June presented a decreased load, July almost reached the normalcy of previous years. In August, the yearly trends appear to diverge, primarily because of the number of sites that are schools, which previously would see an influx of demand during this month. The last event in the 2020 season was called on August 20, over two-weeks before any students could go back to school in-person. In terms of demand reduction, the logic seems to follow that the periods with lighter overall loads would lead to less room to reduce consumption. It may also be true that the reduction of load was a secondary concern, seeing that commercial load was already reduced and COVID-19 restrictions meant an ever-fluctuating guide to daily operations.

After our review of the 2020 Peak Saver program, the Evergreen team offers the following recommendations:

- **Recommendation:** Make the multiplicative adjustment symmetric rather than asymmetric. As per the assessment of CBL accuracy presented in Section **Error! R eference source not found.**, 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. (We'll 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's 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 doesn't 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:** Customer loads are volatile and baselines are not perfect. 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 2020. This chapter presents a summary of the cost effectiveness calculations for all of the PY2020 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
    - 42 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 programs based on net realized savings are shown below in Table 31. Overall, the PY2020 portfolio was found to have a UCT ratio of 2.31.[15]

Table 31: PY2020 Cost Effectiveness

Program	Utility Cost Test (UCT)
Res Comp – Refrigerator Recycling	1.10
Res Comp – Cooling & Pool Pumps	3.58
Res Comp – Home Energy Checkup	0.25
Res Comp – Home Energy Checkup LI	0.42
Residential Lighting	6.51
Comm Comprehensive	2.32
Comm Comprehensive - Multifamily	1.40
Easy Savings	1.99
Energy Smart (MFA)	1.24
New Home Construction	2.99
PNM Home Works	2.15
PNM Power Saver	0.93
PNM Peak Saver	0.91
Overall Portfolio	**2.31**

[15] Note that, at the request of PNM, we made some slight adjustments to the UCT calculation so that evaluation report would be consistent with PNM's internal cost effectiveness calculations. These changes were primarily related to rounding EUL values and changing the timing for discounting future costs and benefits, and resulted in a small increase in the portfolio UCT from 2.28 to 2.31.