

New Jersey Comfort Partners

Final Evaluation Report

January 2021

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Executive Summary

The New Jersey Comfort Partners (NJCP) Program provides no-cost energy efficiency services to income-qualified households in New Jersey. The NJCP Program offers the following benefits.

- *Home Health and Safety Improvements*: The NJCP Program provides services that save lives and improve the well-being of income-qualified households. Some of the important benefits include the identification and resolution of carbon monoxide issues and gas leaks; education about important home maintenance issues that may reduce risk of fire, mold, moisture, and other potential hazards; and improvements to the building envelope that result in increased comfort and safer temperature levels in the homes which can be critical for the elderly and young children.
- Joint Delivery for Dual Utility Customers: The NJCP Program is unique because it enables electric and gas utility customers with more than one utility to receive whole house weatherization services in a seamless approach. The approach reduces fixed costs because customers are visited fewer times, it increases convenience for the customers, and it allows all energy needs to be reviewed. The New Jersey utilities created a unified program and continuously work to ensure consistency and improve the quality of services delivered. Because the electric and natural gas utilities work together on this program, they provide one set of benefits and standards with common eligibility requirements, measure selection procedures, installation standards, and program evaluation.
- *Comprehensive Measure Installation*: The NJCP Program reviews all energy uses in the home where appropriate and provides cost-effective baseload and seasonal measure installation.
- *Comprehensive Customer Education:* The NJCP Program procedures require contractors to follow the partnership approach where the contractors work with the customers to identify potential energy-saving actions that customers are willing and able to undertake. The approach includes working with the customer to identify issues in the home, educating the customer about the energy bill and potential causes for high energy usage, and ensuring that the customer understands how to safely use the equipment in the home.

This report provides a summary of results from the 2020 NJCP Program evaluation.

Comfort Partners Program

The goals of the NJCP Program are as follows.

- Improve participant comfort, health, and safety.
- Achieve the optimum level of cost-effective energy savings in each participant dwelling.
- Achieve persistence of energy savings through effective energy education and the appropriate choice of efficiency measures, materials, and installation techniques.
- Improve participant bill payment capability and bill payment practices.
- Reach targeted USF customer base.

The NJCP Program is funded through the New Jersey Societal Benefits Charge (SBC). New Jersey's 1999 electric utility restructuring legislation authorized the Board of Public Utilities (BPU) to permit utilities to collect funds for public programs through this charge.

Table ES-1 displays the budget for the NJCP Program. The table shows that the budget was \$45.5 million in Fiscal Year 2020 (which was extended through September due to the COVID-19 pandemic).

Table ES-1NJCP Program Budget

	Admin and Program Development	Sales, Marketing, Call Centers, Web Site	Training	Rebates, Grants and Other Direct Incentives	Rebate Processing, Inspections, Other QC	Evaluation and Research	Total					
\$Millions												
7/1/2019-9/30/2020	\$2.87	\$1.25	\$0.89	\$38.79	\$1.64	\$0.07	\$45.50					
7/1/2018-6/30/2019	\$2.16	\$1.00	\$0.69	\$33.29	\$1.36	\$0.00	\$38.50					
7/1/2017-6/30/2018	\$1.83	\$0.75	\$0.48	\$25.67	\$1.24	\$0.03	\$30.00					

Management

The NJCP Program is jointly managed by six NJ investor-owned electric and gas utility companies. The utilities work together to determine program procedures and to make policy decisions. However, the utilities make individual decisions (except where electric and gas territories overlap) with respect to which contractors deliver services to their customers, measures approved that exceed the pre-approved spending guidelines, and customer outreach methods.

The NJCP Program works with six prime service delivery contractors, several subcontractors, and a third-party quality control inspector.

Eligibility

Customers must meet the following criteria to be eligible for the program.

- Annual household income at or below 250 percent of the Federal Poverty Guidelines, or eligible for one or more NJ Assistance programs.
- Use the home as a primary residence.
- Ratepayer of record with a NJ electric or gas utility.
- Live in a building with one to 14 individually metered units.
- Renters must receive permission from their landlord.
- Have not have received NJCP services at their same address for at least five years.
- Home must not be for sale or in foreclosure.
- Home must not be under five years old or under builder's warranty.
- In multi-family housing, at least half of the dwelling units in the multi-unit building must be occupied by NJCP Program-eligible customers for the whole house to be addressed. The customer is still eligible for baseload and other services if this is not the case.

Services Delivered

Energy education offered through the NJCP Program aims to empower customers to control their energy bills and their ability to pay those bills by educating them about how to read their energy bills, actions they can take on their own, and why NJCP is installing some measures, but not others.

The program provides three types of measures.

- Baseload Measures: Baseload appliances use electricity or natural gas all year, including lighting, refrigerators, water heaters, cooking stoves, and dryers. Standard protocols are used for determining installation of baseload measures, rather than spending guidelines.
- Seasonal Measures: These measures affect heating and air conditioning use and include air sealing and insulation. Electric seasonal and gas seasonal spending are determined based on the customer's usage and an amount to spend per ccf or kWh consumed. Spending may exceed the guideline by \$1,000 without prior approval from the utility.
- Health and Safety Measures: These measures affect the health and safety conditions of a home, and include ground covers, recessed light damming, and CO detectors. They cannot exceed 33 percent of the combined spending guidelines of the job and utility permission must be requested for health and safety expenses that exceed \$2,500.

Implementation and Quality Control

The contractor contacts the customer to schedule the initial appointment. The contractor is responsible for obtaining the signed and completed application and verifying income eligibility if these steps have not yet been completed.

The contractor obtains usage data from the appropriate gas and electric utilities to calculate electric seasonal and gas spending allowances. Contractors have some access to utility websites for this purpose.

The utilities provide third-party inspections on a minimum of 15 percent of completed jobs as required by the Board of Public Utilities (BPU). The inspection attempts to confirm whether measures were properly installed. They also conduct Work in Progress inspections that provide immediate coaching and guidance to program auditors and installers while they perform work.

Usage Impacts

The evaluation included analysis of the impacts of the NJCP Program on electric and gas consumption for customers who were treated in 2018. Natural gas savings were estimated for gas heating customers, electric savings were estimated for electric heating customers and are referred to as electric heating savings, and electric savings were estimated for gas heating customers and are referred to as electric secondary savings.

Overall findings were as follows.

- Electric Secondary Savings: The net savings for the electric secondary jobs was estimated to be 466 kWh or 5.5 percent of pre-treatment usage. This is less than the 542 kWh and 6.9 percent savings from the 2017 evaluation but similar to the 408 kWh and 5.6 percent of pre-treatment usage estimated in the 2013 evaluation. The pre-treatment usage was approximately eight percent higher than in the previous evaluation for jobs in the treatment group and 13 percent higher for those in the comparison group.
- Electric Heating Savings: The net savings for the electric heating jobs was estimated to be 190 kWh or 1.4 percent of pre-treatment usage, significantly lower than the 1,100 kWh and 8.1 percent of pre-treatment usage estimated in the previous evaluation. While all three utilities had electric heating savings that were lower than the previous evaluation, JCP&L electric heating jobs increased usage by an average of 137 kWh.
- Gas Heating Savings: The net savings for the gas heating jobs was estimated to be 52 ccf or 4.7 percent of pre-treatment usage, less than the 78 ccf and 7.2 percent of pre-treatment usage estimated in the previous evaluation.

Energy savings for electric secondary, electric heating, and gas heating customers treated in 2018 declined as compared to the 2017 evaluation of jobs completed between April 2015 and March 2016. The largest decline was for the electric heating jobs, driven by negative savings for JCP&L jobs completed by CMC, CRCI, and Honeywell. Based on the following information, it appears that reductions in savings relate primarily to work quality rather than other factors. However, a small part of the reduction may relate to reduction in the percentage of electric secondary jobs with refrigerators installed and a reduction in the percentage of gas jobs with major measures.

- Pre-treatment usage increased somewhat for electric secondary jobs as compared to the 2017 evaluation and remained about the same for electric heating and gas heating jobs.
- Refrigerators were installed in a somewhat lower percentage of electric secondary jobs and electric secondary jobs that did not receive a refrigerator had lower savings than in the 2017 evaluation.
- Approximately the same percentage of electric heating jobs received major measures as in the 2017 evaluation, but they achieved much lower savings. Jobs without major measures had increased usage as compared to a small reduction in the 2017 evaluation.
- Gas heating jobs were somewhat less likely to have major measures installed than in the 2017 evaluation and those jobs achieved somewhat lower savings than in the previous evaluation.

Cost-Effectiveness

There was great variation in savings and in measure costs by contractor.

• Electric Secondary Jobs: NEC provided the most cost-effective work. They had the second highest savings and the third lowest costs. NEC's work cost \$0.10 per kWh saved given a 25-year measure life, and the next closest contractors' costs per kWh saved were CRCI and DES with a cost of \$0.13 per kWh saved. While HON had the highest kWh

savings, their measure costs were among the highest, and they had lower costeffectiveness than three of the other contractors. GES had the highest savings as a percentage of pre-treatment usage, but they had the highest costs and the highest cost per kWh saved at \$0.17 per kWh saved.

- Electric Heating Jobs: NEC provided the most cost-effective services, with a cost of \$0.04 per kWh saved. This was largely due to their low costs, as their savings averaged only 519 kWh. While GES had the highest savings at 1,171 kWh, their measure costs were the highest among the contractors, and they were ranked second in cost-effectiveness with a cost of \$0.37 per kWh saved. HON and CMC had much higher costs per kWh saved, and CMC had significantly negative savings.
- Gas Heating Jobs: DES and CRCI were the most cost-effective, with costs of \$2.67 and \$2.69 per ccf saved, respectively. While GES had the highest savings, their measure costs were significantly higher than the other contractors, and they were ranked last in cost-effectiveness with a cost of \$5.08 per ccf saved. The other contractors had costs of over \$3.00 per ccf saved.

Customer Interviews

The evaluation included in-depth telephone interviews with 42 customers to assess whether there were factors exogenous to the program that may have affected energy savings. The interviews included 22 customers whose savings were higher than expected and 20 customers whose savings were lower than expected. Key findings are discussed below.

- External Factors: One of the goals of the interviews was to investigate reasons for higher and lower than expected energy savings. We found that some customers with lower than expected savings began using energy-consuming devices or increased the number of residents in their home within a year of the NJCP services.
 - Space Heater Usage: Six out of 22 high savers reported that they reduced their use of space heaters, though five of the six customers were selected for reductions in gas usage. One low saver who was an electric heating customer reported that an increase in their use of a space heater occurred following the services.
 - Other Household Changes: Only a small number of customers had changes in household size or use of appliances that may have impacted usage.
- Home Comfort Impacts: Seventeen of the 22 high savers and 12 of the 20 low savers reported that their comfort improved following Comfort Partners services. Two of the 20 low savers reported that their level of comfort worsened following services.
- Program Satisfaction: Almost all of the high and low savers were very or somewhat satisfied with the program. While 17 of the 22 high savers were very satisfied, 14 of the 20 low savers were very satisfied. Only the two low savers who reported a decline in their comfort level said that they were very dissatisfied.

The program should commend the contractors for providing good service and encourage them to continue with their current approach to customer communication.

• Participant Recommendations: The most common recommendation by participants was that the program should advertise more. When prompted for additional comments about their experience, sixteen of the 42 respondents praised the program in some way. Nine respondents indicated that they want the program to visit them again at some point.

Inspections

The evaluation will include inspections of completed jobs at a later date. These inspections were postponed because blower door testing could not be done at the current time due to COVID-19 restrictions.

Energy Saving Protocols

The evaluation included an analysis of the energy saving protocols to assess accuracy and need for formula updates. Key findings are summarized below.

- Electric Secondary Estimates: Protocol estimates for hot water measures and insulation were much lower than what was estimated in the evaluation and protocol estimates for LEDs, HVAC, and refrigerator replacement were much higher than what was reported in the evaluation. Air sealing, duct sealing, and thermostats had protocol estimates that were relatively close to the evaluation estimates, but of those three categories, only duct sealing had a significant evaluation estimate. While the total protocol savings averaged 1,101 kWh, the average evaluation savings for these jobs was 509 kWh.
- Electric Heating Estimates: Only the thermostat evaluation estimate had a high level of significance for the electric heating jobs, due to the small number of observations included in this analysis. There is not a high level of confidence in the electric heating measure-specific saving estimates. Protocol estimates for duct sealing were lower than what was estimated in the evaluation and protocol estimates for air sealing, LEDs, hot water measures, HVAC, insulation, refrigerator replacement, and thermostats were higher than what was reported in the evaluation. While the total protocol savings averaged 1,594 kWh, the average evaluation savings for these jobs was 220 kWh.
- Gas Heating Estimates: The air sealing, hot water measures, HVAC, insulation, and thermostat evaluation regression estimates had a high level of significance. Protocol estimates for air sealing, duct sealing, and HVAC were considerably higher than what was estimated in the evaluation, while the protocol estimates for hot water measures were lower than what was estimated in the evaluation. The protocol estimates for insulation and thermostats were both accurate. While the total protocol savings averaged 75 ccf for gas heating jobs, the average evaluation savings was 67 ccf.
- Recommended Changes to Protocols: While it can be difficult to estimate measurespecific estimates from the evaluation with high confidence when the samples are not large enough, the total protocol savings estimates were often much higher than what was

estimated in the evaluation. This was mainly the case for electric jobs, and less so for gas heating jobs. Therefore, several of the measure protocol formulas for electric secondary and electric heating jobs should be adjusted to reduce the projected savings. We made the following recommendations for the energy saving protocols.

- LEDs: The protocols estimated savings of 45.9 kWh per LED and the evaluation estimated savings of 17.6 kWh per LED. The protocols assume 52 Watts of savings and 2.5 hours of use to reach that estimate. However, given the estimated savings, it is unlikely that the LEDs were used that many hours per day. Contractors should be re-trained to discuss LED placement with customers and the protocols should be revised to reduce the hours-of-use assumption for LED replacements.
- Refrigerators: For electric secondary jobs, the protocols estimated average refrigerator savings of 1,023 kWh, whereas the evaluation estimated refrigerator savings of 427 kWh. There were 858 electric secondary jobs with a refrigerator replaced and 1,609 jobs with no refrigerator replaced. The metered usage for a replaced refrigerator that had a protocol estimate averaged 1,416 kWh for electric secondary jobs. Training should be done to ensure that the contractors are metering correctly and that only refrigerators with high enough metered usage are replaced.
- Air Sealing and Insulation: It is difficult to model air sealing and insulation savings individually because they are usually installed together. The sum of air sealing and insulation saving protocol estimates was very low for electric secondary, very high for electric heat, and accurate for gas heat. While the electric secondary protocol estimates were 30 percent lower and the electric heating protocol estimates were 85 percent higher than the evaluation estimates, the gas heating protocol estimates were only eight percent higher than the evaluation estimates. Given the difference between protocol estimates and evaluation savings for electric jobs specifically, we recommend that the working group consider adjusting the protocol multipliers on space consumption to estimate these savings.
- Duct Sealing: The protocols estimated 227 kWh in savings from duct sealing for electric secondary jobs and 89 kWh for electric heating jobs, whereas the evaluation estimated average savings of 274 kWh for electric secondary jobs and no significant savings for electric heating jobs. For gas heating jobs, the protocols estimated savings of 13 ccf and the evaluation did not find significant savings from duct sealing.

The energy saving protocols estimated duct sealing savings as ten percent of electric space consumption for homes with central air conditioning and two percent of electric space consumption for homes without central air conditioning. The energy saving protocols estimate duct sealing savings as two percent of gas space consumption for gas heated homes. We recommend that the estimates be kept at the current level for now and be reviewed again in a future evaluation.

 Hot Water: The protocols estimated 173 kWh in savings from hot water measures for electric secondary jobs and 188 kWh in savings for electric heating jobs, but the evaluation estimates were not statistically significant for either group. For gas heating jobs, the protocols estimated savings of eight ccf and the evaluation estimated savings of 14 ccf. It is difficult to determine how accurate the protocol savings estimates were for electric jobs due to the incomplete hot water measure protocol savings data for electric jobs.

- HVAC: The protocols estimated 647 kWh in savings from HVAC work for electric secondary jobs and 1,196 for electric heating jobs, whereas the evaluation estimated average savings of 377 kWh for electric secondary jobs and no significant savings for electric heating jobs. The protocols estimated savings of 205 ccf for gas heating jobs and the evaluation estimated average savings of 163 ccf for gas heating jobs. The working group should consider reducing the protocol savings estimates for HVAC measures.
- Thermostats: The protocols estimated 111 kWh in savings from thermostats for electric secondary jobs and 229 kWh for electric heating jobs. However, the electric secondary evaluation estimate was not significant, and the electric heating evaluation estimate was significantly negative. The protocols estimated savings of 24 ccf for gas heating jobs and the evaluation estimated average savings of 28 ccf for gas heating jobs. This evaluation estimate was highly significant, indicating that the protocol estimates for gas heating jobs were fairly accurate.

The energy saving protocols compute savings from thermostats as three percent of the electric or gas space consumption. The working group should re-consider whether these savings should continue to be claimed for electric consumption.

Recommendations

This section provides recommendations based on the findings from the research.

- 1. Training and Quality Control: The lower savings found in this study compared to the previous evaluation appear to relate primarily to work quality rather than other factors assessed in this report. The program should conduct additional quality control to determine the specific causes of the lower savings in homes with installed measures. After determining the specific causes of the lower savings, the program should provide additional training to contractors.
- 2. Major Measures: Part of the reduction in savings on gas heating jobs is related to lower penetration of major measures in those jobs. Contractor training should also focus on identifying and installing major measures where opportunities are available.
- 3. Energy Saving Protocols: The total protocol savings estimates were often much higher than what was estimated in the evaluation. This was mainly the case for electric jobs, and less so for gas heating jobs. Therefore, several of the measure protocol formulas for

electric secondary and electric heating jobs should be adjusted to reduce the projected savings. We made the following recommendations for the energy saving protocols.

- LEDs: The protocols should be revised to reduce the hours-of-use assumption for LED replacements.
- Air Sealing and Insulation: We recommend that the working group consider adjusting the protocol multipliers on space consumption to estimate these savings for electric heating jobs.
- Duct Sealing: We recommend that the estimates be kept at the current level for now and be reviewed again in a future evaluation.
- HVAC: The working group should consider reducing the protocol savings estimates for HVAC measures.
- Thermostats: The working group should re-consider whether these savings should continue to be claimed for electric consumption.
- 4. Refrigerator Measurements: Training should be done to ensure that the contractors are metering correctly and that only refrigerators with high enough metered usage are replaced.
- 5. Lighting Installation: Contractors should be re-trained to discuss LED placement with customers.
- 6. LEEN Data: When attempting to merge the LEEN data with the utility usage data, we found many account number errors. These included a missing final digit; account numbers stored without sufficient precision; account numbers with an extra digit at the beginning, middle, or end; typos in the account number; or completely incorrect account numbers. The utilities should institute checks so that these errors are reduced. (Note that most of these errors were corrected by the utilities prior to the analysis so that these accounts could be included.)

I. Introduction

The New Jersey Comfort Partners Program (NJCP Program) provides critical usage reduction and health and safety services to income-qualified households, resulting in more affordable energy bills, reduced ratepayer bill subsidies, improved comfort, and healthier homes. This report provides findings from an evaluation of NJCP jobs completed in 2018.

A. Evaluation

The goals of the NJCP Evaluation were as follows.

- 1. Assess how program savings were impacted by program refinements.
- 2. Review and provide recommendations for the energy saving protocols.
- 3. Provide feedback on how the program may be modified to better achieve its goals.

The evaluation activities that were undertaken are briefly described below. Summaries of the results from these activities are included in this report.

- 1. Program Changes: We reviewed the changes that the Working Group made to the program since the last evaluation in 2017.
- 2. Billing Analysis: We conducted a weather-normalized, comparison group-adjusted analysis of the impacts of the program on participants' electric and natural gas consumption.
- 3. Cost Effectiveness: We analyzed the cost-effectiveness of the energy savings.
- 4. Customer Interviews: We conducted in-depth telephone interviews with a sample of customers who saved more than expected and a sample who saved less than expected to assess the factors that are associated with those differences.
- 5. Energy Saving Protocols: We reviewed the Energy Saving Protocols, compared the projected savings to the savings estimated through the billing analysis, and made recommendations for adjustments to the protocols.

B. Organization of the Report

Six sections follow this introduction.

- 1) *Section II: New Jersey Comfort Partners Program:* This section provides a description of the program, including goals, resources, services, and implementation procedures. This section also describes changes that have been made to the program since the last evaluation.
- 2) *Section III: Usage Impacts*: This section provides a summary of findings from the analysis of customers' billing data to determine the impacts of NJCP Program services on the energy usage of participating customers.

- 3) *Section IV*: Cost Effectiveness: This section analyzes the cost-effectiveness of the program.
- 4) Section V: Customer Interviews: This section provides a summary of findings from indepth telephone interviews with program participants.
- 5) *Section VI: Energy Saving Protocols*: This section compares the protocol estimates to the billing estimates and provides recommendations for modifications to the protocols.
- 6) *Section VII: Findings and Recommendations*: This section provides a summary of key findings and recommendations for improving the program.

APPRISE prepared this report under contract to FirstEnergy. The New Jersey utilities facilitated this research by furnishing program data to APPRISE. Any errors or omissions in this report are the responsibility of APPRISE. Further, the statements, findings, conclusions, and recommendations are solely those of analysts from APPRISE and do not necessarily reflect the views of the New Jersey utilities.

II. New Jersey Comfort Partners Program

The New Jersey Comfort Partners Program (NJCP Program) provides no-cost energy efficiency services to income-qualified households in New Jersey. The NJCP Program offers the following benefits.

- *Home Health and Safety Improvements*: The NJCP Program provides services that save lives and improve the well-being of income-qualified households. Some of the important benefits include the identification and resolution of carbon monoxide issues and gas leaks; education about important home maintenance issues that may reduce risk of fire, mold, moisture, and other potential hazards; and improvements to the building envelope that result in increased comfort and safer temperature levels in the homes which can be critical for the elderly and young children.
- Joint Delivery for Dual Utility Customers: The NJCP Program is unique because it enables electric and gas utility customers with more than one utility to receive whole house weatherization services in a seamless approach. The approach reduces fixed costs because customers are visited fewer times, it increases convenience for the customers, and it allows all energy needs to be reviewed. The New Jersey utilities have created a unified program and continuously work to ensure consistency and improve the quality of services delivered. Because the electric and natural gas utilities work together on this program, they provide one set of benefits and standards with common eligibility requirements, measure selection procedures, installation standards, and program evaluation.
- *Comprehensive Measure Installation*: The NJCP Program reviews all energy uses in the home where appropriate and provides cost-effective baseload and seasonal measure installation.
- *Comprehensive Customer Education:* The NJCP Program procedures require contractors to follow the partnership approach where the contractors work with the customers to identify potential energy-saving actions that customers are willing and able to undertake. The approach includes working with the customer to identify issues in the home, educating the customer about the energy bill and potential causes for high usage, and ensuring that the customer understands how to safely use the equipment in the home.

A. Goals and Resources

The goals of the program are as follows.

- Improve participant comfort, health, and safety.
- Achieve the optimum level of cost-effective energy savings possible in each participant dwelling.
- Achieve persistence of energy savings through effective energy education and the appropriate choice of efficiency measures, materials, and installation techniques.
- Improve participant bill payment capability and bill payment practices.
- Reach targeted USF customer base.

The program is funded through the New Jersey Societal Benefits Charge (SBC). New Jersey's 1999 electric utility restructuring legislation authorized the Board of Public Utilities (BPU) to permit utilities to collect funds for public programs through this charge. This non-bypassable charge is imposed on all customers of New Jersey's investor-owned electric and gas public utilities.

Table II-1 displays the budget for the NJCP Program. The table shows that the budget was \$45.5 million in Fiscal Year 2020 (which was extended through September due to the COVID-19 pandemic).

	Admin and Program Development	Sales, Marketing, Call Centers, Web Site	Training	Rebates, Grants and Other Direct Incentives	Rebate Processing, Inspections, Other QC	Evaluation and Research	Total					
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7/1/2018-6/30/2019	\$2.16	\$1.00	\$0.69	\$33.29	\$1.36	\$0.00	\$38.50					
7/1/2017-6/30/2018	\$1.83	\$0.75	\$0.48	\$25.67	\$1.24	\$0.03	\$30.00					

Table II-1NJCP Program Budget

B. Utilities

The NJCP Program is jointly managed by six NJ investor-owned electric and gas utility companies, shown in Table II-2.

Table II-2NJ Electric and Gas Utilities

Electric Utilities	Gas Utilities
Atlantic City Electric	Elizabethtown Gas
Jersey Central Power & Light	New Jersey Natural Gas
Public Service Electric & Gas	Public Service Electric & Gas
	South Jersey Gas

Utilities work together to determine program procedures and policy decisions. However, they make individual decisions (except where electric and gas territories overlap) with respect to determining which contractors deliver services to their customers, approving measures that may exceed pre-approved spending guidelines, and customer outreach.

C. Contractors

The NJCP Program works with six prime service delivery contractors, several subcontractors, and a third-party quality control inspection contractor that is also responsible for contractor training. The prime contractors are as follows.

- CLEAResult (CRCI)
- CMC Energy Services (CMC)
- Divine Energy Solutions (DES)
- GreenLife Energy Solutions (GES)
- Honeywell (HON)
- Northeast Energy Conservation Inc. (NEC)

D. Data Tracking System

The data tracking system is a critical aspect of the NJCP Program, as it plays a role in efficient and effective program management and operations. The system should facilitate the following activities.

- Management and Reporting: Utilities need program information to fulfill the following program needs.
 - Ensure that the program meets performance requirements, including expenditures, production, and estimated energy savings.
 - Verify the program's fiscal integrity.
 - o Coordinate with other utilities, contractors, and other programs.
 - Report program data to the Board of Public Utilities.
- Operations: The following program partners need information to make sure the program operates efficiently and effectively.
 - o Utilities
 - Service delivery contractors
 - Quality assurance contractor

They need to use the system for the following purposes.

- Reporting on job status.
- \circ Tracking jobs that have not been completed.
- Reviewing information about specific jobs.
- Invoicing for measures installed and administrative costs.
- Communicating with partners about job issues.
- Determining inspection results and required actions.
- Evaluation: The researchers need data to assess the following.
 - Program participation by utility and contractor.
 - Customer and home characteristics.
 - Customer contact information to select and contact customers for the telephone survey and inspections of completed work.
 - o Measures installed.
 - Inspection results.
 - Projected energy savings.
 - Measured impacts by customer characteristics, job characteristics, and for particular measures.

E. Eligibility

Customers must meet the following criteria to be eligible for the program.

- Annual household income at or below 250 percent of the Federal Poverty Guidelines, or
- Eligible for one or more of the following programs
 - Universal Service Fund (USF)
 - o Lifeline
 - Home Energy Assistance Program (HEAP)
 - Temporary Assistance to Needy Families (TANF)
 - Supplemental Security Income (SSI)
 - Pharmaceutical Assistance to the Aged and Disabled (PAAD)
 - Section 8 Housing Assistance
 - General Welfare Assistance
- Use the home as a primary residence.
- Ratepayer of record with a NJ electric or gas utility.
- Live in a building with one to 14 individually metered units.
- Renters must receive permission from their landlord.
- Customer must not have received NJCP services at their same address for at least five years.
- Home must not be for sale or in foreclosure.
- Home must not be under five years old or under builder's warranty.

In multi-family housing at least half of the dwelling units in the multi-unit building must be occupied by NJCP Program-eligible customers for the whole house to be treated. If not, customers may receive baseload and other measures.

F. Outreach and Intake

Customers may enroll in the NJCP Program through various avenues.

- The utilities generate lists of USF customers with high energy usage.
- Program contractors conduct outbound telemarketing.
- Program contractors receive calls from customers who have seen program brochures.
- CAP agencies and other nonprofits refer customers.
- Customers complete information on the NJ Clean Energy website to be contacted about the program.
- Personalized customer solicitations.
- Mass mailing campaigns.
- NJ winter moratorium mailings.
- NJCP utility bill inserts.

Customers must complete the following steps to enroll.

- Complete a program application (can be obtained after appointment if customer is prequalified).
- Complete a landlord agreement, if applicable (must be completed prior to measure installation).

- Have program eligibility verified. Proof of income must be provided if the customer is not eligible through one of the qualifying programs.
- Acceptable forms of proof of income include the following.
 - If paid weekly, paystubs for four consecutive weeks within last eight weeks of the application submission date.
 - If paid twice a month or every two weeks, two consecutive paystubs.
 - If self-employed, copy of latest federal income tax statement with schedule C showing profit/loss.
 - Current year Social Security benefit award letter, bank statement, or check (including childrens' benefits).
 - Pension benefit award letter, current pension statement, direct deposit, or 1099 forms.
 - Unemployment benefit determination letter or two consecutive benefit pay stubs.
 - Child support or alimony award letters.
 - Copy of latest federal income tax statement with Schedule E or lease for all tenants and/or rent receipts or notarized vacancy agreement letter (for rental income).
 - TANF or General Assistance (GA) award letter or benefits printout indicating amount received.

G. Energy Education

Energy education aims to empower customers to control their ability to pay their energy bills by educating them about how to read their energy bills, actions they can take on their own, and why NJCP is installing some measures, but not others.

Contractors are required to provide a one-hour minimum energy education session during the initial customer visit, utilizing the Energy Education notebook and Resource Section. While contractors are authorized to bill for up to two hours of education, there is no limit on the amount of education that can be provided.

The NJCP Partnership Agreement is intended to remind everyone of their responsibilities and the importance of comprehensively addressing opportunities for cost-effective savings. The NJCP Program commits to the following as part of the agreement.

- An in-home energy evaluation and education session to help the customer understand his/her energy needs and to develop a customized action plan.
- Energy-saving home improvements to help the customer reduce energy usage, lower cost, and improve health, safety, and comfort.
- Payment options to help keep utility bills affordable.

The customer's commitment to NJCP is as follows.

- Prepare for in-home sessions and keep all scheduled appointments.
- Actively participate in identifying ways to use energy wisely and increase comfort, health, and safety.
- Secure all available assistance dollars to help pay utility bills.
- Make every effort to pay utility bills on time.
- Plan and take specified personal and family actions to save energy (documented on action plan by contractor). The form contains a goal statement for the dollar savings in energy.

H. Energy Services

The auditor determines opportunities for cost-effective energy savings by examining customer energy usage and other site-specific information. The auditor is instructed to take the following steps.

- Explain the purpose of the program.
- Discuss customer and NJCP responsibilities.
- Confirm the partnership and sign the partnership agreement.
- Explain the weatherization steps.
- Gather information on family needs, wants, and behaviors and review bills.
- Meter the refrigerator and other appliances that may qualify for replacement.
- Take a house tour to identify potential opportunities, determine usage habits, and install qualifying measures.
- Identify three actions the customers can do themselves to lower energy usage.
- Calculate current costs and projected costs based upon measure installation and customer actions.
- Review options for measures, replacements, and actions with the customer.
- Make decisions and complete the Partnership Agreement and Action Plan.
- Make referrals.
- Follow-up on responsibilities.
- Thank the customer for being a partner in the NJCP Program.
- Instruct the customer to prepare the home as necessary for the next visit.

The program provides three types of measures.

- Baseload Measures: Baseload appliances use electricity or natural gas all year, including lighting, refrigerators, water heaters, cooking stoves, and dryers. Standard protocols are used for determining installation of baseload measures, rather than spending guidelines.
- Seasonal Measures: These measures affect heating and air conditioning use and include air sealing and insulation. Seasonal guidelines are used to determine the amount that can be spent on these measures in an individual home. Electric seasonal and gas seasonal spending are determined based on the customer's usage and an amount to spend per ccf or kWh consumed. Spending may exceed the guideline by \$1,000 without prior approval from the utility.
- Health and Safety Measures: These measures affect the health and safety conditions of a home, and include ground covers, recessed light damming, and CO detectors. The guideline is that these costs should not exceed 33 percent of the combined spending guidelines of the job and utility permission must be requested for health and safety expenses that exceed \$2,500.

The spending guidelines are determined in the following manner.

• Obtain 12 months of consecutive usage from the utility or use default estimates if 12 months are not available.

- Review seasonal use and determine the breakout between winter and summer seasonal usage.
- Electric seasonal spending guidelines are calculated based on seasonal electric usage.
- Gas spending guidelines are calculated based on annual gas usage.
- Gas homes with municipal electric service only receive gas measures.

In multi-family buildings, the spending guidelines of all qualifying customers can be combined to determine total spending levels for the building. Seasonal measures should address the thermal boundary of the entire building, but the heating and cooling systems only for qualified customers. Baseload measures are restricted to the individual qualifying customers.

Measures included in the seasonal spending guideline include the following.

- Duct Sealing
- Insulation
- Air Sealing
- Thermostat Adjustment or Replacement
- AC Filter and Coil Cleaning
- Electric Furnace Filters
- Heat Pump Filter/Coils
- Heat Pump and Central Air Tune-ups
- Central AC Filters
- Gable, Roof, Soffit, and Ridge Vents
- Attic Hatches, Boxing, and Damming
- Incidental Carpentry Expenses for Time and Materials, and Measures
- Interior Air Conditioner Covers

Measures that do not have to be paid out of the seasonal guideline include the following.

- Energy Audits/Education
- Blower Door Diagnostics
- Lighting
- Refrigerators and Freezers
- Waterbed Replacement
- Clothes Drying (Fan Ventilation/Clothes Lines)
- Hot Water Heater Replacement or Repairs
- Aerators and Showerheads
- Combustion Safety and Installation of CO Detectors
- Health and Safety Measures
- Window/Wall Air Conditioning Units
- Window Film
- Reflective Roof Coat

• Repair or Replacement of HVAC Systems

Health and safety measures are defined as those measures that prevent or fix a problem that could cause a fire, carbon monoxide poisoning, moisture, or other health problems. They include the following work.

- Combustion safety repairs
- CO detectors
- Damming of heat producing fixtures
- Venting gas and electric clothes dryers to the outside
- Covering open access panels on electric hot water heaters being treated through the program
- Flue repair
- Repairing or replacing unsafe electric service that interferes with the energy saving work
- Attempting to remedy the cause of moisture problems in the home
- Installing pressure relief valves and overflow pipes on water heaters
- Repairing/replacing a refrigerator that is not cooling and possibly making food unsafe
- Repairing a leaking sewer line in the basement or crawl space to air seal, insulate, or install ground cover
- Removing/replacing halogen light bulbs/torchieres where a fire hazard could occur
- Installing handrails for elderly or handicapped customers
- Ventilating to ASHRAE 62.2-2019 standard

As noted in the NJCP Manual, customers should be referred to other social service agencies for extensive health and safety repairs not covered by the NJCP Program. If recommended program work is put on hold, the contractor must return to complete program work upon notice from the customer that the problem has been resolved.

Detailed procedures are provided in the NJCP Manual for the following conditions.

- Mold and moisture
- Asbestos
- Clothes dryer venting
- Lead
- Air sealing for high temperature applications
- Unvented combustion appliances
- Flood assistance for damage caused by tropical storms

A health and safety cover letter and condition and findings form must be provided on any job where a health and safety condition is found. The form specifies the problems that were found, potential corrective actions, and agencies that may be able to assist with the repairs.

I. Service Delivery

The contractor contacts the customer to schedule the initial appointment. At that time, the customer should be entered into the NJCP database so that WAP agencies can look up customers and make sure they do not serve customers about to receive NJCP services.

The contractor is responsible for obtaining the signed and completed application and verifying income eligibility if these steps have not yet been completed.

The contractor obtains usage data from the appropriate gas and electric utilities to calculate electric seasonal and gas spending allowances. Contractors have some access to utility websites for this purpose.

The contractor is responsible for ensuring that customers sign all forms and that forms are kept on file for seven years. The following forms are required.

- Program Application
- Landlord Rental Agreement (if applicable)
- Partnership Agreement Form
- Action Plan Form
- Health and Safety Release Form
- Audit Form

Contractors are required to complete the audit within 30 days after the application or after the customer is entered into the NJCP database. They are required to complete the installations within 60 days after the audit.

Invoicing is done using the NJCP database system. When the customer receives services from both a gas and electric utility, the contractor is responsible for allocating the costs between the utilities. The NJCP system will allocate the costs based on a pre-defined percentage in the system or a percentage that the contractor enters.

Production goals are provided to each contractor and are re-evaluated on an annual basis.

Contractors are required to obtain contracts with appliance vendors, place orders for replacement appliances, and maintain records of the transactions.

J. Quality Control

The utilities provide third-party inspections on a minimum of 15 percent of completed jobs as required by the Board of Public Utilities (BPU). Quality assurance for the program includes the following activities.

- Final inspections for installed work.
- Comprehensive diagnostics post-work in customers' homes.
- Work in progress inspections.
- Quarterly contractor trainings.
- Quarterly review meetings where the quality assurance vendor reviews inspection results for the previous quarter with each contractor.

Contractors are asked to inform the customer that they may be receiving a call for an inspection appointment from a final inspector. The final inspection may consist of a complete walk through of the home or a comprehensive inspection including partial or complete

diagnostic testing. The final inspection attempts to confirm whether measures were properly installed and includes evaluation of missed savings opportunities.

They also conduct Work in Progress inspections that provide immediate coaching and guidance to program auditors and installers while they perform work.

K. Referrals

If either the Weatherization Assistance Program (WAP) or NJCP does not or is prevented from providing a service, the agency or contractor is instructed to make a referral to the other program. One example is in the case of replacing or repairing air conditioners. This service is provided by NJCP but is not provided by WAP. The WAP agency would refer a customer who is a candidate for an air conditioning repair or replacement to NJCP for their review and eligibility. In this case, a full audit would not be conducted.

NJCP also partners with nonprofits and municipalities to address barriers that allow for more energy efficiency work to be performed. NJCP partners with WAP to jointly serve a home that would have been out of scope for either program due to major health and safety barriers.

Contractors are also instructed to refer customers to the following programs.

- Universal Services Fund (USF)
- Lifeline
- NJ SHARES
- Federal Supplemental Security Income (SSI)
- Home Energy Assistance Program (HEAP)
- NJ 2-1-1 System

L. Program Changes

The 2013 NJCP Evaluation included many recommendations for program refinements. Many of these recommendations were implemented prior to the 2017 evaluation. The following changes have been made since the 2017 evaluation.

- Targeting High Users: The program emailed contractors to reinforce targeting high-usage Universal Service Fund participants.
- LED Lighting: The program moved from providing CFLs to providing LEDs.
- Heat Pump Water Heaters: These were added as a measure for consideration.
- Attic Insulation: The evaluation recommendation of an R38 minimum in attics was adopted.
- Insulation Encapsulation: The evaluation recommendation that all insulation be encapsulated was accomplished through the use of spray foam, which is a combination insulator and air barrier.

- Water Use Measures: NJCP adopted the WaterSense criteria for water use reduction (to reduce water heating).
- Mold Treatment: The utilities updated the NJCP manual to include an updated mold treatment procedure that was developed with contractor input. Performance Systems Development (PSD) conducted a training with contractors on the minimum procedures.
- LEEN System: Revised protocols were implemented to improve the accuracy of the energy saving protocols. Additional checks were added to the new LEEN System to prevent data entry errors which could prevent projected savings from being calculated correctly. Additional reports were provided to help utilities manage the program.
- Heating Savings: The evaluation recommended that the utilities evaluate GES's process to determine how they achieved high heating savings. The utilities found that GES uses an "in-house model" to keep sub-contracting to a minimum by seeking and obtaining a significant number of certifications, licenses and training for their management and staff. GES upper management is actively involved on all aspects of the jobs and seeks improvement where possible. GES does more air sealing than other contractors. For example, GES will typically seek to air seal the top of perimeter walls on homes.

The utilities should use these findings to improve the performance of the other contractors.

- Customer Education: The utilities engaged NJIT to develop a new customer education tool and PSD training has included sessions related to an increased focus on customer education.
- Refrigerator Measurement: PSD trained contractors on refrigerator replacement.

All recommendations from the 2013 evaluation have been completed, are not currently under consideration, or may be considered in the future.

III. Usage Impacts

The evaluation included analysis of the impact of the NJCP program on electric and gas consumption for customers who were treated in 2018. This section provides a summary of the findings from that analysis. Savings estimates are computed by job type across the program and by the following characteristics.

- Utility
- Contractor
- Pre-Treatment Usage
- Measures Installed

A. Methodology

This section provides a detailed discussion of the research methodology. Table III-1 displays the timing for this current research and for the previous evaluations. The previous evaluations estimated impacts for 2010 to 2011 jobs and for 2015 to 2016 jobs. The current evaluation estimated the impact for jobs completed in calendar year 2018.

The comparison group for the current evaluation was comprised of customers treated in 2019. The change in usage for the comparison group was estimated for the two years prior to their treatment to control for other changes during the time period that may have impacted energy usage.

	2020 Eva	luation
Group	Installations Completed	Usage Data Requested
Treatment	1/1/2018 - 12/31/2018	1/1/2017 12/21/2010
Comparison	1/1/2019 - 12/31/2019	1/1/2017 - 12/31/2019
	2017 Eva	luation
Group	Installations Completed	Usage Data Requested
Treatment	4/1/2015 - 3/31/2016	4/1/2014 2/15/2017
Comparison	4/1/2016 - 3/31/2017	4/1/2014 - 5/15/2017
	2013 Eva	luation
Group	Audits Completed	Usage Data Requested
Treatment	9/1/2010 - 8/31/11	8/1/2000 10/21/2012
Comparison	9/1/2011 - 8/31/2012	0/1/2009 - 10/51/2012

Table III-1Treatment and Comparison Group Definitions

Usage data were requested from the electric and gas utilities for the treatment and comparison groups from January 1, 2017 to December 31, 2019. Table III-2 displays the data attrition by natural gas utility. Jobs were considered ineligible for analysis if there was no usage data or if the data received was insufficient, defined as fewer than 270 days of usage data in either

the pre- or post-treatment period. Jobs were also considered ineligible for analysis if they had no real usage readings or if they were extreme outliers in usage. The table shows that across the gas utilities, between 63 and 77 percent of the treatment group was included and between 51 and 61 percent of the comparison group was included in the final analysis group.

		Natural Gas Utility Attrition Analysis														
	ETG				NJNG				PSEG				SJG			
	Г	reat	Comp		Treat		C	Comp		Treat		mp	Treat		Comp	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
All NJ CP Jobs	583	100%	486	100%	683	100%	718	100%	1,892	100%	2,367	100%	419	100%	460	100%
Duplicate Rmvd.	578	99%	483	99%	678	99%	691	96%	1,891	>99%	2,367	100%	419	100%	459	100%
Usage Data Rcvd.	575	99%	483	99%	678	99%	691	96%	1,844	97%	2,317	98%	372	89%	429	93%
Sufficient Data	478	82%	321	66%	595	87%	497	69%	1,450	77%	1,583	67%	324	77%	318	69%
\geq 1 Real Reading	478	82%	321	66%	595	87%	497	69%	1,447	76%	1,579	67%	324	77%	318	69%
Outliers Removed	428	73%	247	51%	525	77%	441	61%	1,190	63%	1275	54%	287	68%	267	58%
Analysis Group	428	73%	247	51%	525	77%	441	61%	1,190	63%	1275	54%	287	68%	267	58%

Table III-2Data Attrition by Natural Gas Utility

Table III-3 displays the data attrition by electric utility. The table shows that across the electric utilities, between 67 and 75 percent of the treatment group was included and between 58 and 65 percent of the comparison group was included in the analysis.

		Electric Utility Attrition Analysis										
		AC	CE			JC	PL		PSE&G			
	Tr	eat	Comp		Treat		Comp		Treat		Co	mp
	#	%	#	%	#	%	#	%	#	%	#	%
All NJ CP Jobs	470	100%	593	100%	996	100%	972	100%	2,394	100%	2,755	100%
Duplicate Jobs Removed	470	100%	589	99%	990	99%	938	97%	2,393	>99%	2,755	100%
Usage Data Received	468	>99%	588	99%	988	99%	938	97%	2,323	97%	2,693	98%
Sufficient Usage Data	403	86%	447	75%	848	85%	652	67%	1,845	77%	1,829	66%
\geq 1 Real Reading	403	86%	447	75%	848	85%	652	67%	1,845	77%	1,827	66%
Outliers Removed	354	75%	386	65%	749	75%	596	61%	1,594	67%	1,606	58%
Analysis Group	354	75%	386	65%	749	75%	596	61%	1,594	67%	1,606	58%

Table III-3Data Attrition by Electric Utility

Table III-4 compares the full population to the analysis group to assess whether differential attrition had the potential to bias the usage impact analysis results. The table shows that the characteristics of the full population generally matched those of the analysis group.

		Electric S	econdary	y		Electric	Heating			Gas Heating			
	Trea	tment	Comp	parison	Trea	tment	Comp	parison	Trea	tment	Comp	parison	
	All	Analysis Group	All	Analysis Group	All	Analysis Group	All	Analysis Group	All	Analysis Group	All	Analysis Group	
Observations	3,476	2,467	3,942	2,402	378	230	340	186	3,567	2,430	4,001	2,230	
Electric Utilit	У												
ACE	12%	13%	12%	13%	16%	17%	30%	33%	12%	12%	12%	13%	
JCP&L	22%	25%	20%	21%	59%	59%	48%	47%	22%	25%	19%	21%	
MUNI	-	-	-	-	-	-	-	-	<1%	<1%	<1%	<1%	
PSE&G	66%	62%	68%	65%	25%	24%	22%	20%	67%	64%	68%	65%	
REC	-	-	-	-	-	-	-	-	0%	0%	<1%	<1%	
Gas Utility													
ETG	16%	16%	12%	11%	25%	32%	3%	6%	16%	18%	12%	11%	
NJNG	20%	22%	18%	20%	3%	3%	6%	6%	19%	22%	17%	20%	
PSE&G	53%	50%	59%	57%	70%	65%	79%	69%	53%	49%	59%	57%	
SJG	12%	12%	11%	12%	2%	0%	12%	19%	12%	12%	12%	12%	
Contractor													
CMC	15%	16%	15%	15%	9%	6%	10%	9%	15%	14%	16%	13%	
DES	1%	1%	2%	2%	0%	0%	2%	2%	1%	2%	2%	2%	
HON	32%	33%	27%	26%	52%	56%	37%	39%	32%	32%	27%	25%	
CRCI	19%	18%	18%	17%	15%	15%	11%	9%	19%	19%	18%	17%	
GES	13%	15%	18%	21%	14%	14%	36%	39%	13%	15%	18%	23%	
NEC	20%	18%	20%	20%	10%	9%	5%	2%	20%	18%	20%	21%	
NYS	<1%	0%	0%	0%	-	-	-	-	<1%	0%	0%	0%	
Own	71%	75%	70%	75%	75%	79%	70%	75%	71%	75%	70%	74%	
Primary Heat	ing Fuel												
Utility Gas	>99%	>99%	>99%	>99%	0%	0%	0%	0%	98%	99%	99%	99%	
Electric	0%	0%	0%	0%	100%	100%	100%	100%	2%	1%	1%	<1%	
Major Measure ¹	36%	35%	33%	31%	55%	57%	63%	67%	42%	42%	49%	50%	

Table III-4Attrition Analysis

		Electric S	econdary	7		Electric	Heating		Gas Heating				
	Treatment		Comparison		Treatment		Comparison		Treatment		Comparison		
	All	Analysis Group	All	Analysis Group	All	Analysis Group	All	Analysis Group	All	Analysis Group	All	Analysis Group	
# Major Meas	sures												
0					25%	24%	23%	21%	38%	38%	26%	25%	
1					15%	14%	11%	12%	16%	16%	20%	20%	
2					18%	17%	21%	18%	18%	17%	23%	23%	
3					30%	29%	35%	39%	23%	25%	26%	27%	
4					13%	15%	9%	10%	4%	4%	4%	4%	
5					25%	24%	23%	21%	0%	1%	1%	1%	
Mean Cost	\$5,368	\$5,260	\$5,899	\$5,750	\$5,044	\$4,978	\$5,206	\$5,137	\$5,291	\$5,221	\$5,911	\$5,853	

¹Refers to refrigerator installation for electric secondary jobs.

B. Program-Level Usage Impacts

This section analyzes the energy usage impacts for the program as a whole and compares the results to the previous two evaluations. Table III-5 shows that the net savings for the electric secondary jobs was estimated to be 466 kWh or 5.5 percent of pre-treatment usage. This is less than the 542 kWh and 6.9 percent savings from the 2017 evaluation but similar to the 408 kWh and 5.6 percent of pre-treatment usage estimated in the 2013 evaluation. The table also shows that the electric secondary pre-treatment usage was approximately eight percent higher than in the previous evaluation for jobs in the treatment group and 13 percent higher for those in the comparison group.

Table III-5
Electric Secondary Savings Analysis

		Treat	tment Gr	oup			Comp		Not Coming				
Year	Obs.	Usage		Savings			Usage		Savings		Net Savings		
		Pre	Post	kWh	%	Obs.	Pre	Post	kWh	%	kWh	%	
2020	2,467	8,462	7,761	701**	8.3%	2,402	8,391	8,156	235**	2.8%	466**	5.5%	
2017	3,184	7,832	7,160	672**	8.6%	1,505	7,448	7,317	130**	1.7%	542**	6.9%	
2013	3,277	7,342	6,931	411**	5.6%	4,508	7,641	7,638	3	<0.1%	408**	5.6%	

**Denotes significance at the 99 percent level. *Denotes significance at the 95 percent level. #Denotes significance at the 90 percent level.

Table III-6 shows that the net savings for the electric heating jobs was 190 kWh or 1.4 percent of pre-treatment usage. This is significantly lower than the 1,100 kWh or 8.1 percent savings from the 2017 evaluation.

		Trea	atment G	roup			Comp		Not Sovings			
Year		Usa	age	Savi	ngs		Usa	age	Sav	vings	Inet Sa	vings
	UDS.	Pre	Post	kWh	%	Obs.	Pre	Post	kWh	%	kWh	%
2020	230	13,408	13,037	370*	2.8%	186	13,763	13,583	180	1.3%	190	1.4%
2017	309	13,584	12,175	1,409**	10.4%	123	12,165	11,856	309**	2.5%	1,100**	8.1%
2013	334	13,490	12,577	913**	6.8%	258	13,935	13,846	89	0.6%	824**	6.1%

Table III-6Electric Heating Savings Analysis

**Denotes significance at the 99 percent level. *Denotes significance at the 95 percent level. #Denotes significance at the 90 percent level.

Table III-7 shows that the net savings for the gas heating jobs was estimated to be 52 ccf or 4.7 percent of pre-treatment usage, less than the 78 ccf and 7.2 percent of pre-treatment usage estimated in the 2017 evaluation but similar to the 43 ccf and 4.1 percent savings found in the 2013 evaluation.

Table III-7Gas Heating Savings Analysis

		Treat	ment Gro	up			Com	parison Gi	roup		Net Savings		
Year		Usa	age	Savings			Us	age	Sa	vings	Net S	avings	
	Obs.	Pre	Post	ccf	%	Obs.	Pre	Post	ccf	%	ccf	%	
2020	2,430	1,103	1,030	73**	6.7%	2,230	1,123	1,102	21**	1.9%	52**	4.7%	
2017	2,980	1,086	996	90**	8.3%	1,496	1,088	1,077	12**	1.1%	78**	7.2%	
2013	3,161	1,039	980	59**	5.7%	4,960	1,042	1,026	16**	1.6%	43**	4.1%	

**Denotes significance at the 99 percent level. *Denotes significance at the 95 percent level. #Denotes significance at the 90 percent level.

C. Utility-Level Usage Impacts

This section presents the energy savings by utility. Table III-8 shows that PSE&G customers had the greatest electric secondary savings with an estimated net savings of 515 kWh or 6.2 percent of pre-treatment usage. JCP&L and ACE customers had approximately the same level of savings, at about 380 kWh and 4.5 percent of pre-treatment usage.¹

¹ Note that there were seven ACE electric secondary customers who had solar. If these customers were excluded from the analysis, ACE's savings would increase from 388 kWh to 410 kWh and from 4.2 percent of pre-treatment usage to 4.4 percent of pre-treatment usage.

		Tre	atment G	roup			Comp		Not Sovings			
Utility		Usa	age	Savings			Usa	nge	Sav	vings	Net Sa	ivings
	Obs.	Pre	Post	kWh	%	Obs.	Pre	Post	kWh	%	kWh	%
PSE&G	1,538	8,363	7,671	692**	8.3%	1,569	8,471	8,294	177**	2.1%	515**	6.2%
JCP&L	613	8,358	7,695	662**	7.9%	509	8,121	7,834	287**	3.5%	375**	4.5%
ACE	316	9,150	8,330	820**	9.0%	324	8,429	7,996	432**	5.1%	388*	4.2%

Table III-8 Electric Secondary Savings Analysis By Electric Utility

**Denotes significance at the 99 percent level. *Denotes significance at the 95 percent level. *Denotes significance at the 90 percent level.

Table III-9A displays the electric heating savings by utility. This table shows that ACE jobs had the greatest electric heating net savings with an estimated savings of 1,019 kWh or 6.3 percent of pre-treatment usage. PSE&G had savings of 609 kWh or 5.1 percent of pre-treatment usage. JCP&L electric heating jobs had an overall *increase* in usage of 137 kWh or one percent of pre-treatment usage.²

Table III-9A Electric Heating Savings Analysis By Electric Utility

		Tre	atment G	roup			Comp	arison G	roup		Net Savings		
Utility		Us	age	Savi	ngs		Usa	ge	Sav	/ings	Net Sa	avings	
	Obs.	Pre	Post	kWh	%	Obs.	Pre	Post	kWh	%	kWh	%	
ACE	38	16,075	14,699	1,376*	8.6%	62	13,893	13,536	357	2.6%	1,019#	6.3%	
PSE&G	56	11,936	11,204	732**	6.1%	37	12,165	12,041	124	1.0%	609#	5.1%	
JCP&L	136	13,269	13,328	-60	-0.4%	87	14,351	14,273	78	0.5%	-137	-1.0%	

**Denotes significance at the 99 percent level. *Denotes significance at the 95 percent level. #Denotes significance at the 90 percent level.

Table III-9B provides an examination of the JCP&L electric heating savings using different normalization methods. The table shows that all analyses show an increase in electric heating usage.

 $^{^2}$ Note that there were two ACE electric secondary customers who had solar. If these customers were excluded from the analysis, ACE's savings would decrease from 1,019 kWh to 989 kWh and from 6.3 percent of pre-treatment usage to 6.1 percent of pre-treatment usage.

		Tre	atment G	froup			Con		Not Sovings			
Normalization Method		Usa	age	Savings			Us	age	Sav	ings	Net S	avings
Witthou	Obs.	Pre	Post	kWh	%	Obs.	Pre	Post	kWh	%	kWh	%
2020												
Raw	136	11,710	12,367	-657**	-5.6%	87	13,584	14,048	-464**	-3.4%	-193	-1.6%
Day adjusted	136	11,995	12,429	-434*	-3.6%	87	13,815	14,037	-222#	-1.6%	-212	-1.8%
Degree Day	136	13,269	13,328	-60	-0.4%	87	14,351	14,273	78	0.5%	-137	-1.0%
PRISM	136	12,736	12,622	113	0.9%	87	14,139	13,867	272^{*}	1.9%	-158	-1.2%

Table III-9B Electric Heating Savings Analysis By Normalization Method JCP&L Customers

**Denotes significance at the 99 percent level. *Denotes significance at the 95 percent level. #Denotes significance at the 90 percent level.

Table III-10 displays the gas heating savings by utility. The table shows that NJNG jobs had the greatest net savings with an estimated 59 ccf or seven percent of pre-treatment usage. These high savings were achieved despite having lower pre-treatment gas usage than the other gas utilities. The other gas utilities had savings ranging from 50 to 56 ccf and 3.9 percent to 5.4 percent of pre-treatment usage.

Table III-10 Gas Heating Savings Analysis By Gas Utility

		Trea	tment Gr	oup			Compa		Not Covings			
Utility		Usa	age	Savings			Usa	ige	Sa	vings	Net S	avings
	Obs.	Pre	Post	ccf	%	Obs.	Pre	Post	ccf	%	ccf	%
NJNG	525	844	787	57**	6.8%	441	862	864	-2	-0.2%	59**	7.0%
SJG	287	945	874	72**	7.6%	267	838	817	21**	2.5%	51**	5.4%
ETG	428	1,073	991	81**	7.6%	247	1,063	1,037	25**	2.4%	56**	5.2%
PSE&G	1,190	1,267	1,189	78^{**}	6.2%	1,275	1,285	1,257	29**	2.2%	50**	3.9%

**Denotes significance at the 99 percent level. *Denotes significance at the 95 percent level. #Denotes significance at the 90 percent level.

D. Contractor-Level Usage Impacts

This section examines savings by contractor. Table III-11 displays the electric secondary savings by contractor. GES had the highest percentage net savings at 499 kWh or 6.3 percent of pre-treatment usage. HON and NEC had similar savings at 5.9 percent of pre-treatment usage. DES had significantly lower savings at 243 kWh and 3.4 percent of pre-treatment usage, but they only completed 31 electric secondary jobs.

		Trea	atment Gr	oup		Comparison Group					Net Savings	
Contractor		Usa	age	Savi	Savings		Usa	age	Sav	rings	Inet Sa	wings
	Obs.	Pre	Post	kWh	%	Obs.	Pre	Post	kWh	%	kWh	%
GES	365	7,884	7,151	733**	9.3%						499**	6.3%
HON	808	9,118	8,344	774**	8.5%						540**	5.9%
NEC	434	8,626	7,884	743**	8.6%	2 402	9 201	8,156	235**	2.80/	508**	5.9%
СМС	384	8,078	7,448	630**	7.8%	2,402	8,391			2.8%	396**	4.9%
CRCI	445	8,012	7,437	575**	* 7.2%						341**	4.3%
DES	31	7,088	6,610	478#	6.7%						243	3.4%
Total	2,467	8,462	7,761	7 01**	8.3%	2,402	8,391	8,156	235**	2.8%	466**	5.5%

Table III-11Electric Secondary Savings AnalysisBy Contractor

**Denotes significance at the 99 percent level. *Denotes significance at the 95 percent level. *Denotes significance at the 90 percent level.

Table III-12A displays the electric heating savings by contractor.

- GES had the highest net electric heating savings at 991 kWh or 6.4 percent of pretreatment usage.
- NEC, the contractor with the next highest savings, only saved 339 kWh or 3.4 percent of pre-treatment usage.
- HON completed more than half of the electric heating jobs and saved 182 kWh or 1.4 percent of pre-treatment usage.
- CMC had an average increase in usage of 1,306 kWh or 9.4 percent of pre-treatment usage, but they only completed 14 electric heating jobs.

		Tre	atment Gi	roup		Comparison Group					Net Savings	
Contractor		Usa	age	Savi	ngs		Usa	ige	Sav	rings	Inel Sav	ings
	Obs.	Pre	Post	kWh	%	Obs.	Pre	Post	kWh	%	kWh	%
GES	32	15,380	14,209	1,171**	7.6%						991**	6.4%
NEC	21	10,053	9,534	519	5.2%	196					339	3.4%
HON	128	13,292	12,929	362	2.7%		12 762	12 502	180	1 20/	182	1.4%
CRCI	35	13,833	13,656	177	1.3%	180	15,705	15,585	180	1.5%	-3	< 1%
СМС	14	13,931	15,057	-1,126	-8.1%						-1,306**	-9.4%
DES	0	-	-	-	-						-	-
Total	230	13,408	13,037	370*	2.8%	186	13,763	13,583	180	1.3%	190	1.4%

Table III-12A Electric Heating Savings Analysis By Contractor

**Denotes significance at the 99 percent level. *Denotes significance at the 95 percent level. #Denotes significance at the 90 percent level.

Table III-12B displays the electric heating savings by contractor for JCP&L customers. GES had the greatest net electric heating savings at 1,177 kWh or 8.0 percent of pre-treatment usage. However, GES only completed six jobs for JCP&L. All other contractors experienced negative net savings. HON completed 73 percent of the JCP&L jobs included in the analysis and on average had a small increase in usage. CMC had the lowest savings on JCP&L electric heating jobs with an estimated -1,214 kWh in savings or -8.1 percent of pre-treatment usage.

Table III-12B Electric Heating Savings Analysis by Contractor JCP&L Customers

		Tre	atment G	roup			Com	parison (Group		Net Savings	
Contractor		Usa	age	Savings			Us	age	Sa	vings	Inel Sa	vings
	Obs.	Pre	Post	kWh	%	Obs.	Pre	Post	kWh	%	kWh	%
GES	6	14,623	13,368	1,255	8.6%						1,177**	8.0%
HON	99	12,953	12,914	40	0.3%						-38	-0.3%
CRCI	19	13,345	13,657	-312	-2.3%	87	14,351	14,273	78	0.5%	-390	-2.9%
СМС	12	15,072	16,208	-1,137	-7.5%	8/	,				-1,214**	-8.1%
DES	0	-	-	-	-						-	-
Total	136	13,269	13,328	-60	-0.4%	87	14,351	14,273	78	0.5%	-137	-1.0%

**Denotes significance at the 99 percent level. *Denotes significance at the 95 percent level. #Denotes significance at the 90 percent level.

Table III-12C displays the number of major measures installed for the electric heating jobs. The table shows that a quarter of jobs received no major measures while 53 percent received three or more major measures.

Number of Major Measures Installed	Air Sealing, Attic Insul HVAC Replacem Refrigerator Treatme	Insulation, Other ation, ent, Duct Sealing, Replacement nt Group
	Observations	%
None	94	25%
1	54	14%
2	31	8%
3	58	15%
4	97	26%
5	44	12%
Total	378	100%

Table III-12C Number of Major Measures Electric Heating Jobs

Table III-12D displays the number of major measures installed by contractor for the electric heating jobs. The table shows that 69 percent of GES jobs received three or more major measures. In comparison, 66 percent of HON jobs, 53 percent of CMC jobs, 26 percent of CRCI jobs, and none of NEC received three or more major measures.

Table III-12D Number of Major Measures Installed by Contractor Treatment Group Electric Heating Jobs

Number of Major	Air Sealing, Attic Insulation, Other Insulation, HVAC Replacement, Duct Sealing, Refrigerator Replacement Treatment Group												
Measures	G	ES	HO	ON	N	EC	CF	RCI	CN	ЛС			
Installeu	Obs.	%	Obs.	%	Obs.	%	Obs.	%	Obs.	%			
None	6	11%	32	16%	30	77%	17	31%	9	26%			
1	3	6%	27	14%	6	15%	15	27%	3	9%			
2	8	15%	7	4%	3	8%	9	16%	4	12%			
3	19	35%	30	15%	0	0%	6	11%	3	9%			
4	15	28%	68	35%	0	0%	8	15%	6	18%			
5	3	6%	32	16%	0	0%	0	0%	9	26%			
Total	54	100%	196	100%	39	100%	55	100%	34	100%			

Table III-13A displays the gas heating savings by contractor. The table shows that GES and DES had the highest net savings at 6.8 percent of pre-treatment usage and about 65 ccf. NEC had the lowest savings at 41 ccf and 2.9 percent of pre-treatment usage.

	u											
		Trea	atment Gr	oup			Comp	arison Gı	oup		No4 Co	
Contractor		Usa	age	Savi	ings		Usa	age	Sav	vings	net Sa	ivings
	Obs.	Pre	Post	ccf	%	Obs.	Pre	Post	ccf	%	ccf	%
GES	366	948	862	86**	9.1%						65**	6.8%
DES	38	937	852	85**	9.0%						63*	6.8%
СМС	346	1,149	1,064	85**	7.4%	2 220	1 1 2 2	1 102	21**	1.00/	63**	5.5%
CRCI	465	1,082	1,003	79**	7.3%	2,230	1,125	1,102	21	1.9%	58**	5.3%
HON	777	1,008	943	65**	6.4%						43**	4.3%
NEC	438	1,404	1,341	62**	4.5%						41**	2.9%
Total	2,430	1,103	1,030	73**	6.7%	2,230	1,123	1,102	21**	1.9%	52**	4.7%

Table III-13A Gas Heating Savings Analysis By Contractor

**Denotes significance at the 99 percent level. *Denotes significance at the 95 percent level. #Denotes significance at the 90 percent level.

Table III-13B displays the number of major measures installed for the gas heating jobs. The table shows that 40 percent of jobs received no major measures while 20 percent received four or more major measures.

Table III-13BNumber of Major Measures Installed for all
Treatment Group Gas Heating Jobs

Number of Major Measures Installed	Air Sealing, Attic Insulation, Floor Insulation, Wall/Perimeter Insulation, Other Insulation, HVAC Replacement, Duct Sealing	
	Treatment Group	
	Observations	%
None	1,420	40%
1	571	16%
2	330	9%
3	511	14%
4	481	13%
5	215	6%
6-7	39	1%
Total	3,567	100%
Table III-13C displays the number of major measures installed by contractor for the gas heating jobs. The table shows that 31 percent of GES jobs and 37 percent of DES jobs received four or more major measures. In comparison, 25 percent of CMC jobs, 23 percent of HON jobs, 21 percent of CRCI jobs, and seven percent of NEC jobs received four or more major measures.

Table III-13C
Number of Major Measures Installed by Contractor
Treatment Group
Gas Heating Jobs

Number	Air Sealing, Attic Insulation, Floor Insulation, Wall/Perimeter Insulation, Other Insulation, HVAC Replacement, Duct Sealing													
of Major						,	Treatme	nt Group)					
Measures Installed	G	ES	CN	АС	D	ES	CF	RCI	HO	DN	N	EC	NYS	
	Obs.	Obs. % Obs.												%
None	94	20%	131	25%	8	18%	305	45%	570	50%	311	43%	1	100%
1	11	2%	113	22%	5	11%	86	13%	84	7%	272	38%	0	0%
2	45	10%	92	18%	4	9%	49	7%	71	6%	69	10%	0	0%
3	165	36%	59	11%	11	24%	94	14%	164	14%	18	3%	0	0%
4	109	24%	67	13%	10	22%	83	12%	189	17%	23	3%	0	0%
5	33	7%	50	10%	6	13%	47	7%	60	5%	19	3%	0	0%
6-7	2 <.5% 10 2% 1 2% 7 1% 8 1% 0 0%												0%	
Total	459	100%	522	100%	45	100%	675	100%	1,145	100%	720	100%	1	100%

E. Energy Savings by Pre-Treatment Usage

This section analyzes savings by pre-treatment usage. Table III-14 displays the electric secondary savings by pre-treatment usage. The table shows that jobs with higher pre-treatment usage had higher kWh savings, but not higher savings as a percentage of pre-treatment usage. Jobs with pre-treatment usage over 10,000 kWh had mean electric savings of 777 kWh or 5.5 percent of pre-treatment usage. Only 29 percent of the electric secondary jobs were in this group.

Pre-		Treat	ment Gr	oup			Comp		N-4 C-	•		
Treatment		Usa	age	Savi	ngs		Usa	age	Sav	ings	Net Sa	vings
Usage (kWh)	Obs.	Pre	Post	t kWh %		Obs.	Pre	Post	kWh	%	kWh	%
≤6,000	863	4,318	4,110	208**	4.8%	833	4,380	4,478	-98**	-2.2%	306**	7.1%
6,001-10,000	884	7,819	7,344	475**	6.1%	894	7,823	7,699	124**	1.6%	351**	4.5%
>10,000	720	14,219	12,650	1,569**	11.0%	675	14,092	13,300	792**	5.6%	777**	5.5%

Table III-14Electric Secondary Savings AnalysisBy Pre-Treatment Usage

*Denotes significance at the 99 percent level. *Denotes significance at the 95 percent level. #Denotes significance at the 90 percent level.

Table III-15A displays the electric heating savings by pre-treatment usage. The table shows that jobs with higher pre-treatment usage had higher net savings. Jobs with pre-treatment usage of more than 16,000 kWh had mean savings of 303 kWh or 1.6 percent of pre-treatment usage. Only 28 percent of the electric heating jobs were in this group.

Table III-15AElectric Heating Savings AnalysisBy Pre-Treatment Usage

Pre-		Treat	ment Gr	oup			Com	parison G	oarison Group			
Treatment		Usa	age	Savi	ngs		Us	age	Sa	vings	Inet Sa	vings
Usage (kWh)	Obs.	Pre	Pre Post		%	Obs.	Pre	Post	kWh	%	kWh	%
≤10,000	61	8,134	8,134 8,136		-2 0%		8,174	8,128	46	0.6%	-49	-0.6%
10,001-16,000	104	13,084	12,874	210	210 1.6%		12,977	13,026	-49	-0.4%	259	2.0%
>16,000	65	18,876	17,899	,899 977* 5.2%		54	19,066	18,392	673*	3.5%	303	1.6%

**Denotes significance at the 99 percent level. *Denotes significance at the 95 percent level. #Denotes significance at the 90 percent level.

Table III-15B displays the electric heating savings by pre-treatment usage for JCP&L jobs. The table shows that jobs with pre-treatment energy usage between 10,000 and 16,000 kWh have an increase in usage averaging 511 kWh and four percent of pre-treatment usage.

Table III-15B
Electric Heating Savings Analysis by Pre-Treatment Usage
JCP&L Customers

		Trea	tment Gr	oup			Com		Net Savings			
Pre-Treatment Usage (kWh)		Usa	age	Savi	ings		Usa	age	Sa	vings	Thet Savings	
Couge (KVII)	Obs.	Pre	Post	Post kWh %		Obs.	Pre	Post	kWh	%	kWh	%
≤10,000	31	8,358	8,350	8	0.1%	13	8,563	8,573	-10	-0.1%	18	0.2%
10,001-16,000	70	12,848	13,232	-384	-3.0%	47	13,296	13,168	127	1.0%	-511	-4.0%
>16,000	35	18,459	17,930	528	2.9%	27	18,973	18,940	34	0.2%	495	2.7%
Total	136	13,269	13,328	-60	-0.4%	87	14,351	14,273	78	0.5%	-137	-1.0%

**Denotes significance at the 99 percent level. *Denotes significance at the 95 percent level. #Denotes significance at the 90 percent level.

Table III-16 displays the gas heating savings by pre-treatment usage. Jobs with higher pretreatment gas usage had higher savings. Those with pre-treatment usage over 1,200 ccf had mean savings of 78 ccf or 4.7 percent of pre-treatment usage. Thirty-four percent of gas heating jobs had pre-treatment usage over 1,200 ccf.

Table III-16 Gas Heating Savings Analysis By Pre-Treatment Usage

Pre-		Trea	tment G	roup			Comj	parison G	roup		Net Savings		
Treatment		Us	age	Sav	vings		Us	sage	Sa	vings	Inet 5a	vings	
Usage (ccf)	Obs.	Pre	Post	ccf	%	Obs.	Pre	Post	ccf	%	ccf	%	
≤800	746	624	611	13**	2.0%	625	609	623	-14**	-2.3%	27**	4.3%	
801-1,200	865	982	920	62**	6.3%	805	990	983	7	0.7%	54**	5.5%	
>1,200	819	1,669	1,527	141**	8.5%	800	1,659	1,596	63**	3.8%	78**	4.7%	

**Denotes significance at the 99 percent level. *Denotes significance at the 95 percent level. #Denotes significance at the 90 percent level.

F. Measures Installed

This section examines savings by the measures that were installed. Table III-17 shows that 35 percent of electric secondary jobs had refrigerators installed, lower than the 43 percent in 2017 and 2013. Savings for electric secondary jobs with refrigerators replaced averaged 741 kWh or 8.7 percent of pre-treatment usage. This compares to savings of 318 kWh or 3.8 percent for jobs without a refrigerator replaced. While savings for electric secondary jobs with refrigerators replaced was about the same or somewhat higher than in the 2013 and 2017 evaluations, savings for jobs without refrigerators replaced was lower than in the 2017 evaluation and higher than in the 2013 evaluation.

			Treatm	ent Gro	սթ			Com		Not So	···inca		
Refrigerator Installed		0/	Us	age	Sav	ings		Us	age	Sav	vings	The bavings	
- mstanica	Obs.	%0	Pre	Post	kWh	%	Obs.	Pre	Post	kWh	%	kWh	%
2020													
Refrigerator	858	35%	8,475	7,482	993**	11.7%	741	8,346	8,094	252**	3.0%	741**	8.7%
No Refrigerator	1,609	65%	8,456	7,911	545**	6.4%	1,661	8,411	8,184	227**	2.7%	318**	3.8%
2017													
Refrigerator	1,380	43%	7,812	6,977	835**	10.7%	1 505	7 1 10	7 217	120**	1 70/	705**	9.0%
No Refrigerator	1,804	57%	7,847	7,300	547**	7.0%	1,303	7,448	7,517	150	1.7%	417**	5.3%
2013													
Refrigerator	1,455	44%	7,367	6,649	718**	9.7%	1,773	7,834	7,806	28	0.4%	690**	9.4%
No Refrigerator	1,821	56%	7,317	7,152	165**	2.3%	2,733	7,515	7,529	-14	-0.2%	180**	2.5%

Table III-17Electric Secondary Savings AnalysisBy Refrigerator Installation

**Denotes significance at the 99 percent level. *Denotes significance at the 95 percent level. #Denotes significance at the 90 percent level.

Table III-18 shows that the refrigerator metering rate was high, averaging 89 percent overall and ranging from 84 percent for DES to 96 percent for CMC. Most jobs with refrigerators replaced had metered refrigerator usage over 1,000 kWh.

Table III-18 Refrigerator Metering, Usage, and Net Savings Treatment Group Electric Secondary Jobs

Contractor						Refrigerat	or Replac	ed	
Contractor	Obs.	% Metered	% Replaced	Yes	No	Yes	No	Yes	No
				% U >1,00	Jsage 0 kWh	Meteree (kV	d Usage Vh)	Net S (kV	avings Vh)
NEC	434	93%	49%	86%	7%	1,274	578	813	430
CMC	384	96%	45%	96%	8%	1,675	685	712	210
CRCI	445	88%	33%	92%	7%	1,236	579	561	398
HON	808	85%	30%	87%	9%	1,326	596	789	339
GES	365	91%	21%	91%	2%	1,400	546	678	300
DES	31	84%	23%	57%	0%	1,238	635	82	2
Total	2,467	89%	35%	90%	6%	1,369	593	741	318

Table III-19 provides more detail on the metered usage of refrigerators that were replaced. The table shows that half of the replaced refrigerators had metered usage that was more than 1,261 kWh and only five percent had usage below 876 kWh.

Table III-19 Refrigerator Metered Usage Treatment Group Electric Secondary Jobs

					Meteree	d Usage v	where Re	frigerator	was Rej	placed	
Contractor	Oha	#	# Metered				P	ercentile			
Contractor	Obs.	Metered	& Replaced	Mean	5	10	25	50	75	90	95
NEC	434	404	212	1,274	915	955	1,082	1,244	1,415	1,612	1,831
CMC	384	368	170	1,675	946	1,077	1,218	1,498	2,172	2,575	2,638
CRCI	445	391	143	1,236	964	964	1,051	1,139	1,489	1,664	1,664
HON	808	686	242	1,326	832	964	1,139	1,314	1,489	1,664	1,840
GES	365	331	75	1,400	613	964	1,126	1,314	1,664	2,102	2,453
DES	31	26	7	1,238	526	613	964	1,226	1,577	1,752	1,752
Total	2,467	2,206	849	1,369	876	964	1,082	1,261	1,577	1,927	2,339

Table III-20 displays the percent of electric heating jobs that received major measures. We defined electric and gas heating jobs as having a major measure if at least \$1,000 was spent on air sealing, insulation, duct sealing, and HVAC combined. Table III-20 shows that 57 percent of electric heating jobs had a major measure installed, compared to 54 percent in the 2017 evaluation and 39 percent in the 2013 evaluation. Savings for electric heating jobs with major measures averaged 472 kWh compared to a 209 kWh increase in usage for jobs without a major measure installed. However, savings for jobs with major measures was much lower than the 1,760 kWh in the 2017 evaluation and the 1,561 kWh savings in the 2013 evaluation.

Table III-20Electric Heating Savings AnalysisBy Major Measure Installation

			Treatn	nent Grou	ıp			Com	parison G	Froup		Not Sovings	
Major Measure Installed	Obs. % Usage		age	e Savin			Usa	age	Sav	vings	Inel Sa	ivings	
msuneu	Obs.	%0	Pre	Post kWh %		%	Obs.	Pre	Post	kWh	%	kWh	%
2020													
Major Measure	130	57%	14,029	13,423	606**	4.3%	124	14,105	13,971	134	0.9%	472#	3.4%
No Major Measure	100	43%	12,600	12,536	64	0.5%	62	13,080	12,807	273	2.1%	-209	-1.7%

	ê 📃		Treatm	nent Grou	ър			Com	parison (Froup		Net Savings	
Major Measure Installed	Oha	0/	Usa	age	Savi	ings	Oha	Us	age	Sav	vings	Thet Savings	
mstuneu	Obs.	%	Pre	Post	kWh	%	Obs.	Pre	Post	kWh	%	kWh	%
2017													
Major Measure	166	54%	14,646	12,570	2,076**	14.2%	46	12,948	12,632	316	2.4%	1,760**	12.0%
No Major Measure	143	46%	12,351	11,717	634**	5.1%	77	11,698	11,393	305*	2.6%	329	2.7%
2013													
Major Measure	129	39%	15,416	13,855	1,561**	10.1%	89	14,913	14,913	<1	<0.1%	1,561**	10.1%
No Major Measure	205	61%	12,278	11,773	505**	4.1%	169	13,419	13,284	136	1.0%	370#	3.0%

**Denotes significance at the 99 percent level. *Denotes significance at the 95 percent level. #Denotes significance at the 90 percent level.

Table III-21 displays the number of major measures installed in electric heating jobs. We define major measures in two different ways.

- The first definition considers air sealing, insulation, duct sealing, and refrigerator replacement as major measures.
- The second definition considers air sealing, attic insulation, other insulation, HVAC replacement, duct sealing, and refrigerator replacement as major measures.

The table shows that regardless of the definition used, the savings from the jobs increased as the number of major measures increased. This trend is consistent with the previous two evaluations. Under the first definition of major measures, jobs with four or five major measures achieved net savings of 842 kWh or 5.9 percent of pre-treatment usage. However, this compares to savings of 1,983 kWh or 13.5 percent of pre-treatment usage in 2017 and 2,139 kWh or 13.4 percent of pre-treatment usage in 2013.

Table III-21Electric Heating Savings AnalysisBy Number of Major Measures Installed

			A	Air Sealing	, Insulatio	n, Duct Se	aling, Refr	igerator R	eplacemer	nt			
Number		20	20			2017				2013			
Measures	Observations		Net Savings		Observations		Net Savings		Observations		Net Savings		
	#	%	kWh	%	#	%	kWh	%	#	%	kWh	%	
None	95	23%	-202	-1.7%	73	24%	163	1.3%	73	22%	69	0.6%	
1	55	13%	-121	-0.9%	48	16%	529*	4.3%	89	27%	376	2.9%	
2	73	18%	132	0.9%	55	18%	1,130**	8.4%	96	29%	1,232**	9.0%	
3	139	33%	401	3.0%	97	31%	1,743**	11.9%	61	18%	1,542**	10.3%	
4-5	54	13%	842	5.9%	36	12%	1,983**	13.5%	15	4%	2,139**	13.4%	
Total	416	100%	190	1.4%	309	100%	1,100**	8.1%	334	100%	824**	6.1%	

	Air	Air Sealing, Attic Insulation, Other Insulation, HVAC Replacement, Duct Sealing, Refrigerator Replacement												
Number of Major		20	20			2017				2013				
Measures	asures Observations Net Savings		avings	Obser	Observations Net Savings		Observations		Net Savings					
	#	%	kWh	%	#	%	kWh	%	#	%	kWh	%		
None	92	22%	-175	-1.5%	69	22%	210	1.6%	72	22%	3	<0.1%		
1	57	14%	-234	-1.7%	50	16%	453#	3.9%	90	27%	427	3.3%		
2	32	8%	256	2.2%	25	8%	430	3.3%	87	26%	1,172**	8.8%		
3	80	19%	58	0.4%	45	15%	1,228**	9.4%	63	19%	1,429**	9.4%		
4-6	155	37%	623	4.4%	120	39%	1,973**	13.1%	22	7%	2,293**	14.1%		
Total	416	100%	190	1.4%	309	100%	1,100**	8.1%	334	100%	824**	6.1%		

**Denotes significance at the 99 percent level. *Denotes significance at the 95 percent level. #Denotes significance at the 90 percent level.

Table III-22 displays the percent of gas heating jobs that received major measures. This table shows that 42 percent of gas heating jobs had a major measure installed, compared to 50 percent in the 2017 evaluation and 46 percent in the 2013 evaluation. Net savings for gas heating jobs with major measures averaged 109 ccf or 10.3 percent of pre-treatment usage, lower than the 139 ccf achieved for gas heating jobs with major measures in 2017.

			Treatm	ent Gro	up			Comp	arison G	froup		Not Sovings	
Major Measure Installed				Usage		Savings		Usa	age	Sav	ings	Net S	avings
Instance	Obs.	%	Pre	Post	ccf	%	Obs.	Pre	Post	ccf	%	ccf	%
2020													
Major Measure	1,015	42%	1,057	932	125**	11.8%	1,107	1,059	1,043	16**	1.5%	109**	10.3%
No Major Measure	1,415	58%	1,137	1,101	36**	3.2%	1,123	1,187	1,161	27**	2.2%	10	0.9%
2017													
Major Measure	1,483	50%	1,073	925	147**	13.7%	656	1,096	1,087	9#	0.8%	139**	12.9%
No Major Measure	1,497	50%	1,098	1,065	33**	3.0%	840	1,083	1,069	14**	1.3%	19 [*]	1.7%
2013													
Major Measure	1,438	46%	1,114	1,005	109**	9.8%	1,894	1,100	1,076	24**	2.2%	85**	7.6%
No Major Measure	1,722	54%	976	959	17**	1.7%	3,063	1,005	994	11^{**}	1.1%	6	0.6%

Table III-22Gas Heating Savings AnalysisBy Major Measure Installation

**Denotes significance at the 99 percent level. *Denotes significance at the 95 percent level. #Denotes significance at the 90 percent level.

Table III-23 displays the number of major measures installed in gas heating jobs. We define major measures in two different ways.

• The first definition considers air sealing, insulation, HVAC, duct sealing, and water heater replacements as major measures.

• The second definition considers air sealing, attic insulation, floor insulation, wall/perimeter insulation, other insulation, HVAC replacement, and duct sealing as major measures.

Under the first definition of major measures, 31 percent of gas heating jobs had three or more major measures installed, compared to 35 percent in the 2017 evaluation and 22 percent in the 2013 evaluation. Gas heating jobs with five to six major measures had mean savings of 294 ccf or 24.9 percent of pre-treatment usage.

					T	·	C D	C 19	TT - 4 TT/- 4			
			A	ir Sealing	g, Insulat	10n, HV A	AC, Duct	Sealing,	Hot wat	er		
Number of	r of 2020				2017				2013			
Major Measures	Observations Net Sa		avings	ngs Observations		Net Savings		Observations		Net Savings		
	#	%	ccf	%	#	%	ccf	%	#	%	ccf	%
None	1,487	32%	14	1.2%	880	30%	26^{*}	2.4%	938	30%	8	0.8%
1	830	18%	19	1.6%	329	11%	15	1.3%	678	21%	15	1.6%
2	931	20%	77**	6.7%	722	24%	106**	9.1%	838	27%	25**	2.5%
3	1,212	26%	92**	9.5%	841	28%	103**	10.4%	506	16%	111**	9.9%
4	173	4%	186**	18.6%	161	5%	183**	17.7%	168	5%	170**	13.5%
5-6	27	1%	294**	24.9%	47	2%	240**	22.3%	32	1%	237**	17.3%
Total	4,660	100%	52**	4.7%	2,980	100%	78 **	7.2%	3,161	100%	43**	4.1%

Table III-23Gas Heating Savings AnalysisBy Number of Major Measures Installed

NT 1	Air Se	Air Sealing, Attic Insulation, Floor Insulation, Wall/Perimeter Insulation, Other Insulation, HVAC Replacement, Duct Sealing												
Number of Maior		20	20		2017				2013					
Measures	Observations Net S		Net Sa	avings	ings Observations		Net Savings		Observations		Net Savings			
	#	%	ccf	%	#	%	ccf	%	#	%	ccf	%		
None	1,558	33%	12	1.0%	83	3%	23*	2.1%	346	11%	3	0.3%		
1	817	18%	24	1.9%	864	29%	32#	2.7%	509	16%	3	0.3%		
2	457	10%	56**	5.1%	323	11%	55**	5.0%	705	22%	24**	2.3%		
3	776	17%	56**	5.9%	378	13%	76**	7.4%	803	25%	53**	5.3%		
4	699	15%	120**	11.5%	620	21%	131**	12.7%	607	19%	69**	6.3%		
5-7	353	8%	182**	16.2%	712	23%	157**	14.2%	190	6%	149**	12.0%		
Total	4,660	100%	52**	4.7%	2,980	100%	78**	7.2%	3,161	100%	43**	4.1%		

**Denotes significance at the 99 percent level. *Denotes significance at the 95 percent level. #Denotes significance at the 90 percent level.

G. Summary

The 2020 evaluation analyzed the impact of the NJCP Program on electric and gas consumption for customers who were treated in 2018. This section provides a summary of the findings from that analysis.

• Electric Secondary Savings: Net savings were 466 kWh or 5.5 percent of pre-treatment usage, lower than the 542 kWh and 6.9 percent of pre-treatment usage in 2017, but similar to the 408 kWh and 5.6 percent in 2013.

Electric secondary pre-treatment usage was considerably higher than in the previous evaluation for both jobs in the treatment group and those in the comparison group.

PSE&G customers had the greatest electric secondary savings with an estimated savings of 515 kWh or 6.2 percent of pre-treatment usage.

• Electric Heating Savings: Net savings were 190 kWh or 1.4 percent of pre-treatment usage, significantly lower than the 1,100 kWh or 8.1 percent savings in 2017. This decline was largely due to an average increase in usage of 137 kWh for JCP&L jobs.

ACE jobs had the greatest electric heating savings, averaging 1,019 kWh or 6.3 percent of pre-treatment usage.

• Gas Heating Savings: Net savings were 52 ccf or 4.7 percent of pre-treatment usage, lower than the 78 ccf and 7.2 percent in 2017, but similar to the 43 ccf and 4.1 percent in 2013.

NJNG jobs had the greatest net savings with an estimated 59 ccf or seven percent of pretreatment usage. These high savings were achieved despite having lower pre-treatment gas usage than the other gas utilities. The other gas utilities had savings ranging from 50 to 56 ccf and 3.9 percent to 5.4 percent of pre-treatment usage.

- Contractor Impacts: Savings varied significantly by contractor.
 - Electric Secondary: GES had the highest percentage net savings at 499 kWh or 6.3 percent of pre-treatment usage. HON and NEC had similar savings at 5.9 percent of pre-treatment usage. DES had significantly lower savings at 243 kWh and 3.4 percent of pre-treatment usage, but they only completed 31 electric secondary jobs.
 - Electric Heating: GES had the highest net electric heating savings at 991 kWh or 6.4 percent of pre-treatment usage. NEC, the contractor with the next highest savings, only saved 339 kWh or 3.4 percent of pre-treatment usage. HON completed more than half of the electric heating jobs and saved 182 kWh or 1.4 percent of pre-treatment usage. CMC had an average increase in usage of 1,306 kWh or 9.4 percent of pre-treatment usage.
 - Gas Heating: GES and DES had the highest net savings at 6.8 percent of pre-treatment usage and about 65 ccf. NEC had the lowest savings at 41 ccf and 2.9 percent of pre-treatment usage.

- Pre-Treatment Usage
 - Electric Secondary: Jobs with higher pre-treatment usage had higher kWh savings, but not higher savings as a percentage of pre-treatment usage. Jobs with pre-treatment usage over 10,000 kWh had mean electric savings of 777 kWh or 5.5 percent of pretreatment usage.
 - Electric Heating: Jobs with higher pre-treatment usage had higher net savings. Jobs with pre-treatment usage of more than 16,000 kWh had mean savings of 303 kWh or 1.6 percent of pre-treatment usage.
 - Gas Heating: Jobs with higher pre-treatment gas usage had higher savings. Those with pre-treatment usage over 1,200 ccf had mean savings of 78 ccf or 4.7 percent of pre-treatment usage.
- Measure Impacts
 - Electric Secondary: 35 percent had refrigerators installed, lower than the 43 percent in 2017 and 2013. Savings for electric secondary jobs with refrigerators replaced averaged 741 kWh or 8.7 percent of pre-treatment usage. This compares to savings of 318 kWh or 3.8 percent for jobs without a refrigerator replaced. While savings for electric secondary jobs with refrigerators replaced was about the same or somewhat higher than in the 2013 and 2017 evaluations, savings for jobs without refrigerators replaced was lower than in the 2017 evaluation and higher than in the 2013 evaluation.
 - Electric Heating: 57 percent of electric heating jobs had a major measure installed (at least \$1,000 was spent on air sealing, insulation, duct sealing, and HVAC combined), compared to 54 percent in the 2017 evaluation and 39 percent in the 2013 evaluation. Savings for electric heating jobs with major measures averaged 472 kWh compared to a 209 kWh increase in usage for jobs without a major measure installed. However, savings for jobs with major measures was much lower than the 1,760 kWh in 2017 and 1,561 kWh in the 2013 evaluation.
 - Gas Heating: 42 percent of gas heating jobs had a major measure installed, compared to 50 percent in the 2017 evaluation and 46 percent in the 2013 evaluation. Net savings for gas heating jobs with major measures averaged 109 ccf or 10.3 percent of pre-treatment usage, lower than the 139 ccf achieved for gas heating jobs with major measures in 2017.

IV. Cost-Effectiveness

This section provides an analysis of the cost per unit of energy saved to allow for a comparison of cost-effectiveness by contractor. The previous section showed that there was great variation in savings and in measure costs by contractor.

Table IV-1 examines electric secondary savings and cost-effectiveness by contractor. NEC provided the most cost-effective work. They had the second highest savings and the third lowest costs. NEC's work cost \$0.10 per kWh saved given a 25-year measure life, and the next closest contractors' costs per kWh saved were CRCI and DES with a cost of \$0.13 per kWh saved. While HON had the highest kWh savings, their measure costs were among the highest, and they had lower cost-effectiveness than three of the other contractors. GES had the highest savings as a percentage of pre-treatment usage, but they had the highest costs and the highest cost per kWh saved.

		Average	Savings		Cost Per kWh Saved			Contractor Ranking			
Contractor	Obs.	Electric Measure Cost			Measure Life			Lowest	Highest	Lowest Cost	
			kWh	%	15	20	25	Cost	Savings	Per kWh Saved	
NEC	434	\$1,045	743	8.6%	\$0.14	\$0.11	\$0.10	3	2	1	
CRCI	445	\$1,024	575	7.2%	\$0.17	\$0.14	\$0.13	2	5	2	
DES	31	\$887	478	6.7%	\$0.18	\$0.15	\$0.13	1	6	3	
HON	808	\$1,534	774	8.5%	\$0.19	\$0.16	\$0.14	5	1	4	
СМС	384	\$1,442	630	7.8%	\$0.22	\$0.18	\$0.16	4	4	5	
GES	365	\$1,748	733	9.3%	\$0.23	\$0.19	\$0.17	6	3	6	
Total	2,467	\$1,365	701	8.3%	\$0.19	\$0.16	\$0.14	-	-	-	

Table IV-1Electric Secondary Savings and Cost-EffectivenessBy Contractor

Table IV-2 examines electric heating savings and cost-effectiveness by contractor. NEC provided the most cost-effective services, with a cost of \$0.04 per kWh saved. This was largely due to their low costs, as their savings averaged only 519 kWh. While GES had the highest savings at 1,171 kWh, their measure costs were the highest among the contractors, and they were ranked second in cost-effectiveness with a cost of \$0.37 per kWh saved. HON and CMC had much higher costs per kWh saved, and CMC had significantly negative savings.

		Average	Savings		Cost Per kWh Saved			Contractor Ranking			
Contractor	Obs.	Electric Measure Cost			Measure Life			Lowest	Highest	Lowest Cost	
			kWh	%	15	20	25	Cost	Savings	Per kWh Saved	
NEC	21	\$308	519	5.2%	\$0.06	\$0.05	\$0.04	1	2	1	
GES	32	\$6,120	1,171	7.6%	\$0.50	\$0.42	\$0.37	5	1	2	
CRCI	35	\$2,416	177	1.3%	\$1.32	\$1.10	\$0.97	2	4	3	
HON	128	\$5,984	362	2.7%	\$1.59	\$1.33	\$1.17	4	3	4	
CMC	14	\$5,460	-1,126	-8.1%	-	-	-	3	5	5	
Total	230	\$4,910	370	2.8%	\$1.28	\$1.06	\$0.94	-	-	-	

Table IV-2Electric Heating Savings and Cost-EffectivenessBy Contractor

Table IV-3 examines gas heating savings and cost-effectiveness by contractor. DES and CRCI were the most cost-effective, with costs of \$2.67 and \$2.69 per ccf saved, respectively. While GES had the highest savings, their measure costs were significantly higher than the other contractors, and they were ranked last in cost-effectiveness with a cost of \$5.08 per ccf saved. The other contractors had costs of over \$3.00 per ccf saved.

Table IV-3Gas Heating Savings and Cost-EffectivenessBy Contractor

		Average Cas	Savings		Cost	Per ccf S	Saved	Contractor Ranking			
Contractor	Obs.	Measure			Measure Life			Lowest	Highest	Lowest Cost	
		Cost	ccf	%	15	20	25	Cost	Savings	Per ccf Saved	
DES	38	\$3,199	85	9.0%	\$3.63	\$3.02	\$2.67	2	2	1	
CRCI	465	\$2,997	79	7.3%	\$3.65	\$3.04	\$2.69	1	3	2	
СМС	346	\$3,683	85	7.4%	\$4.17	\$3.48	\$3.07	4	2	3	
HON	777	\$3,579	65	6.4%	\$5.30	\$4.42	\$3.91	3	4	4	
NEC	438	\$3,851	62	4.5%	\$5.98	\$4.98	\$4.41	5	5	5	
GES	366	\$6,163	86	9.1%	\$6.90	\$5.75	\$5.08	6	1	6	
Total	2,430	\$3,915	73	6.7%	\$5.17	\$4.30	\$3.81	-	-	-	

V. Customer Interviews

This section provides a summary of the findings from in-depth interviews conducted with program participants.

A. Introduction and Methodology

APPRISE conducted in-depth telephone interviews with 42 customers who received services from the New Jersey Comfort Partners program in 2018. Interviews investigated reasons for higher and lower than expected energy savings and assessed satisfaction with the program. Interviews were conducted between August 3, 2020 and August 14, 2020. Advance letters were mailed to all potential respondents and a toll-free number was provided for respondents to call in to complete the interview. However, most interviews were completed through outbound calling.

A sample of 110 customers was selected for the survey. The sample was restricted to gas and electric heating customers with installations completed in 2018 who were classified as higher and lower than expected savers as follows.

- High energy savings.
 - Electric heating customers with savings between 2,000 and 5,000 kWh and savings of at least 20 percent of pre-treatment usage.
 - Gas heating customers with savings between 250 and 400 ccf and at least 20 percent of pre-treatment usage.
 - Between one and four major measures installed.
- Low energy savings.
 - Electric heating customers with savings between -2,500 and 150 kWh.
 - Gas heating customers with savings between -100 and 25 ccf, and no more than three percent of pre-treatment usage.
 - At least three major measures installed.

Customers were selected within the high- and low-saving groups to represent all of the utilities. Utility representation for the selected sample is shown by Table V-1.

Table V-1
Number of Customers from Each Utility Included in Sample

Electri	c Heating Custo	omers	Ga	s Heating Custor	ners
Electric Utility	High Savers	Low Savers	Gas Utility	High Savers	Low Savers
ACE	4	5	ETG	10	10
PSE&G	3	1	NJNG	10	10
JCP&L	8	9	PSE&G	10	10
			SJG	10	10
Total	15	15	Total	40	40

The sample consisted of 55 customers with higher-than-expected savings and 55 customers with lower-than-expected savings. While 22 of the interviewed customers were high savers, 20 were low savers.

Completed Interviews									
Heating Type High Savers Low Savers									
Electric Heating	5	3							
Gas Heating	17	17							
Total	22	20							

Table V-2Number of Completed Interviews by Group

B. Findings

This section provides a summary of findings within the following areas.

- Perceived Change in Energy Usage
- Energy Usage Behavior Changes
- Space Heater Usage
- Other Household Changes
- Home Comfort Impacts
- Program Satisfaction
- Additional Comments

Perceived Change in Energy Usage

Customers were asked how the NJ Comfort Partners Program impacted their energy usage. Table V-3 shows that there was not a large difference between the perceptions of the customers with high and low savings.

- 16 of the 22 high savers reported that their usage declined.
- 12 of the 20 low savers reported that their usage declined.

How has the NJ Comfort Partners Program impacted your energy usage?									
	High Savers	Low Savers							
Small Decrease in Usage	8	8							
Large Decrease in Usage	8	4							
No Effect on Usage	4	5							
Don't Know	2	3							
Total	22	20							

Table V-3Perceived Impact of NJCP Program on Usage

The four low savers who said they had a large reduction in usage offered the following comments.

- It did help us a lot, especially with the gas. We are using much less in the winter months than we used to.
- My gas bill has certainly improved and it's much more comfortable in the house. I think my usage has decreased a lot.
- The program cut it [usage] down dramatically. [How can you tell?] By looking at the bills, both gas and electric.
- My usage has gone down a lot. If I look at the bill, the graphic shows me and I can tell right away. I was on a budget plan and now I'm in the positive [i.e., does not owe money].

Participants who said the program had no effect on their usage offered the following comments.

- The usage didn't change at all. I thought they were going to insulate the room I wanted done the living room but they didn't. If they had, the usage would have improved.
- Not much change. I have been checking my bill and it seems about the same. The place where I'm living is public housing and [the CP program] really didn't have much to work with.
- I don't see how it affected me too much. I don't see it on my bill. May have changed by a couple dollars.

Participants who were unsure whether their usage changed as a result of the program offered the following comments.

- I feel like the usage has gone down but I do not check the bill.
- I'm on a budget program with [my utility]. I pay the same amount every month. I have no idea if the usage changed.
- They keep raising the price. My energy bill is ridiculous. [The program] may have helped. I don't keep track of it. If anything, it went down.

Energy Usage Behavior Changes

Customers were asked if they changed the way they use energy based on the information provided by the program. Table V-4 shows that while 10 of the 22 high savers said that they changed their energy usage behavior, 12 of the 20 low savers said that they changed their behavior.

The high savers who reported that they changed their usage behavior reported the following changes.

- Three said they buy energy-efficient LED lightbulbs because of the program.
- Three said they now avoid behaviors that are not energy efficient.
- Two said they make use of their programmable thermostat.
- Two said they have reduced their heating usage.
- Two said they have reduced their use of an air conditioner.

The low savers who reported that they changed their usage behavior reported the following changes.

- Six said they buy energy-efficient LED lightbulbs because of the program.
- Six said they now make use of their programmable thermostat.
- Three said they avoid behaviors that are not energy efficient.
- Three said they have reduced their heating usage.
- Three said they have reduced their A/C use.
- One said he read their energy bill more carefully because of the program.

Table V-4Changes in Energy Usage Habits

Have you changed the way you use energy based on the information or education provided by the program? If yes, please describe how you have changed your usag								
	Low Savers							
Buy LED Lightbulbs	3	6						
Made Use of Programmable Thermostat	2	6						
Avoid Inefficient Behaviors	3	3						
Reduce Heating Usage	2	3						
Reduce A/C Usage	2	3						
Reading Energy Bill More Carefully	0	1						
Other	1	2						
No Change	12	8						

Participants who indicated that they changed the way they use energy offered the following comments regarding the changes.

- We shut the lights off when we leave the room.
- We put the AC and heat on lower settings.
- I've changed the lightbulbs I buy because of the program.
- The contractors actually taught me how to really work with the thermostat. I never knew that if you did this or that, it keeps you warm. I just changed it as I feel without knowing about the programming part.
- I put LED bulbs in the rest of the house.
- Programming the thermostat is so simple. I already had one, but I use the programming more.
- Every time we leave the house, we set the temperature to minimum. And we time the temperature to be good when we come home.
- We change the air filters regularly now.

Some participants reported that they did not receive energy education from the program.

• I don't have any memory of energy education.

- They didn't really give me any education. They just did the work and left.
- They didn't give me any kind of brochure or any kind of pamphlet. They didn't seem to give any instruction. No knowledge was obtained.

Other responses were as follows.

- The guy who came to my home mentioned something about not having a second refrigerator that's empty. He said I should fill it up [so as not to waste energy].
- I used to turn off the lights all the time. But LED bulbs last longer if you leave them on sometimes. Now when I leave a room, I don't always turn off the bulb if I know I'll be back soon.
- They told us when it was really bright, pull the shades down [to keep the house cool].

Space Heater Usage

Customers were asked if their use of a space heater had changed since they received Comfort Partners services. Table V-5 shows that while six of the 22 high savers said they reduced their use of a space heater, three of the 20 low savers said they reduced their use of a space heater.

- Six high savers reported that they reduced their use of a space heater. However, five of these six were gas heating customers.
- Three low savers reported that they reduced their use of a space heater. All three of these customers were gas heating customers.
- One low saver reported that he increased the use of a space heater. This respondent was an electric heating customer.

Have you changed your use of a space heater that is not your main source of heat since you received Comfort Partners service?							
High Savers Low Savers							
Reduced Use of Space Heater	6	3					
Increased Use of Space Heater	0	1					
No Change / Never Used	16	16					
Total	22	20					

Table V-5Change in Use of Space Heater

The customers who reduced their use of a space heater after the services offered the following comments.

- I used the space heater less after the Comfort Partners services. I had it in the living room. I got rid of it altogether shortly after the CP service.
- The only one I had was in the bathroom upstairs. It was an oil-filled radiator that was electric. I haven't had to use that since they put in the new furnace and the insulation. I immediately stopped using it.

- I had at least two space heaters prior to the services. I stopped using them after Comfort Partners came.
- Last winter, I only used one space heater but before I would use two. It wasn't necessarily due to the program. It was just related to the weather this past winter.

The one low saver who reported that he increased the use of a space heater offered the following comment.

• I didn't have a space heater before the service. I purchased one — within a year of the service — and I use it every once in a while.

Other Household Changes

Customers were asked questions about household changes that may have impacted their usage following the program services. First, customers were asked if the number of people in their home had changed since receiving Comfort Partners service. Table V-6 shows that, in both groups, most respondents had no change in the number of people living in the home.

Have you had any changes in the number of people living in your home since you received Comfort Partners service?								
	High Savers Low Savers							
Overall Increase	3	2						
No Change	18	18						
Overall Decrease	1	0						
Total	22	20						

Table V-6Changes in Number of Household Occupants

Customers were asked whether they experienced any changes in the use of medical equipment, appliances, or other devices in their home since receiving Comfort Partners services. Table V-7 shows that while one of the 22 high savers reported a change, four of the 20 low savers reported changes.

- One high saver began using a medical device that increased their usage.
- Two low savers began using a medical device that increased their usage.
- Two low savers began using an appliance that increased their usage.

Have you had any changes in the use of medical or other equipment or devices in your home since the Comfort Partners service that may have impacted your energy usage?								
High Savers Low Savers								
Medical Device Increased Usage	1	2						
Other Appliances Increased Usage	0	2						
No Changes	21	16						
Total	22	20						

 Table V-7

 Changes in Use of Devices or Equipment in the Home

Participants who indicated that a change did occur offered the following comments.

- I use a CPAP machine for sleep apnea. I started using it around the same time as the CP service. It uses electricity, but only slightly adds to my usage.
- My husband is on daily breathing a liquid nebulizer twice a day. He started using it shortly after the Comfort Partners did the insulation.
- I put another air conditioner in. It's a 5,000 BTU wall AC. I think that uses more energy.

Customers were asked if they had any other changes in their home that could impact their energy usage. Two customers said they had changes that reduced their energy usage within a year of the CP services. The first customer, a high saver, offered the following comments regarding the change.

• Because we did not have a good, warm house, my daughter had a machine for her asthma. That used energy. But after the services, her asthma got better so we used it less.

The other customer, a low saver, offered the following comments about the changes in usage in their home.

• As far as gas is concerned [customer uses gas heating], I have not had any new devices. Some devices would cause a minor increase in [electric] usage due to the new baby... I bought smart LED bulbs for my flood lights outside. They have a timer on them and you can control them from your phone. That probably decreased my electric usage.

Home Comfort Impacts

Customers were asked how the Comfort Partners program impacted the comfort of their home. Table V-8 shows a mostly positive impact for both groups. Seventeen of the 22 high savers and 12 of the 20 low savers reported that their comfort improved following Comfort Partners services. Two of the 20 low savers reported that their level of comfort worsened.

How have the program services impacted the comfort of your home?								
	High Savers	Low Savers						
Increased Level of Comfort	17	12						
No Change	5	6						
Decreased Level of Comfort	0	2						
Total	22	20						

Table V-8Changes in Home Comfort

Participants who said they experienced an improvement in their comfort level offered the following comments.

- Once they did all the insulation throughout the house, it's amazing that it could be 90 degrees outside and I don't even know what temperature it is. I don't feel the heat at all in the house.
- With the insulation, the house holds heat now in the winter.
- The temperature is much more consistent now. In the winter and in the summer. The house is more comfortable because of that.
- The insulation made a big difference. The comfort is a tremendous amount better in the wintertime. On a scale of 1-10, before it was probably a four; now it is around a seven or eight.
- Now we are able to use the living room more, because it was an ice cube before.
- My mom [the homeowner] is 92 years old. She's very sensitive to changes. She has said it's now very comfortable.

Participants who said they experienced no change in their comfort level offered the following comments.

- I still feel cold in the same rooms and it is still drafty.
- They did most of the insulation in the attic. The attic is still scorching hot.
- The house could have used a ton of other stuff. We have so much moisture in the house and the house never gets cool, even with the air conditioning on. They did nothing to help with the A/C.

Participants who said their level of comfort decreased offered the following comments.

- The services decreased the level of comfort in the home. I don't feel like the insulation and things improved my comfort. In the attic, they pushed everything into the center of the floor. They left everything all over the place. My attic floor was not safe; there was fear of falling through the floor. It's been a few years and now we are still cautious.
- I'm less comfortable now. I have a closet in my daughter's room with an entrance to the attic. They put insulation around. They said the room would not be as hot as before, but I don't feel a big difference. The room is still hot. The main problem they didn't fix it. They did work on the front door insulation but the work made it worse.

Program Satisfaction

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Customers were asked about their satisfaction with the program services. Table V-9 shows that only two customers reported that they were very dissatisfied, and both were low savers.

- 21 of the 22 high savers reported that they were very or somewhat satisfied with the program services.
- 18 of the 20 low savers reported that they were very or somewhat satisfied with the program services.

How satisfied were you with the services that you received from the NJCP Program?							
	High Savers	Low Savers					
Very Satisfied	17	14					
Somewhat Satisfied	4	4					
Somewhat Dissatisfied	1	0					
Very Dissatisfied	0	2					
Total	22	20					

Table V-9Overall Satisfaction with Program Services

Many customers mentioned they were promised certain measures would be installed, but for various reasons, the installations never occurred. Comments of this kind are included in those presented below.

Participants who were very satisfied with the services offered the following comments.

- The first gentleman who came to do the work was a great guy. He gave me a schedule that showed who is going to come to the house. He put a note on his list, a notation about the windows, saying that someone would come to fix the windows. No one ever came to do the windows. But I was very satisfied because the initial person was very good and very informative.
- [The workers/contractors] were very professional, clean, and they did an excellent job.
- [The contractors] were very nice people. They didn't bother me at all.
- [The contractors] were very polite, very efficient, and they made sure they were clear.
- [The contractors] were courteous. They didn't leave a mess. There was no goofing around.
- [The work was] fantastic. Didn't have one complaint. And I'm a contractor myself.

Participants who were somewhat satisfied had the following comments.

- [The contractors] said they would do a change in the electric where I could set the temperature, but they couldn't because of my wiring.
- I think there is a misconception [among the contractors] when they come to properties in a mixed neighborhood with mixed socioeconomic status. The workers assumed I was uneducated or less vocal. Their practices were changed because of that. There's

professional courtesy — taking shoes off. I don't really care what you're doing; watch your language. I don't want to hear your music playing while you're doing your job.

- I wasn't quite ready for [the contractors]. I wanted to move things and prepare. They came sooner than I was expecting, which didn't give me a chance to prepare. They were a little messy with the mastic. When it dries, it's pretty tough stuff.
- They were sloppy when they were doing the basement insulation. All the foam insulation dripped.
- I haven't had any issues with the stuff they installed. But I feel like it didn't have much effect.

Participants who were somewhat or very dissatisfied offered the following comments.

- Getting the workers here took a couple weeks from when we got approved. If I was paying for the service, I would have complained. They were supposed to come back. They were going to do the basement windows, but they were waiting on something for approval. They stopped answering my calls after a while.
- I had problems with some of [the contractors'] attitudes. In the beginning, they told me they need to put up insulation in the garage. But later on, they said that they couldn't do it. They changed a part of the roof said they needed to fix it. I tried hard to contact them and they said no we couldn't do it. They said they did their best. I feel like a waste of time. They just made me dream. They were rude and they did not follow through.
- Very dissatisfied with the people that came out. They were not pleasant. When they came in, I was told they were going to do everything and I wouldn't have to do anything. Then the guy got mad at me because I had things in the attic under the eave.

Additional Comments

Participants were asked if they had any other comments about the program.

- Sixteen participants stated that the program is very good or great.
- Nine participants indicated that they want the program to come back to their home.
- Four participants stated that the program should be advertised more heavily.

Participants offered the following positive comments.

- They need to continue this program in the future. There are a lot of needy people out there who deserve that kind of help.
- It is a great program, especially for seniors and people who don't know much about home improvement.
- I hope they continue the program ... It makes a difference, not only to people's pockets, but also helping the planet.
- Especially for seniors on fixed income, the program is a big deal. The program should be advertised more. As soon as I was on the program, I got in touch with other people and told them about it.
- I recommended the program to at least four of my friends. I know two people who got it done after me. I hope they [Comfort Partners] continue the program.

Participants offered the following negative comments.

- I'm disappointed that they did not fix my windows.
- I still need a lot of help. My son gets nosebleeds from the heat.
- I wish there was a follow-up, maybe a year later. This would have been good for collecting data and having a dialogue with the owner.
- The workers could have been more responsible with cleaning up.
- They ran a vent through my living room and it was easy to trip on it.

C. Summary and Recommendations

Findings from the interviews conducted with participants in the New Jersey Comfort Partners Program are summarized in this section.

- External Factors: One of the goals of the interviews was to investigate reasons for higher and lower than expected energy savings. We found that some customers with lower than expected savings began using energy-consuming devices or increased the number of residents in their home within a year of the NJCP services.
 - Space Heater Usage: Six out of 22 high savers reported that they reduced their use of space heaters, though five of the six customers were selected for reductions in gas usage. One low saver who was an electric heating customer reported that an increase in their use of a space heater occurred following the services.
 - Other Household Changes: Only a small number of customers had changes in household size or use of appliances that may have impacted usage.
- Home Comfort Impacts: Seventeen of the 22 high savers and 12 of the 20 low savers reported that their comfort improved following Comfort Partners services. Two of the 20 low savers reported that their level of comfort worsened following services.
- Program Satisfaction: Almost all of the high and low savers were very or somewhat satisfied with the program. While 17 of the 22 high savers were very satisfied, 14 of the 20 low savers were very satisfied. Only the two low savers who reported a decline in their comfort level said that they were very dissatisfied.
- Participant Recommendations: The most common recommendation by participants was that the program should advertise more. When prompted for additional comments about their experience, 16 of the 42 respondents praised the program in some way. Nine respondents indicated that they want the program to visit them again at some point.

VI. Energy Saving Protocols

The evaluation includes an analysis of the energy saving protocols to assess their accuracy and the need for formula updates. This section provides an analysis of the protocol data, a comparison of the projected savings values with the evaluation estimated, and recommendations for changes to protocol formulas.

A. Background

NJ Comfort Partner's Energy Saving Protocols are an important aspect of the program, as they are used to estimate program savings. The protocols are used to assess program impacts and calculate energy and resource savings for the following purposes.

- Reports to the Board of Public Utilities (BPU) on program performance.
- Inputs for planning and cost-effectiveness calculations.
- Determination of eligibility for administrative performance incentives.³
- Assessment of the environmental benefits of program implementation.

In this section, we utilize findings from the evaluation to make recommendations for updating the protocols.

B. Protocol Savings and Evaluation Savings for Electric Secondary Jobs

Table VI-1 displays the mean protocol savings for electric secondary jobs. Results are shown for all electric secondary jobs during the analysis period that had protocol savings estimates and for the subset that also had enough data to be included in the usage impact analysis — i.e., the analysis group.

Many jobs that had a measure installed from one of the protocol categories did not have corresponding protocol savings data for that measure. Therefore, there is a distinction between "Jobs with CP Measure" and "Jobs with Protocol Savings," which is used throughout this section.

- HVAC jobs often did not have savings reported because the only measure installed was a furnace filter. Jobs with gas HVAC repairs also did not have savings reported, but this is a small percentage of jobs that both had these repairs and had an improvement in steady state efficiency. These savings will now be reported in the new Comfort Partners data system.
- Refrigerator replacement jobs sometimes did not have savings reported for a variety of reasons including that the needed data were not reported by the contractor, a second unit was replaced instead of a first unit, or the refrigerator was replaced for health and safety reasons. The new Comfort Partners data system will now prevent contractors from billing for refrigerators if required data are not entered into the system.

³To the extent that such incentives are approved by the BPU.

The results for the full treatment group and for the analysis group were very similar. The table shows that 86 percent of jobs in the full treatment group, and 85 percent of jobs in the analysis group had a protocol savings estimate for at least one category. The total savings estimate across all 2018 jobs was 1,110 kWh and the total savings estimate for jobs in the analysis group was 1,101 kWh.

Electric Secondary Jobs											
		Full	Treatmen	t Group			А	nalysis Gr	oup		
Protocol Category	Jobs with CP Measure		Jobs with Protocol Savings		Mean Savings	Jobs with CP Measure		Jobs Protocol	with Savings	Mean Savings	
	#	%	#	%	(kWh)	#	%	#	%	(kWh)	
Air Sealing	1,783	51%	533	15%	201	1,269	51%	391	16%	197	
LEDs	2,638	76%	2,636	76%	692	1,872	76%	1,870	76%	689	
Duct Sealing	1,150	33%	398	11%	234	873	35%	290	12%	227	
Hot Water	2,275	65%	95	3%	179	1,591	64%	66	3%	173	
HVAC	1,834	53%	200	6%	689	1,264	51%	139	6%	646	
Insulation	1,431	41%	232	7%	367	1,049	43%	160	6%	367	
Refrigerator	1,236	36%	1,003	29%	1,017	849	34%	688	28%	1,023	
Thermostats	979	28%	237	7%	118	645	26%	155	6%	111	
Total	3,310	95%	2,984	86%	1,110	2,341	95%	2,100	85%	1,101	

Table VI-1Electric Secondary JobsMean Protocol Savings

Table VI-2 provides more detail on the protocol savings estimates for the analysis group. The table shows the distribution of savings, as well as the number of jobs that did not have savings values reported.

The table shows how the savings projections vary based on the installed measures. While some protocol categories such as air sealing and thermostats exhibit relatively low variation, other categories exhibit a high level of variation. The table shows that, of jobs with LED protocol savings data, ten percent had LED savings projections that were lower than 190 kWh and ten percent had LED savings projections that were greater than 1,329 kWh. This is due to the fact that the number of LEDs installed in homes ranged from one to 47.

		Electric Secondary Jobs - Analysis Group										
Protocol	# Jobs with	Mean		Per	centile S	avings		# Jobs with				
Category	Protocol Savings	Savings (kWh)	10	25	50	75	90	Data Missing				
Air Sealing	391	197	112	130	171	246	308	878				
LEDs	1,870	689	190	356	617	972	1,329	2				
Duct Sealing	290	227	70	136	200	303	402	583				
Hot Water	66	173	61	61	71	182	360	1,525				
HVAC	139	646	269	437	568	808	1,099	1,125				
Insulation	160	367	196	240	349	443	546	889				
Refrigerator	688	1,023	601	707	893	1,177	1,692	161				
Thermostats	155	111	67	77	102	135	164	490				

Table VI-2Electric Secondary JobsProtocol Savings Distribution

Table VI-3A compares the protocol savings estimates to the evaluation estimates for the electric secondary jobs. Most of the evaluation regression estimates had a high level of significance, though the estimates for air sealing, hot water measures, and thermostats were not statistically significant. The table shows that protocol estimates for hot water measures and insulation were lower than what was estimated in the evaluation and that the protocol estimates for LEDs, HVAC, and refrigerator replacement were higher than what was reported in the evaluation. Air sealing, duct sealing, and thermostats had protocol estimates that were relatively close to the evaluation estimates, but of those three categories, only duct sealing had a statistically significant evaluation estimate.

Table VI-3AElectric Secondary JobsComparison of Protocol Savings and Evaluation Estimates

	Electric Secondary Jobs - Analysis Group									
Protocol		Mean	Evaluation Estimate							
Category	# with Savings	Protocol Savings (kWh)	Estimate (kWh)	Significance Level	95 Confi Inte	% dence rval				
Air Sealing	391	197	189	NO	-72	450				
LEDs	1,870	689	264	99%	83	444				
Duct Sealing	290	227	274	90%	-6	554				
Hot Water	66	173	395	NO	-80	870				
HVAC	138	647	377	95%	37	717				
Insulation	160	367	616	99%	272	960				

Protocol	Electric Secondary Jobs - Analysis Group								
		Mean	Evaluation Estimate						
Category	# with Savings	Protocol Savings (kWh)	Estimate (kWh)	Significance Level	95 Confi Inte	% dence rval			
Refrigerator	688	1,023	427	99%	256	599			
Thermostats	155	111	95	NO	-227	416			

Table VI-3B compares the total protocol savings estimate to the evaluation billing analysis estimate. While the total protocol savings averaged 1,101 kWh, the average evaluation savings estimate for these jobs was 509 kWh. The table also shows how the figures from the current evaluation compared to the 2017 evaluation. While this evaluation overestimated the electric secondary savings by 116 percent, the 2017 evaluation overestimated the savings by 65 percent.

Table VI-3BElectric Secondary JobsComparison of Total Protocol Savings and Evaluation Estimates

Total Savings	Electric Secondary Jobs - Analysis Group									
		Mean	H	Evaluation Estimate						
	# with Savings	Protocol Savings (kWh)	Estimate (kWh)	Estimate (kWh) Significance Level		% dence rval	Savings Overestimate			
2020 Evaluation	2,100	1,101	509	99%	423	594	116%			
2017 Evaluation	2,687	1,041	632	99%	564	700	65%			

C. Protocol Savings and Evaluation Savings for Electric Heating Jobs

Table VI-4 displays the protocol savings estimates for electric heating jobs. Results are shown for all electric heating jobs that had protocol savings estimates and for the subset that also had enough data to be included in the usage impact analysis. The results from the full treatment group and for the analysis group were very similar. The table shows that 90 percent of both groups had a protocol savings estimate for at least one category. The total savings estimate across all treatment group jobs was 1,675 kWh and the total savings estimate for jobs in the analysis group was 1,594 kWh.

	Electric Heating Jobs											
		Full 7	Freatment	Group			A	analysis G	roup			
Protocol Category	Jobs with CP Measure		Jobs with Protocol Savings		Mean Savings	Jobs v Mea	Jobs with CP Measure		Jobs with Protocol Savings			
	#	%	#	%	(kWh)	#	%	#	%	(kWh)		
Air Sealing	238	63%	212	56%	394	151	66%	133	58%	377		
LEDs	290	77%	290	77%	588	181	79%	181	79%	581		
Duct Sealing	137	36%	131	35%	83	93	40%	88	38%	89		
Hot Water	242	64%	113	30%	182	146	63%	66	29%	188		
HVAC	90	24%	38	10%	1,251	48	21%	19	8%	1,196		
Insulation	215	57%	134	35%	705	136	59%	82	36%	672		
Refrigerator	134	35%	116	31%	987	74	32%	63	27%	953		
Thermostats	105	28%	105	28%	246	72	31%	72	31%	229		
Total	345	91%	339	90%	1,675	210	91%	207	90%	1,594		

Table VI-4Electric Heating JobsMean Protocol Savings

Table VI-5 provides more detail on the protocol savings estimates for the analysis group. The table shows the distribution of savings, as well as the number of jobs that did not have protocol savings estimates.

While some protocol categories exhibit relatively low variation in the protocol savings estimates, such as insulation and thermostats, other categories exhibit a high level of variation. The table shows that ten percent had HVAC savings projections that were lower than 633 kWh and ten percent had HVAC savings projections that were greater than 2,328 kWh.

Table VI-5 Electric Heating Jobs Protocol Savings Distribution

	Electric Heating Jobs - Analysis Group										
Protocol Category	# Jobs with	Mean		Per	# Jobs with						
Category	Savings	(kWh)	10	25	50	75	90	Data Missing			
Air Sealing	133	377	201	277	379	462	535	18			
LEDs	181	581	190	332	522	735	1,085	0			
Duct Sealing	88	89	14	20	45	86	200	5			
Hot Water	66	188	61	61	121	360	360	80			
HVAC	19	1,196	633	879	1,152	1,541	2,328	29			
Insulation	82	672	453	550	688	757	861	54			

	Electric Heating Jobs - Analysis Group									
Protocol Category	# Jobs with	Mean		Per	# Jobs with					
	Protocol Savings	Savings (kWh)	10	25	50	75	90	Protocol Savings Data Missing		
Refrigerator	63	953	688	776	871	1,126	1,229	11		
Thermostats	72	229	121	158	223	277	341	0		

Table VI-6A provides a comparison of the protocol savings estimates with the evaluation estimates for the electric heating jobs. Due to the small number of observations included in this analysis, only the thermostat evaluation regression estimate had a high level of significance. The table shows that the protocol estimate for duct sealing was lower than what was estimated in the evaluation and that the protocol estimates for all other categories were higher than what was reported in the evaluation.

Table VI-6AElectric Heating JobsComparison of Protocol Savings and Evaluation Estimates

		Electric l	Heating Job	s - Analysis Gr	oup					
Protocol		Mean	Evaluation Estimate							
Category	# with Savings	Protocol Savings (kWh)	Estimate (kWh) Significance Level		95% Confidence Interval					
Air Sealing	133	377	29	NO	-1,088	1,145				
LEDs	181	581	68	NO	-832	968				
Duct Sealing	88	89	220	NO	-709	1,148				
Hot Water	66	188	-145	NO	-939	649				
HVAC	19	1,196	-277	NO	-1,549	995				
Insulation	82	672	538	NO	-396	1,471				
Refrigerator	63	953	-3	NO	-784	777				
Thermostats	72	229	-661	90%	-1,414	92				

Table VI-6B compares the total protocol savings estimate to the evaluation billing analysis estimate. While the total protocol savings estimate was 1,594 kWh, the mean evaluation savings for these jobs was 220 kWh. As discussed in the usage impacts section, the evaluated savings were often very low for electric heating customers, even negative at times. The table also shows how the figures from the current evaluation compared to the 2017 evaluation. While this evaluation overestimated the electric heating savings by 625 percent due to the low electric heating savings, the 2017 evaluation overestimated the savings by 45 percent.

Table VI-6B
Electric Heating Jobs
Comparison of Total Protocol Savings and Evaluation Estimates

		Electric Heating Jobs - Analysis Group									
		Mean]	Evaluation Estimate							
Total Savings	# with Protoco Savings Saving (kWh)		Estimate (kWh)	Significance Level	95% Confidence Interval		Savings Overestimate				
2020 Evaluation	207	1,594	220	NO	-148	588	625%				
2017 Evaluation	281	1,715	1,179	99%	909	1,448	45%				

D. Protocol Savings and Evaluation Savings for Gas Heating Jobs

Table VI-7 displays the protocol savings estimates for the gas heating jobs. Results are shown for all gas heating jobs that had protocol savings estimates and for the subset that also had enough data to be included in the usage impact analysis. The results from the full treatment group and for the analysis group were very similar. The table shows that 78 percent of the full treatment group and 77 percent of the analysis group had a protocol savings estimate for at least one category. The total savings estimate across all treatment group jobs was 75 ccf and the total savings estimate for jobs in the analysis group was also 75 ccf.

Table VI-7Gas Heating JobsMean Protocol Savings

	Gas Heating Jobs													
		Full 1	Freatment (Group			A	nalysis Gro	սթ					
Protocol Category	Jobs with CP Measure		Jobs with Protocol Savings		Mean Savings	Jobs with CP Measure		Jobs with Protocol Savings		Mean Savings				
	#	%	#	%	(ccf)	#	%	#	%	(ccf)				
Air Sealing	1,817	51%	1,277	36%	35	1,259	52%	921	38%	34				
Duct Sealing	1,154	32%	915	26%	13	832	34%	662	27%	13				
Hot Water	2,317	65%	1,808	51%	7	1,545	64%	1,179	49%	8				
HVAC	1,803	51%	253	7%	198	1,207	50%	147	6%	205				
Insulation	1,448	41%	571	16%	111	1,021	42%	415	17%	111				
Thermostats	997	28%	938	26%	23	638	26%	616	25%	24				
Total	3,095	87%	2,766	78%	75	2,094	86%	1,873	77%	75				

Table VI-8 provides more detail on the protocol savings estimates for the analysis group. The table shows the distribution of savings, as well as the number of jobs that had savings reported as either zero or missing.

The distribution shows how savings projections can vary based on the installed measures. While some protocol categories exhibit relatively low variation, such as insulation and duct sealing, other categories exhibit a high level of variation. The table shows that ten percent had HVAC savings projections below 36 ccf and ten percent had HVAC savings projections of at least 408 ccf.

	Gas Heating Jobs - Analysis Group									
Protocol Category	# with	Mean		Per	# with Protocol					
	Savings	Savings (ccf)	10	25	50	75	90	Savings = 0 or Missing		
Air Sealing	921	34	12	21	31	44	58	338		
Duct Sealing	662	13	5	8	12	17	23	170		
Hot Water	1,179	8	3	3	5	10	16	366		
HVAC	147	205	36	75	147	297	408	1,060		
Insulation	415	111	57	75	101	133	173	606		
Thermostats	616	24	8	13	21	30	42	22		

Table VI-8 Gas Heating Jobs Protocol Savings Distribution

Table VI-9A provides a comparison of the protocol savings estimate with the evaluation estimate for the gas heating jobs. Apart from the duct sealing estimate, all evaluation estimates were statistically significant. The table shows that protocol estimates for air sealing, duct sealing, and HVAC were considerably higher than what was estimated in the evaluation. The protocol estimates for hot water measures were lower than what was estimated in the evaluation, but the protocol estimates for insulation and thermostats were accurate.

Table VI-9AGas Heating JobsComparison of Protocol Savings and Evaluation Estimates

	Gas Heating Jobs - Analysis Group									
Protocol		Mean	Evaluation Estimate							
Category	# with Savings	Protocol Savings (ccf)	Estimate (ccf)	Significance Level	95% Confidence Interval					
Air Sealing	921	34	24	95%	4	43				
Duct Sealing	662	13	7	NO	-11	26				
Hot Water	1,179	8	14	90%	-1	29				
HVAC	147	205	163	99%	132	193				
Insulation	415	111	110	99%	87	132				
Thermostats	616	24	28	99%	11	46				

Table VI-9B provides a comparison of the total protocols savings estimate and the evaluation billing analysis savings estimate. While the total protocol savings estimate was 75 ccf, the average evaluation savings estimate for these jobs was 67 ccf. The table also shows how the figures from the current evaluation compared to the 2017 evaluation. While this evaluation overestimated the gas savings by 12 percent, the 2017 evaluation overestimated the savings by 37 percent.

Table VI-9B
Gas Heating Jobs
Comparison of Total Protocol Savings and Evaluation Estimates

Total Savings	Gas Heating Jobs - Analysis Group									
		Mean]	Protocol						
	# with Savings	Protocol Savings (ccf)	Estimate (ccf)	Significance Level	ce 95% Confidence Interval		Savings Overestimate			
2020 Evaluation	1,873	75	67	99%	58	77	12%			
2017 Evaluation	2,611	118	86	99%	78	94	37%			

E. Protocol Review

This section provides recommendations for the energy saving protocols based on the comparison of protocol and evaluation savings estimates. Because the overall evaluation estimates were generally lower than the protocol savings estimates, the overall adjustment goal should be to reduce the protocol savings estimates. However, the protocol savings estimates for gas heating jobs were mostly accurate and do not require as much adjustment as the protocol savings estimates for electric jobs.

Overview

Table VI-10 provides an overview of the comparison of protocol savings estimates and the evaluation estimates. While it can be difficult to estimate measure-specific estimates from the evaluation with high confidence when the samples are not large, the overall protocol savings estimates were much higher than what was estimated in the evaluation, and several of the measure protocol formulas should be adjusted to reduce the projected savings.

Though protocol estimates were often much higher than the evaluation estimates, the protocol estimates improved since the previous 2017 Comfort Partners evaluation in terms of the number of categories that were overestimated. In the 2017 evaluation, five of the six gas heating protocol categories had estimates that were "very high" compared to the evaluation estimate and in this evaluation, none of the gas heating protocol savings estimates were very high compared to the evaluation estimate.

However, the estimates for electric secondary and electric heating remained highly inaccurate for the most part. Three of the protocol savings categories were overestimated for electric secondary and seven of the eight categories were overestimated for electric heating.

Protocol	Electric S	Secondary	Electric	Heating	Gas I	Heating
Category	Protocol Estimate	Evaluation Confidence	Protocol Estimate	Evaluation Confidence	Protocol Estimate	Evaluation Confidence
LEDs	Very High	Very High	Very High	Very Low		
Refrigerator	Very High	Very High	Very High	Very Low		
Air Sealing	Accurate	Very Low	Very High	Very Low	High	Very High
Insulation	Very Low	Very High	High	Very Low	Accurate	Very High
Duct Sealing	Accurate	High	Very Low	Very Low	High	Very Low
Hot Water	Very Low	Very Low	Very High	Very Low	Low	High
HVAC	Very High	Very High	Very High	Very Low	High	Very High
Thermostats	Accurate	Very Low Very High High Accurate		Accurate	Very High	
Total	Very High	Very High	Very High	Very Low	Accurate	Very High

 Table VI-10

 Comparison of Protocol Savings and Evaluation Estimates

LEDs

Table VI-11A compares the protocol and evaluation LED savings estimates. The table shows that the protocols estimated 689 kWh in savings from LEDs for electric secondary jobs, whereas the evaluation estimated average savings of 264 kWh. The protocols estimated savings of 45.9 kWh per LED and the evaluation estimated savings of 17.6 kWh per LED, given the average of 15 LEDs per home (shown in Table VI-11B) in these electric secondary jobs. The protocols assume 52 Watts of savings and 2.5 hours of use each day⁴ to reach that estimate. However, given the estimated savings, it is unlikely that the LEDs were used that many hours per day.

Contractors should be re-trained to discuss LED placement with customers and the protocols should be revised to reduce the hours per day assumption for LED replacement.

⁴ These two figures vary for other types of lighting installations. The protocol savings estimate assumes 42 Watts of savings for CFL bulbs, with 2.5 hours of assumed daily use. The protocol savings estimate assumes 245 Watts of savings for a Torchiere, with 2.5 hours of assumed daily use. The protocol savings estimate assumes 6.75 Watts of savings for nightlights, with 12 hours of assumed daily use. However, roughly 90 percent of the lighting installations reported in the protocol savings data were LED installations.

		Protocol Estimate					Evaluation Estimate						
	# with Savings	# with Mean	Percentile Savings					Estimate	Sig	95%		Protocol Estimate	Evaluation Confidence
Saving		Saved (kWh)	10	25	50	75	90	(kWh)	Level	Confidence Interval		Estimate	Confidence
Elec BL	1,870	689	190	356	617	972	1,329	264	99%	83	444	Very High	Very High
Elec Heat	181	581	190	332	522	735	1,085	68	NO	-832	968	Very High	Very Low

Table VI-11A LED Savings Estimates

Table VI-11B Number of LEDs per Home

	# with	Mean #	# of LEDs Installed - Percentile							
	Savings	LEDs	10	25	50	75	90			
Electric Secondary	1,870	15	4	8	14	21	28			
Electric Heating	181	12	4	8	11	16	22			

Refrigerators

Table VI-12A compares the protocol and evaluation refrigerator replacement savings estimates. The table shows that the protocols estimated an average of 1,023 kWh in savings from refrigerators for electric secondary jobs, whereas the evaluation estimated savings of 427 kWh.

Table VI-12ARefrigerator Savings Estimates

			Pr	otocol	Estim	ate		Eval	uation E	stimate			
	# with Savings	Mean Percentile Savings Estimate Sig 95%					Protocol Estimate	Evaluation Confidence					
	Savings	Saved (kWh)	10	25	50	75	90	(kWh)	Level	Interval		Estimate	Comfuence
Elec BL	688	1,023	601	707	893	1,177	1,692	427	99%	256	599	Very High	Very High
Elec Heat	63	953	688	776	871	1,126	1,229	-3	NO	-784	777	Very High	Very Low

Table VI-12B shows that while 688 jobs with refrigerators replaced had a protocol savings estimate, 170 had a missing value for the refrigerator protocol estimate. That table also shows that 1,609 electric secondary jobs did not have a refrigerator replaced.

	Refrigerators – Electric Secondary						
Protocol Category	Has Protocol Estimate	Protocol Savings Data Missing					
Refrigerator Replaced	688	170					
Refrigerator Not Replaced	0	1,609					
Total	688	1,779					

Table VI-12BRefrigerators with Protocol Estimates

Table VI-12C shows that the metered usage was very similar for replaced refrigerators that had a protocol savings estimate and replaced refrigerators that did not have a protocol estimate. Both groups had a mean metered usage of roughly 1,400 kWh.

Based on the statistics provided in these tables, the refrigerator savings were much lower in the evaluation than the protocols estimated. Training should be done to make sure that the contractors are metering correctly and that only refrigerators with high enough metered usage are replaced.

Table VI-12CMetered Refrigerator Usage by Presence of Protocol Estimate

	Obs.	# With Metered	# With No Metered	Mean Metered	Refrigerator Metered Usage (kWh) Percentile					
		Usage	Usage	Usage (kWh)	10	25	50	75	90	
Missing Protocol Estimate	170	161	9	1,383	788	1,113	1,332	1,586	2,190	
Non-Missing Protocol Estimate	688	688	0	1,416	1,021	1,139	1,314	1,577	2,015	

Air Sealing and Insulation

Table VI-13A compares the protocol and evaluation air sealing savings estimates and Table VI-13B compares insulation savings estimates. It is difficult to model these savings individually because the measures are usually implemented in the same homes. Therefore, Table VI-13C provides a combined estimate of air sealing and insulation savings.

			Prot	tocol E	Estima	te		E	valuation				
	# with Savings	Mean		Percer	ntile S	avings			Sig	95% Confidence Interval		Protocol Estimate	Evaluation Confidence
	Bavings	Saved	10	25	50	75	90	Estimate	Level			Estimate	Connuence
Elec BL (kWh)	391	197	112	130	171	246	308	189	NO	-72	450	Accurate	Very Low
Elec Heat (kWh)	133	377	201	277	379	462	535	29	NO	-1,088	1,145	Very High	Very Low
Gas Heat (ccf)	921	34	12	21	31	44	58	24	95%	4	43	High	Very High

Table VI-13AAir Sealing Savings Estimates

Table VI-13BInsulation Savings Estimates

			Protocol Estimate						luation E				
	# with Savings	with avings Mean Saved	ean Percentile Savings						Sig	95%		Protocol Estimate	Evaluation Confidence
	Savings		10	25	50	75	90	Estimate	Level	Inte	dence rval	Estimate	connuclice
Elec BL (kWh)	160	367	196	240	349	443	546	616	99%	272	960	Very Low	Very High
Elec Heat (kWh)	82	672	453	550	688	757	861	538	NO	-396	1,471	High	Very Low
Gas Heat (ccf)	415	111	57	75	101	133	173	110	99%	87	132	Accurate	Very High

Table VI-13C shows that the sum of air sealing and insulation saving protocol estimates were very low for electric secondary, very high for electric heat, and accurate for gas heat compared to the evaluation estimates. While the electric secondary protocol estimates were 30 percent lower and the electric heating protocol estimates were 85 percent higher than the evaluation estimates, the gas heat protocol estimates were only eight percent higher than the evaluation estimates.
			Mean	Saved				
		Protocol Esti	mate	E	valuation Es	Protocol	%	
	Air Sealing Insulation		Air Sealing + Insulation	Air Sealing	Insulation	Air Sealing + Insulation	Estimate	Difference
Elec BL (kWh)	197	367	564	189	616	805	Very Low	-30%
Elec Heat (kWh)	377	672	1,049	29	538	567	Very High	85%
Gas Heat (ccf)	34	111	145	24	110	134	Accurate	8%

Table VI-13CAir Sealing and Insulation Savings Estimates

Table VI-13D shows the protocol estimate multipliers that are currently in use. The amount of space consumption is multiplied by these factors to obtain the protocol savings estimate. Given the difference between protocol estimates and evaluation savings, we recommend that the working group consider adjusting the protocol estimates as shown in the table below. However, given that the total protocol savings estimates are higher than the total evaluation estimates, other measure protocols should be adjusted downward if the electric secondary protocols are increased.

Table VI-13DProtocol Estimate FormulasAir Sealing and Insulation

	Daga	Ν	Aultipli	er	Protocol	%	Recommended
	Base	Seal	Insul	Total	Estimate	Difference	Multiplier
Elec BL (kWh)	Electric Space Consumption	.05	.08	.13	Very Low	-30%	.17
Elec Heat (kWh)	Electric Space Consumption	.05	.08	.13	Very High	85%	.11
Gas Heat (ccf)	Gas Space Consumption	.05	.13	.18	Accurate	8%	.18

Duct Sealing

Table VI-14A compares the protocol and evaluation duct sealing savings estimates. The table shows that the protocols estimated 227 kWh in savings from duct sealing for electric secondary jobs and 89 kWh for electric heating jobs, whereas the evaluation estimated average savings of 274 kWh for electric secondary jobs and no significant savings for electric heating jobs. While the protocol savings estimates for the electric jobs were lower than the evaluation estimates, the protocol savings estimates for gas heating jobs were higher than the evaluation savings estimate. The protocols estimated savings of 13 ccf from duct sealing for gas heating jobs, but the evaluation did not find significant savings.

	# with		Pro	tocol]	Estima	nte		Eva	luation F	Estimat				
		Mean		Perce	ntile S	aving	s		Sig	95%		Protocol Estimate	Evaluation Confidence	
	Savings	Saved	10	25	50	75	90	Estimate	Level	Interval		Estimate	Comfuence	
Elec BL (kWh)	290	227	70	136	200	303	402	274	90%	-6	554	Low	High	
Elec Heat (kWh)	88	89	14	20	45	86	200	220	NO	-709	1,148	Very Low	Very Low	
Gas Heat (ccf)	662	13	5	8	12	17	23	7	NO	-11	26	High	Very Low	

Table VI-14A Duct Sealing Savings Estimates

The electric duct sealing protocol savings formulas separate the estimation for homes with and without central air conditioning. Therefore, Table VI-14B provides these separate estimates. The table shows that, for both electric heat and secondary, the duct sealing protocol estimates were considerably lower than the evaluation estimates for homes with no central air conditioning. However, the sample size was very low in both cases, and the evaluation estimates were not statistically significant. For homes with central air conditioning, the electric heating and electric secondary protocol estimates were somewhat lower than the evaluation estimates, though the electric heating evaluation estimate was not statistically significant.

Table VI-14BDuct Sealing Savings EstimatesBy Central Air Conditioning

	# with	Protocol		Evaluation Est	imate			
	Duct Sealing	Estimate Mean Saved (kWh)	Estimate (kWh)	Significance Level	95% Confidence Interval		Protocol Estimate	Evaluation Confidence
			ELECTRIC	C SECONDARY	[
Central AC	284	231	273	90%	-9	556	Low	High
No Central AC	6	24	307	NO	-1,250	1,864	Very Low	Very Low
All Elec BL	290	227	274	90%	-6	554	Low	High
			ELECTR	RIC HEATING				
Central AC	81	82	160	NO	-782	1,101	Very Low	Very Low
No Central AC	7	162	973	NO	-1,137	3,082	Very Low	Very Low
All Elec Heat	88	89	220	NO	-709	1,148	Very Low	Very Low

The energy saving protocols estimate duct sealing savings as ten percent of electric space consumption for homes with central air conditioning and two percent of electric space consumption for homes without central air conditioning. The energy saving protocols

estimate duct sealing savings as two percent of gas space consumption for gas heated homes. We recommend that the estimates be kept at the current level now and be reviewed again in a future evaluation.

Hot Water

Table VI-15 compares the protocol and evaluation hot water savings estimates. The table shows that the protocols estimated 173 kWh in savings from hot water measures for electric secondary jobs and 188 kWh in savings for electric heating jobs, whereas the evaluation estimated average savings of 395 kWh for electric secondary jobs and -145 kWh for electric heating jobs, neither of which were statistically significant estimates. Analysis for electric jobs was difficult given the number of jobs with missing protocol savings data. As the table shows, only 66 electric secondary jobs had savings data for hot water measures, a small fraction of the 1,591 electric secondary jobs that had hot water measures installed (shown in Table VI-1). The protocols estimated savings of eight ccf for gas heating jobs and the evaluation estimated savings of 14 ccf for gas heating jobs.

			Prot	tocol E	Estima	te		Ε	valuation Estir				
	# with Savings	Mean		Perce	ntile S	avings			Significance	95%		Protocol Estimate	Evaluation Confidence
	Savings	Saved	10	25	50	75	90	Estimate	Level	Interval		LStimate	Connuence
Elec BL (kWh)	66	173	61	61	71	182	360	395	NO	-80	870	Very Low	Very Low
Elec Heat (kWh)	66	188	61	61	121	360	360	-145	NO	-939	649	Very High	Very Low
Gas Heat (ccf)	1,179	8	3	3	5	10	16	14	90%	-1	29	Very Low	High

Table VI-15Hot Water Savings Estimates

In prior evaluations, we recommended that separate savings be applied for each of the following measures.

- Water Heater Pipe Insulation
- Water Heater Replacement/Removal
- Low Flow Faucet Aerators
- Low Flow Showerheads

The protocol savings estimates for hot water measures are now calculated separately for these different measures.⁵ We recommend continuing to separate estimates based on the categories of hot water measures listed above.

⁵This was not the case in the previous evaluation.

HVAC

Table VI-16 compares the protocol and evaluation HVAC savings estimates. For all three groups, the protocol savings estimates were much higher than the evaluation estimates. The table shows that the protocols estimated 647 kWh in savings from HVAC work for electric secondary jobs and 1,196 kWh for electric heating jobs, whereas the evaluation estimated average savings of 377 kWh for electric secondary jobs and no significant savings for electric heating jobs. The protocols estimated savings of 205 ccf for gas heating jobs and the evaluation estimated average savings of 163 ccf for gas heating jobs.

			Р	rotoco	ol Estima	ate		I	Evaluation Esti				
	# with Savings	Mean		Per	centile S	Savings			Significance	95% Confidence Interval		Protocol Ectimate	Evaluation Confidence
	Savings	Saved	10	25	50	75	90	Estimate	Level			Estimate	Confidence
Elec BL (kWh)	138	647	269	437	569	808	1,099	377	95%	37	717	Very High	Very High
Elec Heat (kWh)	19	1,196	633	879	1,152	1,541	2,328	-277	NO	-1,549	995	Very High	Very Low
Gas Heat (ccf)	147	205	36	75	147	297	408	163	99%	132	193	Very High	Very High

Table VI-16HVAC Savings Estimates

Thermostats

Table VI-17 compares the protocol and evaluation thermostat savings estimates. The electric secondary protocol savings estimates were fairly close to the evaluation estimate, but the evaluation did not estimate statistically significant savings. The electric heating protocol savings estimates were much higher than the evaluation estimate, which was negative. The protocols estimated savings of 24 ccf for gas heating jobs and the evaluation estimated average savings of 28 ccf for gas heating jobs.

Table VI-17Thermostat Savings Estimates

			Pro	tocol F	Estima	te		I	Evaluation Esti				
	# with Savings N S	Mean		Perce	ntile S	avings	5		Significance	95%		Protocol Estimate	Evaluation Confidence
		Saved	10	25	50	75	90	Estimate	Level	Confid Interv	ence val	Estimate	Confidence
Elec BL (kWh)	155	111	67	77	102	135	164	95	NO	-227	416	Accurate	Very Low
Elec Heat (kWh)	72	229	121	158	223	277	341	-661	90%	-1,414	92	Very High	High

		Protocol Estimate						I	Evaluation Esti				
	# with Savings	Mean		Perce	ntile S	avings	5		Significance	95% Confidence Interval		Protocol Estimate	Evaluation Confidence
	Savings	Saved	10	25	50	75	90	Estimate	Level			Estimate	Confidence
Gas Heat (ccf)	616	24	8	13	21	30	42	28	99%	11	46	Accurate	Very High

The energy saving protocols compute savings from thermostats as three percent of the electric or gas space consumption. The working group should re-consider whether these savings should continue to be claimed for electric consumption. This was recommended in the last evaluation as well.

F. Summary

This section provided a review of the energy saving protocol data, comparisons with the evaluation estimates, and recommendations for revising some of the protocol formulas. Key findings are summarized below.

- Electric Secondary Estimates: Protocol estimates for hot water measures and insulation were much lower than what was estimated in the evaluation and protocol estimates for LEDs, HVAC, and refrigerator replacement were much higher than what was reported in the evaluation. Air sealing, duct sealing, and thermostats had protocol estimates that were relatively close to the evaluation estimates, but of those three categories, only duct sealing had a significant evaluation estimate. While the total protocol savings averaged 1,101 kWh, the average evaluation savings for these jobs was 509 kWh.
- Electric Heating Estimates: Only the thermostat evaluation estimate had a high level of significance for the electric heating jobs, due to the small number of observations included in this analysis. There is not a high level of confidence in the electric heating measure-specific saving estimates. Protocol estimates for duct sealing were lower than what was estimated in the evaluation and protocol estimates for air sealing, LEDs, hot water measures, HVAC, insulation, refrigerator replacement, and thermostats were higher than what was reported in the evaluation. While the total protocol savings averaged 1,594 kWh, the average evaluation savings for these jobs was 220 kWh.
- Gas Heating Estimates: The air sealing, hot water measures, HVAC, insulation, and thermostat evaluation regression estimates had a high level of significance. Protocol estimates for air sealing, duct sealing, and HVAC were considerably higher than what was estimated in the evaluation, while the protocol estimates for hot water measures were lower than what was estimated in the evaluation. The protocol estimates for insulation and thermostats were both accurate. While the total protocol savings averaged 75 ccf for gas heating jobs, the average evaluation savings was 67 ccf.
- Recommended Changes to Protocols: While it can be difficult to estimate measurespecific estimates from the evaluation with high confidence when the samples are not large enough, the total protocol savings estimates were often much higher than what was

estimated in the evaluation. This was mainly the case for electric jobs, and less so for gas heating jobs. Therefore, several of the measure protocol formulas for electric secondary and electric heating jobs should be adjusted to reduce the projected savings. We made the following recommendations for the energy saving protocols.

- LEDs: The protocols estimated savings of 45.9 kWh per LED and the evaluation estimated savings of 17.6 kWh per LED. The protocols assume 52 Watts of savings and 2.5 hours of use to reach that estimate. However, given the estimated savings, it is unlikely that the LEDs were used that many hours per day. Contractors should be re-trained to discuss LED placement with customers and the protocols should be revised to reduce the hours-of-use assumption for LED replacements.
- Refrigerators: For electric secondary jobs, the protocols estimated average refrigerator savings of 1,023 kWh, whereas the evaluation estimated refrigerator savings of 427 kWh. There were 858 electric secondary jobs with a refrigerator replaced and 1,609 jobs with no refrigerator replaced. The metered usage for a replaced refrigerator that had a protocol estimate averaged 1,416 kWh for electric secondary jobs. Training should be done to ensure that the contractors are metering correctly and that only refrigerators with high enough metered usage are replaced.
- Air Sealing and Insulation: It is difficult to model air sealing and insulation savings individually because they are usually installed together. The sum of air sealing and insulation saving protocol estimates was very low for electric secondary, very high for electric heat, and accurate for gas heat. While the electric secondary protocol estimates were 30 percent lower and the electric heating protocol estimates were 85 percent higher than the evaluation estimates, the gas heating protocol estimates were only eight percent higher than the evaluation estimates. Given the difference between protocol estimates and evaluation savings for electric jobs specifically, we recommend that the working group consider adjusting the protocol multipliers on space consumption to estimate these savings.
- Duct Sealing: The protocols estimated 227 kWh in savings from duct sealing for electric secondary jobs and 89 kWh for electric heating jobs, whereas the evaluation estimated average savings of 274 kWh for electric secondary jobs and no significant savings for electric heating jobs. For gas heating jobs, the protocols estimated savings of 13 ccf and the evaluation did not find significant savings from duct sealing.

The energy saving protocols estimated duct sealing savings as ten percent of electric space consumption for homes with central air conditioning and two percent of electric space consumption for homes without central air conditioning. The energy saving protocols estimate duct sealing savings as two percent of gas space consumption for gas heated homes. We recommend that the estimates be kept at the current level for now and be reviewed again in a future evaluation.

• Hot Water: The protocols estimated 173 kWh in savings from hot water measures for electric secondary jobs and 188 kWh in savings for electric heating jobs, but the

evaluation estimates were not statistically significant for either group. For gas heating jobs, the protocols estimated savings of eight ccf and the evaluation estimated savings of 14 ccf. It is difficult to determine how accurate the protocol savings estimates were for electric jobs due to the incomplete hot water measure protocol savings data for electric jobs.

- HVAC: The protocols estimated 647 kWh in savings from HVAC work for electric secondary jobs and 1,196 for electric heating jobs, whereas the evaluation estimated average savings of 377 kWh for electric secondary jobs and no significant savings for electric heating jobs. The protocols estimated savings of 205 ccf for gas heating jobs and the evaluation estimated average savings of 163 ccf for gas heating jobs. The working group should consider reducing the protocol savings estimates for HVAC measures.
- Thermostats: The protocols estimated 111 kWh in savings from thermostats for electric secondary jobs and 229 kWh for electric heating jobs. However, the electric secondary evaluation estimate was not significant, and the electric heating evaluation estimate was significantly negative. The protocols estimated savings of 24 ccf for gas heating jobs and the evaluation estimated average savings of 28 ccf for gas heating jobs. This evaluation estimate was highly significant, indicating that the protocol estimates for gas heating jobs were fairly accurate.

The energy saving protocols compute savings from thermostats as three percent of the electric or gas space consumption. The working group should re-consider whether these savings should continue to be claimed for electric consumption.

VII. Findings and Recommendations

This section provides key findings from the research and recommendations for the program.

A. Key Findings

This evaluation included analysis of the impacts of the NJCP Program on electric and gas consumption for customers who were treated in 2018. Energy savings from all job types declined from what was found in the 2017 evaluation for customers who were treated between April 2015 and March 2016. Overall findings were as follows.

- Electric Secondary Savings: The net savings for the electric secondary jobs was estimated to be 466 kWh or 5.5 percent of pre-treatment usage. This is less than the 542 kWh and 6.9 percent savings from the 2017 evaluation but similar to the 408 kWh and 5.6 percent of pre-treatment usage estimated in the 2013 evaluation. The pre-treatment usage was approximately eight percent higher than in the previous evaluation for jobs in the treatment group and 13 percent higher for those in the comparison group.
- Electric Heating Savings: The net savings for the electric heating jobs was estimated to be 190 kWh or 1.4 percent of pre-treatment usage, significantly lower than the 1,100 kWh and 8.1 percent of pre-treatment usage estimated in the previous evaluation. While all three utilities had electric heating savings that were lower than the previous evaluation, JCP&L electric heating jobs increased usage by an average of 137 kWh.
- Gas Heating Savings: The net savings for the gas heating jobs was estimated to be 52 ccf or 4.7 percent of pre-treatment usage, less than the 78 ccf and 7.2 percent of pre-treatment usage estimated in the previous evaluation.

Energy savings for electric secondary, electric heating, and gas heating customers treated in 2018 declined as compared to the 2017 evaluation of jobs completed between April 2015 and March 2016. The largest decline was for the electric heating jobs, driven by negative savings for JCP&L jobs completed by CMC, CRCI, and Honeywell. Based on the following information, it appears that reductions in savings relate primarily to work quality rather than other factors. However, a small part of the reduction may relate to reduction in the percentage of electric secondary jobs with refrigerators installed and a reduction in the percentage of gas jobs with major measures.

- Pre-treatment usage increased somewhat for electric secondary jobs as compared to the 2017 evaluation and remained about the same for electric heating and gas heating jobs.
- Refrigerators were installed in a somewhat lower percentage of electric secondary jobs and electric secondary jobs that did not receive a refrigerator had lower savings than in the 2017 evaluation.
- Approximately the same percentage of electric heating jobs received major measures as in the 2017 evaluation, but they achieved much lower savings. Jobs without major measures had increased usage as compared to a small reduction in the 2017 evaluation.

• Gas heating jobs were somewhat less likely to have major measures installed than in the 2017 evaluation and those jobs achieved somewhat lower savings than in the previous evaluation.

Almost all of the customers interviewed were very or somewhat satisfied with the services that were delivered. The program should commend the contractors for providing good service and encourage them to continue with their current approach to customer communication.

B. Recommendations

This section provides recommendations based on the findings from the research.

- 1. Training and Quality Control: The lower savings found in this study compared to the previous evaluation appear to relate primarily to work quality rather than other factors assessed in this report. The program should conduct additional quality control to determine the specific causes of the lower savings in homes with installed measures. After determining the specific causes of the lower savings, the program should provide additional training to contractors.
- 2. Major Measures: Part of the reduction in savings on gas heating jobs is related to lower penetration of major measures in those jobs. Contractor training should also focus on identifying and installing major measures where opportunities are available.
- 3. Energy Saving Protocols: The total protocol savings estimates were often much higher than what was estimated in the evaluation. This was mainly the case for electric jobs, and less so for gas heating jobs. Therefore, several of the measure protocol formulas for electric secondary and electric heating jobs should be adjusted to reduce the projected savings. We made the following recommendations for the energy saving protocols.
 - LEDs: The protocols should be revised to reduce the hours-of-use assumption for LED replacements.
 - Air Sealing and Insulation: Given the difference between protocol estimates and evaluation savings for electric jobs specifically, we recommend that the working group consider adjusting the protocol multipliers on space consumption to estimate these savings.
 - Duct Sealing: We recommend that the estimates be kept at the current level for now and be reviewed again in a future evaluation.
 - HVAC: The working group should consider reducing the protocol savings estimates for HVAC measures.
 - Thermostats: The energy saving protocols compute savings from thermostats as three percent of the electric or gas space consumption. The working group should reconsider whether these savings should continue to be claimed for electric consumption.

- 4. Refrigerator Measurements: Training should be done to ensure that the contractors are metering correctly and that only refrigerators with high enough metered usage are replaced.
- 5. Lighting Installation: Contractors should be re-trained to discuss LED placement with customers.
- 6. LEEN Data: When attempting to merge the LEEN data with the utility usage data, we found many account number errors. These included a missing final digit; account numbers stored without sufficient precision; account numbers with an extra digit at the beginning, middle, or end; typos in the account number; or completely incorrect account numbers. The utilities should institute checks so that these errors are reduced. (Note that most of these errors were corrected by the utilities prior to the analysis so that these accounts could be included.)