

New Jersey Comfort Partners

Final Evaluation Report

December 2014

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Executive Summary

The New Jersey Comfort Partners Program (NJCP program) provides no cost energy efficiency services to low-income 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 well-being of low-income 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 shell 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 joined together to create 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 uses, and ensuring that the customer understands how to safely use the equipment in the home.

This report provides a summary of results from the NJCP program evaluation. The evaluation found many benefits of the program and also identified several areas for improvement to increase the efficiency and effectiveness of the program services that are delivered. During the time that the comprehensive evaluation has been implemented, the NJCP Working Group has already planned and/or implemented several refinements to the program to address some of the key issues that were identified.

In addition to this report, more detailed findings are provided in a series of memos that address each research activity undertaken as part of this 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 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. The SBC is a charge for each kWh or therm consumed that equals approximately 3.8 percent of a customer's energy bill. In 2010, there was \$698.2 million spent on SBC funded programs.

Table ES-1 displays the budget for the NJCP program. The table shows that the budget was approximately \$30 million per year in 2010 through 2013.

**Table ES-1
NJCP Program Budget
2010-2012**

	Admin and Program Development	Sales, Marketing, Call Centers, Web Site	Training	Rebates, Grants and Other Direct Incentives	Rebate Processing, Inspections, Other QC	Evaluation and Related Research	Total
2010	\$1,856,184	\$554,100	\$283,300	\$27,566,024	\$1,934,889	\$12,000	\$32,206,497
2011	\$1,679,788	\$460,211	\$243,362	\$26,512,212	\$1,933,736	\$0	\$30,829,308
1/2012-6/2013	\$2,853,576	\$868,086	\$403,292	\$42,416,969	\$2,458,076	\$1,000,000	\$50,000,000

Management

The NJCP program is jointly managed by the 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 five prime service delivery contractors, several subcontractors, and a third party quality control inspector. Honeywell and CMC conduct the audits with their own staff and works with subcontractors on measure installation. The other three contractors, EIC, Northeast Energy, and Optimal Energy, use their own staff for audits and almost all measure installation.

Rather than directly providing regular training to contractors and their staff, the NJCP program designated monthly administrative funding for contractors that must be used for staff training. One use of the funding that is encouraged is sending contractors to the ACI Home Performance conferences. The NJCP program has trained contractors on the use of the NJCP Tracking System.

One of the process improvements that the NJCP has planned is quarterly training provided by the program's quality assurance contractor, CSG. Starting in the first quarter of 2015, CSG will begin holding a quarterly training class to provide technical guidance to contractors in areas that had been identified as weaknesses during the quality control reviews. Program auditors and crew leads will be required to attend at least two of the four training classes each fiscal year.

Eligibility

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

- Annual household income at or below 225 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.

Service Delivered

Energy education offered through the NJCP program 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 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 \$500 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 \$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.

A third party quality assurance inspector may visit a customer’s home to inspect the work performed by the contractor. The inspection attempts to confirm whether measures were properly installed. There are several different types of inspections that may be conducted.

- Comprehensive inspection with full health and safety diagnostics and air leakage diagnostics.
- Inspection with full health and safety diagnostics.
- Inspection with air leakage diagnostics.
- Inspection with gas leak test only.
- Inspection with no diagnostics.

The utilities provide third party inspections on a minimum of 15 percent of completed jobs as required by the Board of Public Utilities (BPU).

Needs Assessment

The Needs Assessment provided data and analysis to assess the characteristics of low-income households in New Jersey who were eligible for the NJCP program. It focused on

households with income at or below 225 percent of the poverty level, the income-eligibility standard for the program.

Several key facts about this population are important for analyzing program need and eligibility for NJCP program services, and how this varies throughout the diverse state.

- 26 percent of households in New Jersey had income at or below 225 percent of the poverty level.
- About 62 percent of the low-income households had housing and energy bill characteristics that made them eligible for the NJCP program.
 - 85 percent of these households heated with natural gas or electricity.
 - About 78 percent lived in a housing type that is eligible (single family or multi-family buildings with no more than 14 units).
 - 90 percent paid directly for gas or electric.
- Some demographic characteristics can make it more difficult to serve segments of the population.
 - Only 39 percent owned their homes, and renters can be more difficult to serve, as landlord permission must be obtained.
 - 39 percent did not speak English in the home and may have the need for service provided in another language if a family member or friend is not available to interpret.
- Many of these households had usage at a level that indicates a need for energy efficiency services.
 - 50 percent of those who did not heat with electricity were estimated to have annual electric usage over 8,000 kWh.
 - 24 percent of those who heated with electricity were estimated to have annual electric usage over 16,000 kWh.
 - 55 percent of those with gas heat were estimated to have annual gas usage above 1,200 ccf.

Another key finding from this analysis is the extent of diversity across the state.

- *Poverty level:* While 26 percent of households were income-eligible for NJCP in the state as a whole, the percent eligible varied from 14 percent in Hunterdon County to 36 percent in Cumberland and Passaic Counties.
- *Main Heating Source:* The majority of households in most counties used natural gas as the main heating fuel, but this was not the case in Cape May, Hunterdon, Sussex, and Warren Counties.
- *Home Type:* The majority of low-income households in Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Hunterdon, Mercer, Morris, Ocean, Salem,

Somerset, Sussex, and Warren Counties lived in single family homes, and the majority of low-income households in Bergen, Essex, Hudson, Middlesex, Passaic, and Union Counties lived in multi-family buildings.

- *Language:* While 87 percent of low-income households in Hunterdon County spoke English at home, only 32 percent in Hudson County spoke English at home. While only seven percent of low-income households in Hunterdon County and five percent in Sussex County spoke Spanish at home, 52 percent in Hudson County and 49 percent in Passaic County spoke Spanish at home.
- *Eligibility for the NJCP program:* We estimated that 62 percent of low-income households in New Jersey were eligible for the NJCP program, but this percentage varied from 30 percent of low-income households in Sussex County to 79 percent in Ocean County.

These factors should be reviewed when thinking about the challenges, possibilities, and strategies for the NJCP program in different parts of the state.

Procedures Review

The NJCP Program provides procedures, specifications, and guidelines in two documents.

- The New Jersey Comfort Partners Procedures Manual (Manual)
- The New Jersey Comfort Partners Building Performance Field Guide (Field Guide)

The utilities view the Manual as a work in progress and update the document on a regular basis.

This review resulted in key recommendations for changes to the NJCP program procedures. Some of these recommendations relate to changes in current procedures but many relate to increased emphasis or clarity on the most important areas for service delivery. These recommendations were based upon review of the Manual and Field Guide, as well as findings from the on-site observation of service delivery, the inspections of completed jobs, and the usage impact analysis.

Participant Characteristics and Program Services

The NJCP program tracking database provides rich information to examine the population of households served by the program, their home and job characteristics, program spending and measures, and inspection results. These data add greatly to the understanding of who the program is able to serve and how these services are delivered.

Data were analyzed for the periods covered in the impact evaluation.

- **Treatment Group:** Customers who received NJCP audits between September 2010 and August 2011.
- **Comparison Group:** Customers who received NJCP audits between September 2011 and August 2012.
- **Production:** While 6,437 homes were audited in the Treatment Period, 9,780 homes were audited in the Comparison Period. In both periods, approximately 85 percent were gas and electric jobs, nine percent were electric only, and two percent were gas only.

Honeywell completed 63 percent of the audits in the Treatment Period and 52 percent in the Comparison Period. The three other contractors that performed a significant percentage of the audits were EIC, CMC, and Northeast Energy. CMC's share of the jobs increased from 13 percent during the Treatment Period to 25 percent during the Comparison Period.

- **Demographics:** Most of the households served by the NJCP program, about 70 percent, had at least one vulnerable household member who was a child, elderly, or disabled.

While the Needs Assessment found that 59 percent of income-eligible households rented their homes, the tracking database analysis showed that only 30 percent of those served were renters. However, some low-income renters would not be eligible because they lived in buildings with over 14 units or did not pay directly for electricity or gas.

- **Home Characteristics:** About 70 percent of the homes treated were single family and most of the rest were multi-family homes. Row homes were about ten percent of those served, and mobile homes were only about three percent.

About 90 percent of treated homes had natural gas heat and about ten percent had electric heat. Supplemental heating was used in a large percentage, 38 percent, of homes. Almost all of the supplemental heating was electric heating.

While 45 percent had window air conditioning units, 42 percent had central air conditioning.

- **Expenditures:** Total job costs averaged \$3,757 for homes with gas heat and gas hot water and averaged \$2,922 for homes with electric heat and electric hot water.
- **Testing Results:** There are many barriers to conducting blower door tests in the housing stock served by the NJCP program. Contractors reported that they were not able to perform blower door tests due to health and safety issues, such as mold, asbestos, vermiculite insulation, use of breathing apparatuses or other medical equipment, and customer refusals. On-site observations and inspections confirmed the frequency of such issues.

The data showed that one third of the jobs did not have a pre-treatment blower door test, and 52 percent did not have a post-treatment blower door test.

When examining the half of the homes that had pre- and post-treatment blower door test results, the analysis shows that 19 percent had a reduction of 1,000 CFM50 or more, and eight percent had a reduction of 1,500 CFM50 or more. The mean reduction was about 600 CFM50. However, previous research has found that there is not a correlation between such reductions in blower door readings and the amount of energy saved, as air leakage reductions must result from sealing at the top and bottom of the envelope in order to achieve significant impacts on energy usage.

Refrigerators were monitored in about 80 percent of the treated homes. The metering results showed that about 56 percent of the metered refrigerators had usage over 1,000 kWh, most of which would be eligible for replacement under the program.

- *Measures:* Measure installation was examined both by protocol savings category and by detailed measure group. The protocol savings category analysis showed that 79 percent had CFL's installed, 65 percent had air sealing, and 61 percent had hot water measures. Other categories where about one third or more of the jobs had measures were HVAC, refrigerators, thermostats, duct sealing, and insulation.

The NJCP program database provided a detailed list of 406 different measures. The most common measures, with penetration of over 85 percent, were the audit, energy education, and combustion testing. Air sealing was performed in 60 percent, and attic insulation in 27 percent.

The analysis showed that health and safety measures are one of the most common treatments performed by the program. These services were provided in 78 percent of homes.

- *Third Party Inspections:* 18 percent of jobs in the Treatment Group had a third party inspection, and 33 percent failed the inspection. The most common reasons for failure were health and safety problems, followed by missed opportunities.

Customer Feedback

A 15-minute telephone survey was conducted with 977 participants who received program services approximately one year earlier.

- *Respondent Characteristics* – The customer survey collected information on program participants that was not available in the NJCP Tracking database. This information demonstrates that the program is serving a group of customers who have need for assistance.
 - The survey found that 15 percent of customers served by Comfort Partners had one or more veterans in the household.

- The most common income source was retirement income. While 47 percent reported that they received retirement income in the past year, 27 percent received cash assistance, and 22 percent received employment income. In addition, 40 percent received non-cash assistance.
- Thirty-seven percent reported that someone in the household had been unemployed and looking for work in the past year.
- Reasons for Participation
 - The most common source of information for the program was a friend or relative. While 27 percent learned about the NJCP program through a friend or relative, 18 percent learned about the program through the utility, 16 percent through a government or community agency, and 15 percent through the contractor.
 - The majority of customers, 61 percent, reported that the main reason they wanted to participate in the NJCP program was to reduce their energy bills.
- Understanding of Energy Bill
 - While 43 percent of Honeywell customers reported that the provider reviewed their energy bills, 35 percent of CMC customers, 34 percent of Northeast Energy customers, and 24 percent of EIC customers reported that the service provider reviewed the energy bills.¹
 - Forty-eight percent reported that the provider explained how energy use is measured. EIC customers were less likely to report that they received such an explanation.
 - Most customers, 78 percent, reported that they felt they had a good understanding of how to review their energy bill.
- Action Plan and Actions Taken
 - Overall, 54 percent reported that the service provider gave them a written plan of actions to save energy. While 58 percent of Honeywell and CMC customers reported that their provider furnished a plan, 44 percent of EIC and 46 percent of Northeast Energy customers reported this.²
 - Twenty-seven percent reported that the service provider told them how much money they could expect to save by taking the actions on their plan.
 - Sixty percent reported that they had taken energy-saving actions, and when asked what they did, 48 percent reported at least one action.
 - When asked about specific actions, 47 percent said they reduced their heating use, 36 percent said they reduced their hot water use, ten percent said they reduced their space heating use, and 38 percent said they reduced their air conditioning use. CMC and Honeywell customers were more likely to report that they reduced their heating, hot water, and air conditioning use than EIC and Northeast Energy customers.

¹ This is consistent with the on-site observation findings. Observers found that natural gas bills were reviewed in 35 percent of applicable cases and electric bills were reviewed in 38 percent of applicable cases.

² However, evaluation observers found that a higher 77 percent of the auditors used the action plan when discussing the customers' ability to take energy-saving actions. Some customers may not recall this discussion or the survey may have been conducted with a household member other than the one home at the time of the NJCP visit.

- Program Measures
 - Most customers, 92 to 95 percent, reported that they were very or somewhat satisfied when asked specifically about insulation, air sealing, and heating system work.
- Home Comfort
 - When asked about changes in home comfort after receiving NJCP program services, 50 percent said that the winter temperature in their home improved and 39 percent said that their summer temperature had improved. Northeast Energy respondents were more likely than other respondents to report that their winter temperature had improved.
- Understanding, Impact, and Usage
 - Eighty-nine percent of respondents reported that they felt they had a good understanding of the benefits of the NJCP program.
 - When asked whether they felt the main benefit of the program was lower energy bills, lower energy use, energy education, a safer or more comfortable home, or something else, customers were most likely to report that lower energy bills, followed by a safer or more comfortable home was the main benefit. However, most customers agreed that all of these were benefits of the program.
- Satisfaction
 - Most customers provided high ratings for all aspects of the program.
 - Eighty-four percent stated that the program was very or somewhat important in helping the customer to meet his or her needs.
 - Eighty-five percent said that the program was very or somewhat helpful in teaching about energy.
 - Ninety percent said they were very or somewhat satisfied overall with the program.
 - The majority of customers did not have recommendations for improving the program. Those who did have recommendations were most likely to request additional measures, follow up or follow through on work, and improved quality of refrigerators, or additional contractor training.
- Recommendations
 - *Customer Need – The NJCP program should assert that one important program benefit is that they are helping customers in the state who are very much in need of assistance, including veterans, customers who receive cash and non-cash assistance, and unemployed customers.*
 - *Program Information Source – The prevalence of “word of mouth” marketing is an important reason to ensure that participants understand the program purpose, benefits, and customer role.*
 - *Energy Education – The utilities should provide additional guidance to EIC and Northeast Energy on providing energy education to customers, as customers served*

by other contractors were more likely to report that they received energy education and that they changed their energy usage behavior.

- *Customer Actions – Providers should be trained to furnish education on potential dollar savings from energy actions, as customers are most interested in reducing their energy bills.*
- *Program Satisfaction – There is room for improvement in the percent of customers who say they are very or somewhat satisfied with the program and providers should work on improved customer communication.*

Service Delivery Assessment

This section provides a summary of the findings from the observations and inspections. A general finding with respect to the assessment was that the auditors did not appear to see the connection between the tests they conducted, and how those findings should guide the work scope. This appears to be a significant training opportunity.

Additionally, some observers noted that the two audits per day requirement, imposed by contractors on their staff, was not always realistic in complicated homes with long travel time, data entry, and work order development. Auditors were required to work long days and complete data entry work in the evenings.

Key areas for improvement in the audit were customer education, diagnostic testing, use of testing results to inform the work scope, and baseload assessments (refrigerators, lighting, and hot water heating.)

There appeared to be a mindset among the contractors that they needed to complete all of the installation work in one day. This led to work at the end of the day being very haphazard, and the quality of this work suffering. Additionally, staff members installed certain measures when they were not appropriate. Examples include door weather stripping (removing good quality door weather strips and installing new ones), programmable thermostats, and excess insulation (wall insulation in a fully insulated wall).

Both the observations and inspections found that while the installers were likely to do the work correctly, they often did not perform the work that would have the greatest impact on energy usage. Key areas for improvement in terms of measure installation were using the blower door to guide air sealing work and general use as a diagnostic tool, duct sealing quality, safety procedures, and customer education.

The information from the observations and inspections inform the recommendations for procedures, training, and quality control.

Usage Impacts

This section provides an analysis of the energy saving impacts of the NJCP program using electric and gas usage data provided by the six participating utilities. Overall savings estimates were as follows.

- *Electric Baseload* – Savings averaged 473 kWh, or 6.6 percent of pre-treatment usage.
- *Electric Heating* – Savings averaged 1,071 kWh, or 8.2 percent of pre-treatment usage.
- *Gas Heating* – Savings averaged 50 ccf, or 4.9 percent of pre-treatment usage.

One reason that overall savings were lower than expected was the low penetration rate for major measures. This is at least partially related to the joint electric and gas service delivery model. The NJCP program serves customers with both electric and gas treatments if they are referred for one of the fuels and the customer has regulated utility service for the other fuel. For example, if a gas heating customer was targeted for service delivery due to high gas usage, the customer would also receive electric baseload NJ CP services if the customer was served by a regulated electric utility, regardless of the electric usage level of the customer. This process provides advantages to the program because the contractors are already in the home and the fixed costs of getting to the home can be allocated between the two utilities. The process also provides advantages to the customer because the customer receives more comprehensive services and only needs to work with one contractor and one set of appointments. However, it does provide constraints on the homes that each individual utility can choose to serve and may result in lower pre-treatment usage homes being served than otherwise would have been served in an individual utility program.

An analysis of the data shows that 88 percent of the treatment group received both electric baseload and gas heating services. The analysis also showed that high gas users and electric baseload users were usually not the same and most customers do not have high usage with both fuels.

Savings for jobs with major measures were as follows.

- *Electric Baseload* – Savings for jobs with refrigerator replacement (45 percent of baseload jobs) averaged 742 kWh, or 10.3 percent of pre-treatment usage.
- *Electric Heating* – Savings for jobs with at least \$1,000 in spending on air sealing, insulation, duct sealing and HVAC combined (40 percent of electric heating jobs) were 1,867 kWh or 12.6 percent of pre-treatment usage. Jobs with air sealing, insulation, duct sealing, and refrigerator replacement saved an average of 2,714 kWh or 17.8 percent of pre-treatment usage.
- *Gas Heating* – Savings for jobs with at least \$1,000 in spending on air sealing, insulation, duct sealing and HVAC combined (45 percent of gas heating jobs) were 80 ccf, or 7.3 percent of pre-treatment usage. Jobs with air sealing, insulation, HVAC

work, duct sealing, and hot water work saved 124 ccf, or 10.4 percent of pre-treatment usage.

Savings were found to vary by contractor.

- *Electric Baseload* – Honeywell had higher savings than the other contractors, averaging 540 kWh or 7.5 percent of pre-treatment usage, compared to about 300 kWh on average for the other contractors. Honeywell achieved higher savings by metering and replacing a higher percentage of refrigerators, by installing a greater number of CFLs, and by achieving higher savings in jobs with refrigerator replacement than some of the other contractors.
- *Electric Heating* – Honeywell averaged about 900 kWh in savings, compared to about 750 kWh for CMC and EIC. However, differences were not statistically significant due to the small sample sizes.
- *Gas Heating* – Northeast Energy saved about 100 ccf or eight percent of pre-treatment usage and CMC saved about 70 ccf or 7.5 percent of pre-treatment usage compared to 37 ccf for Honeywell and 48 ccf for EIC. While Honeywell and CMC installed major measures in about 40 to 50 percent of these jobs, EIC and Northeast Energy installed major measures in close to 60 percent of these jobs. CMC and Northeast Energy had higher savings than EIC and Honeywell in homes with major measures.

The overall program was not found to be cost-effective due to the lower than expected savings. However, electric heating jobs with major measures overall, insulation work on electric heating jobs, and programmable thermostats on gas heating jobs were close to cost-effective or cost-effective.

The realization rate analysis showed that savings estimated through the usage impact analysis were generally lower than those projected using the protocols. NJCP applies deemed savings protocols as required by the BPU.

- Average electric baseload realization rates were 35 percent of those projected through the NJCP Energy Saving protocols.
- Average electric heating realization rates were 65 percent.
- Average gas heating realization rates were 50 to 60 percent. CMC had the highest gas heating realization rates, with an average customer realization of 130 percent and an average program realization of 92 percent.

Affordability Impacts

The Affordability Analysis examined the impact of reduced usage on bill affordability and payment coverage rates.

- *Electric and Gas Charges:* The analysis showed a net reduction in charges for electric baseload, electric heating, and combination gas and electric bill customers. While electric baseload customers had a \$58 net decline in electric charges, electric heating customers had an \$87 net decline in electric charges, and combination customers had a \$107 net decline in electric and gas charges.
- *Coverage Rates:* Most of the average total coverage rates did not improve for participants due to the decline in assistance payments. However, electric heating customers in the treatment group were more likely to cover their full bill after receiving services as compared to the comparison group. While the treatment group increased the percent covering the full bill from 58 percent in the pre period to 70 percent in the post period, the comparison group increased their percent covering the full bill from 56 percent in the pre period to only 60 percent in the post period.
- *USF Participation and Credits:* Treatment group customers who received a USF credit in the pre and post periods were more likely to reduce the credit amount and were less likely to increase the credit amount than comparison group customers who had a credit in both periods. While 32 percent of the treatment group had their monthly credit increase compared to 37 percent of the comparison group, 56 percent had their monthly credit decrease, compared to 51 percent of the comparison group. This positive impact of the NJCP program results in reduced ratepayers subsidies for the USF program.

Overall, the analysis showed small but positive impacts on affordability and a positive impact for ratepayers, as the USF credit declined.

Energy Saving Protocols

The Energy Saving Protocols review provided an analysis of current NJCP Energy Saving Protocols, made recommendations for changes to some of the protocols, and provided additional protocols for measures that are not currently included or are being considered for addition.

Checks of the Energy Saving Protocol calculations found that almost all of the savings data in the NJCP Tracking database matched the specifications provided in the documentation. The one exception was furnace and boiler replacements.

The following key changes were recommended.

- Refrigerator Removal – The savings from additional refrigerator removal should be calculated.
- Hot Water Measures – The savings from individual measures should be calculated rather than including savings for a standard package of measures.

- Shell Measures – The spending thresholds for applying percentage savings should be increased for air sealing and insulation. The percentage savings applied should be lowered for duct sealing and insulation.
- HVAC Replacement and Repairs – Savings for replacement and repairs should be calculated separately.

Additional protocols were recommended for measures that were not included in the protocols or that were being considered for addition to the program. Engineering estimates were provided for the protocols where input data were available or default values could be used.

Recommendations

The evaluation found that the program was not achieving the savings that were expected, that there were weaknesses in the audit and installation procedures, and that there were many missed opportunities for installing the most cost-effective measures. Many of these missed opportunities would not result in greater expenditures, as they would require re-prioritizing or better quality work done, for example performing blower-door guided air sealing to ensure that the most important leaks in the attic were sealed. However, the analysis also found that in over 70 percent of the cases where there were missed opportunities, the contractors did not spend up to the seasonal guideline, and could have done a more thorough job.

Recommendations for the data tracking system, program procedures, training, customer targeting, quality control, and the improvement process are summarized in this section. Additional details on these recommendations are provided in the final section of this report.

Data Tracking System

The NJCP Tracking System provides important data to manage and implement the program, to evaluate the program, and to determine how the program can be improved. The system is one of the strengths of the program, as data that are available to program managers and contractors are much more comprehensive than have been seen in many other programs. Recommendations for improving the system to provide for more efficient program management and operations and to allow for a more comprehensive evaluation are summarized below. However, it is important to weigh the benefits of such improvements with the costs of the required programming work.

- Management – Two utilities noted that they utilize the messaging function in the NJCP system. All utilities should use this function as it is important that critical information becomes a permanent part of the customer's job record.
- Reporting – Additional reports that provide summary statistics could provide useful information to help manage the program. For example, the following types of reports,

by contractor and utility over specified time periods, may be useful for utilities and/or contractors.

- Number of jobs audited, installed, and completed
 - Percent of jobs deferred or partial due to service delivery barriers
 - Average job cost
 - Percent of jobs that have certain key measures installed
 - Average measure cost for key measures installed
- Operations – The NJCP Tracking System should allow contractors to download data on the jobs that they served. This could allow the contractors to then upload those data into their own systems to avoid double data entry and reduce data errors. It could also allow the contractors to generate their own reports for program management.
 - Data Accuracy – In our use of the NJCP tracking database to request usage, billing, and payment data from the utilities, we found many inaccuracies in the account numbers contained within the tracking system. We recommend that the utility managers require that the contractors develop and submit a data quality control plan and that the tracking system include, as planned, additional data quality checks.
 - Evaluation Data – Previous research has documented the potential and actual health and safety benefits that result from energy efficiency services. Some of these impacts can be best documented using data that are collected on the audit paperwork, but that are not currently included in the tracking system data fields. Adding fields to the database would allow for analysis of the prevalence of these types of issues and how frequently they are resolved by the program. The NJCP program could then document the health and safety impacts.

Program Procedures

The following were the ten most important recommendations for changes to the NJCP program procedures. While some of these recommendations relate to changes in current procedures, many relate to increased emphasis or clarity on the most important areas for service delivery.

1. Testing – Use testing results to guide work and affirm continuous thermal boundary.

The observation and inspection work found that while extensive testing was conducted, that testing was not used in most cases to inform the process and perform air sealing work in a way to achieve the best results for each individual home.

We recommend the following changes in procedures to align the work with audit and testing results.

- Continuous thermal boundary – Contractors should be required to identify the thermal boundary, use testing for verification, and document this assessment in the audit write-up.³
- Air sealing targets – The auditor should be required to develop air sealing targets that are based on the condition of the home and the blower door should be used by installers as a guide and reduction measurement tool during the air sealing process.
- Prioritize air sealing work in the most important areas of the home – Establish a clear priority for air sealing activities.⁴
- Consider linking payment to contractors for air sealing measures on air leakage reduction.
- Use zonal testing to determine when insulation can be installed and attics left unventilated.⁵
- Target comfort issues noted by customer.⁶

2. Duct Sealing - Use pressure testing to guide duct sealing, and focus work on areas with the greatest potential for savings.⁷

The pressure pan testing should be used to ensure that leak sealing focuses on ducts that are outside the thermal barrier. Duct leakage to attics and crawlspaces results in moisture issues and significant heat loss. Leakage into basements and other conditioned

³It may be useful to create form sections that force the auditors to identify the existing and proposed thermal boundaries for knee wall attics and crawlspaces. For example, they could be required to state whether the existing thermal boundary for knee wall attics is (1) the rafters, or (2) the knee wall and attic floors. Then they would be required to state where the proposed thermal boundary should be. A similar approach for crawl spaces would require them to state whether that space will be (1) vented and isolated from the house, or (2) unvented and connected to the house.

⁴This procedure is included in the NJCP Procedures Manual, but needs additional emphasis in implementation.

⁵Ideally, every attic should have ventilation installed. Installing insulation in a ceiling without ventilating the attic above presents a risk of moisture condensation. However, there are cases where it is impractical to install effective low and high ventilation, such as knee wall attics, houses with no eave overhang, and row houses with parapet walls.

In these cases, it may still be desirable to install insulation, but the contractors should have clear guidelines about completing pressure testing to ensure that the attic has been thoroughly air-sealed from the living space. This testing can be difficult because the readings will be difficult to interpret due to the lack of existing ventilation.

One viable approach is to have the program QA contractor complete a study on program houses. They can measure the house-to-attic pressure, note whether the attics are vented and apply a qualitative assessment of the air sealing work. Once adequate data has been collected, a minimum allowable attic-to-house pressure threshold can be established for both vented and unvented attics. Additional detail on the importance of attic ventilation is available at: <http://www.buildingscience.com/documents/digests/bsd-102-understanding-attic-ventilation>

⁶This was not emphasized by the auditors in our observations. In many cases, the auditor asked the customer about comfort issues and wrote the information down on the data collection form, but did not use that information when developing the proposed work scope. It was rare to see insulation, air sealing, or distribution modifications specifically targeted at comfort complaints. It was also rare for an auditor to follow up with the customer at the end of the audit and explain what the program might be able to do to help resolve the comfort issues that were noted by the customer.

⁷This is not what was observed. The auditors and crews routinely took pressure pan readings. It was clear that they knew that they had to collect the data and write it down on the forms. However, in many cases, they didn't use that information to ensure effective work. For example, auditors were observed measuring low pressure pan readings on first floor registers, but still specifying sealing of basement supply ducts in the work scopes. And crews were observed getting (post-duct sealing) pressure pan readings nearly identical to those on the audit report, but not investigating to see why their work had not resulted in an appreciable performance improvement.

zones should not be a focus unless visual inspection and CAZ testing indicate that there is return leakage that is creating substantial depressurization of the CAZ. Post testing should be used to confirm the leaks have been sealed.

3. Work Order - Require use of a work order that provides clear direction on work to be done.

The current manual contains a data collection form that is also used as a work order. The program should develop and require the use of a work order that provides clear directions to the installers on what measures are to be installed and where they should be installed. The work order should also include air sealing and duct sealing targets.

4. Health and Safety – Provide clear guidance to contractors on work to be done.

A judgment call is required when determining whether work should proceed if there are existing Health and Safety issues in a home, but the program should provide better guidance in this area and should collect information to provide more complete and consistent tracking of these issues.

- Provide a stand-alone worksheet for health and safety items where the auditor and installers will inspect, and repair or replace any item on that checklist.⁸
- Provide a systematic way to address minor health and safety issues.⁹
- Develop a systematic means for tracking issues that are not addressed so that deferred homes are not again treated by the program unless the issue(s) have been resolved. We found that homes with health and safety issues identified previously were being re-visited for treatment although the issues had not been resolved.

5. Spending Guidelines – Refine the guidelines to provide better relation to savings opportunities.

We recommend review of the following aspects of the spending guidelines.

- Large Fluctuations at Discrete Points: The gas spending guideline as a function of annual usage has large jumps at specific usage values. While this structure has the advantage of simplicity, a smoother structure may produce better results. We have provided a proposed spending guideline (in a separate Excel document) that approximates the current guideline but provides a smoother structure.

⁸We recommend that NJCP develop a checklist that is part of the project documentation that gets passed along from the auditor to the installers and final inspector. The current health and safety protocols are resulting in confusion throughout the process that results in major measures not being installed, installers having to abort installation visits, and homes deferred in the past reentering the program with the problems still existing. Having a checklist will allow the decision process to be clear and should be monitored to see that everyone has the same view of a home so that missed opportunities and disruptions to measure installations can be reduced. Deferred customers should be flagged, allowing those that resolve the problem back into the program before five years and stopping deferred customers that still have problems from reentering. The current NJCP list of health and safety issues is good. The checklist should show whether an issue exists and if it does the location(s) should be indicated.

⁹ There is \$500 available to address minor health and safety issues in a home.

- For attic air sealing and insulation, the guidelines have similar sharp cutoffs to the spending guidelines. Consider allowing all attics to be air sealed and insulated to current Code levels (IECC 2009).¹⁰
- Only Usage-Adjusted: The spending guidelines are currently based on absolute annual usage levels and do not vary by the size of the home. The usage should be weather normalized, and the size of the home should be taken into account.
- Default Values: The spending guideline approach instructs contractors to use default values if twelve months of customer usage history is not available. However, if usage data are available for most of the year, these data should be extrapolated to estimate a full year of usage.
- End Usage Breakout: The disaggregation of electric and gas bills, and the assignment of usage by end use, i.e. heating, cooling, water heating and baseload, would allow the spending to be more closely aligned with the savings opportunities.

6. Manual Organization – Reformat the Manual and provide laminated information sheets to use in the field.

Modify the Manual to make it more useful. The Manual has been modified over time and is in need of an overhaul to be more effective.

7. Wall Insulation and Kneewalls – Require insulation work to be encapsulated.

Any wall insulation installed by the program should be encapsulated. An air barrier of house-wrap, bubble-wrap, or rigid foam on the exterior side of wall insulation would greatly improve the effectiveness of the wall insulation.¹¹

¹⁰The current guidelines only allow attics to be addressed if usage is high enough to create a seasonal spending allowance large enough to cover the cost. Attic air sealing and insulation is a long life measure that has both comfort and energy saving benefits. We are suggesting that the program consider bypassing the spending limits to install this measure even in cases where the current usage is low. We recommend that the NJCP utilities implement a pilot process whereby contractors are not required to request permission from utilities for this measure. The utilities should review the costs of this change after one quarter and determine if the pilot should be continued as a regular program procedure.

¹¹Insulation on vertical surfaces is fully effective only if it is protected from air movement. For fiberglass insulation, it must be enclosed on all six sides (encapsulated). During the evaluation, we frequently saw program contractors leave the exterior side of insulation exposed to attics. We recommend that any wall insulation installed by the program be required to be encapsulated. If cost-control is a concern, the use of house-wrap is the most affordable option.

This treatment is already included in BPI retrofit standards. The Envelope Professional Standard states “Insulation installed in kneewalls or other exposed vertical areas must be covered on the cold side with an air barrier such as plywood or housewrap to protect the insulation from wind-washing and free convection within the insulation. This measure is not necessary if rigid foam insulation is used.” The 2009 IECC also requires in Table 402.4.2 that “Air-permeable insulation is inside of an air barrier.”

8. Programmable Thermostat – Provide guidance on installation determination and models to install.

Too many setback thermostats are installed in homes where the occupants don't understand and can't learn how to program them. A decision tree should be developed so the auditor can determine if a setback thermostat is appropriate.

The following major factors should be considered:

- Current Behavior – Is the customer effectively practicing manual setback? If yes, a programmable thermostat will not result in savings.
- Interest – Is the customer interested in a programmable thermostat? Many seniors will not want them.
- Are the residents away from the house during a significant percentage of hours each week? Many seniors will not be.
- Is the heating system appropriate for a programmable thermostat? Heat pumps present challenges, due to the possibility of expensive strip heaters being activated. Electric baseboards and steam heat systems can also be troublesome, due to slow recovery times.

The program should review the June 2014 Consumer Reports list of recommended models and have contractors submit proposed models for approval.

9. Water Heater Wrap – Provide guidance on assessment and installation.

Tank wraps are installed with high frequency, but the impact is limited, in part because they are installed on tanks that don't need them¹² and in part because the materials are not installed properly. Reflective insulation requires that an air gap exist between the insulation and the tank. The program should provide guidelines for when to install and require that the installation be done in this manner or remove this type of insulation from the list of acceptable materials.¹³

10. Windows and Doors – Provide clear specification on how to address.

Problems with windows and doors related to operation and energy efficiency are common. We recommend the following program changes to better address these issues.

- Perform selective window and door replacement to address performance issues that have a significant impact on comfort, energy use, and/or health and safety.

¹²They don't need them because they were manufactured with adequate insulation or because they are installed in conditioned spaces.

¹³ The NJCP manual already states "Install supplemental insulation jackets on electric water heaters if the heater has a manufacturer's insulation that is less than R-12." The form should require the auditor to document this rating. It doesn't specify what to do with gas models, on which the insulation is less useful because most of the heat loss is up the flue. It also states to "Wrap water heaters whether in heated or non-heated areas." This should be reconsidered.

- The window sealing work scope should be guided by blower door tests and explicitly describe where to seal. The current work order description “caulk windows” is insufficient direction to a work crew.
- Evaluate cost-effective alternatives to window replacement, such as interior storm products (Quanta Panel is one such product).
- Standardize door weather-stripping, such as Q-lon, to ensure quality, ease of installation and use, and uniformity.

Contractor Training

Specific recommendations for contractor training are summarized below.

1. Contractors appear to need review of basic building science, the “house as a system”, why the work is being done, and how the measures work.
2. Using testing results to guide work and affirm continuous thermal boundary.
3. Use of pressure pan testing to guide duct sealing.
4. Writing a clear and comprehensive work order that effectively passes information from the auditor to the installation team.
5. Customer education, partnership development, action plan, thermostats, and lighting. Working with the customer to obtain and use information to improve service delivery and effective measure installation.
6. Diagnosing and addressing high electric baseload usage.
7. Currently, the primary credential held by the contractors is BPI Building Analyst Professional (BA). It is required for all of the auditors and installation crew leads.

Given that much of the work done by the contractors is insulation and air sealing, and that the program evaluation found that this work often fell short of expectations, it may be sensible to also require auditors to attain BPI Envelope Professional certification.

It could also be helpful to require all crew leads to attain Building Analyst certification to ensure they have a sound understanding of the theory behind the retrofits and testing they undertake on treated homes.

In some cases, the contractors encounter unusual issues with heating systems that require knowledge beyond what a BA must know. It would be useful for each contractor to have a certified BPI Heating Professional on staff who could serve as a resource for their other staff members.

Customer Targeting

The NJCP program has faced challenges in continuing to find high usage customers to serve. The program should reassess outreach procedures and consider the following options.

1. Health and Safety Issues – Many homes do not receive comprehensive services due to health and safety issues. In rare cases, the customer resolved these issues and the contractor has refused to return to the home. The NJCP program should require that contractors follow-up on these jobs. In other cases, the customer does not have the resources to address the identified issues. The NJCP program should investigate whether the program can cost-effectively resolve a greater percentage of these issues.

The NJCP Working Group has already identified a plan to address these issues. Honeywell will now request a price quote for one of their approved vendors when they identify a home with moisture or mold that needs to be remediated prior to NJ CP work being performed. Following approval from the utility, this work will be implemented and then the NJ CP energy conservation work will proceed. The Working Group has also hired an additional contractor that will address health and safety issues. GreenLife Energy Solutions will eliminate moisture problems that are the source of the mold growth and then proceed with energy efficiency measures.

2. USF Participants – Many USF participants refuse to participate in the NJCP program. The utilities should investigate whether they can provide greater encouragement for these customers to participate in an audit and perhaps be convinced to move forward with service delivery.¹⁴
3. Previously Treated Homes – The NJCP program returns to many homes that were treated more than five years ago but still do not have cost-effective energy-saving opportunities. The NJCP program should consider a more extensive analysis of usage and opportunities prior to returning to these homes.

Quality Control

Utilities revised the third party quality control inspection process in August 2012 so that jobs with “non-critical problems” passed inspections rather than failing. A new category of “Pass with Action Required” was added so that if the inspector visits the home more than 30 days after the services are delivered and finds an issue, the job would be considered “Pass with Action Required” instead of failed.

The evaluation found (as a result of observations, inspections, and usage impacts) that better work quality should be demanded of the contractors. Based on initial evaluation findings, the Working Group has already refined the quality assurance plan. They hired a new quality assurance contractor that will implement additional quality assurance procedures and contractor training beginning in 2015.

¹⁴Some vendors have used gift cards as an incentives. Call center personnel have been trained on how to engage these low-income customers.

Improvement Process

We recommend that the NJCP program undertake a quality improvement process with the following steps.

1. Refine – Review and refine the program procedures. Train the contractors on areas of key weakness.
2. Pilot program changes – Pilot a new process for compensating contractors to achieve results. Pilot new procedures for treating different types of homes, including homes with low usage, high baseload usage, health and safety problems, and homes previously treated by the NJCP program.
3. Conduct quality control – Continue to observe work in the field and conduct inspections of completed jobs. Review all aspects of the work, including audits, documentation of the work scope, and measure installation.
4. Hold contractors accountable – Periodically review work at the contractor level. Remove contractors who do not meet NJCP program standards or require remedial training and improved results for continued participation in the NJCP program.
5. Assess results – Conduct analysis of the energy saving results on a regular basis. One evaluation every ten years is not sufficient to ensure that the program is achieving the expected results. If done on a regular basis, utilities could develop procedures to more easily extract usage data and the impact evaluation could be completed at much lower cost. Compare results over time, assess what is working, and refine the program regularly.

I. Introduction

The New Jersey Comfort Partners Program (NJCP program) provides critical usage reduction and health and safety services to low-income households, resulting in more affordable energy bills, reduced ratepayer bill subsidies, improved comfort, and healthier homes. New Jersey ratepayers invest significantly in NJCP program services, as the annual budget is over \$30 million. A comprehensive evaluation was undertaken to determine the extent to which the program investments have accomplished the program goals, where there are opportunities for increased effectiveness and/or reduced costs, and how those improvements can be accomplished.

A. *Evaluation*

The goals of the NJCP Evaluation were as follows.

1. Determine the extent to which the program goals are achieved.
2. Provide feedback on how the program may be modified to better achieve those goals.

The evaluation activities that were undertaken are briefly described below. Summaries of results from all of these activities are included in this report. More detailed memos are available that provide comprehensive information on the research methodology and findings.

1. *Procedures and Materials Review* – We reviewed and assessed the NJCP program procedures manual and additional materials including staff training, marketing, and reporting.
2. *Needs Assessment* – We analyzed American Community Survey data to provide information on the characteristics and needs of NJ households that are eligible for the program.
3. *Utility Manager Interviews* – We conducted in-depth interviews with managers and staff at the six participating utilities to develop a complete understanding of program design and implementation. We reviewed utility decision making for consistency and potential barriers to program effectiveness.
4. *Contractor Manager Interviews* – We conducted in-depth interviews with managers and staff at the five prime service delivery contractors and the quality control inspector. The interviews included discussion of staff experience, training and certification procedures, performance tracking, and recommendations for program improvement.

5. On-Site Contractor Interviews and Assessments – We spent one day on site at each of the five service delivery contractors to assess program management and operations. We conducted interviews with auditors and installation staff at each contractor’s office.
6. Program Data Analysis – We conducted analysis of the NJCP program tracking system data to characterize the program, including customer and housing characteristics, measure installation penetration and costs, and health and safety spending.
7. Data Tracking System Review – We identified the program’s information needs; reviewed the content and quality of information in the current tracking system; assessed the sufficiency, accuracy, and efficiency of the system; determined how the system is used by program partners to effectively manage the program; and developed recommendations for enhancements to and use of the system.
8. Customer Survey – We conducted a survey with program participants to assess program understanding, impact, and satisfaction.
9. On-Site Observations – We conducted on-site observations of audits, measure installation, and final inspections using a detailed data collection system to assess whether key steps and tests were conducted, and rated the quality and comprehensiveness of the services.
10. Inspections of Completed Jobs – We conducted inspections of 288 completed jobs to provide a statistically reliable analysis of the quality and comprehensiveness of Comfort Partners jobs.
11. Usage Impact Analysis – We obtained energy usage data from the six utilities and conducted weather normalized, comparison group adjusted analysis of the energy impacts of the program on natural gas and electricity consumption by contractor, utility, heating fuel, and measures installed. We conducted cost-benefit analysis on the program as a whole and on the measures installed.
12. Engineering Impact Estimates – We used the data on measures installed in the tracking system to estimate impacts for new recommended energy saving protocols.
13. Savings Realization Rates – We compared Protocol Savings Estimates to savings estimated in the usage impact analysis and computed the savings realization rates.
14. Affordability and Payment Impact Analysis – We analyzed customer billing and payment data to estimate the program’s impact on energy bills, USF subsidies, energy burden, and energy bill payment.
15. Energy Saving Protocols – We reviewed and verified the appropriateness of existing energy saving protocols, recommended changes that could improve the accuracy of the savings estimates based on findings from the impact analysis, and provided information

on energy savings equations used by energy programs in the Northeast for additional measures not currently included in the NJCP program savings protocols.

B. Organization of the Report

Ten 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.
- 2) *Section III: Needs Assessment* – This section provides a profile of New Jersey’s low-income households based on data from the 2009-2011 American Community Survey. The section provides information on the demographic characteristics, energy assistance needs, and efficiency service needs of low-income households throughout the state and by county.
- 3) *Section IV: Procedures Review* – This section provides recommendations for changes to the NJCP program procedures, based on review of the procedures manual, Building Performance Field Guide, audit forms, application, education materials, and brochures.
- 4) *Section V: Participant Characteristics and Program Services* – This section provides information on the demographic characteristics of participants, their home characteristics, and program services delivered based on analysis of data included in the NJCP Data Tracking System.
- 5) *Section VI: Customer Feedback* – This section provides a summary of findings from telephone interviews with 977 program participants who had their installations completed approximately one year prior to the survey.
- 6) *Section VII: Service Delivery Assessment* – This section provides a summary of findings from the 18 weeks of on-site observation and the 288 inspections of completed jobs. The section also provides an assessment of the quality and comprehensiveness of service delivery and makes recommendations for additional contractor training.
- 7) *Section VIII: 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 energy usage by participating customers. This section analyzes the cost-effectiveness of the program and the realization of savings projected using the NJCP Energy Saving Protocols.
- 8) *Section IX: Affordability Impacts* – This section provides an analysis of the impacts of the program on energy bills, energy burden, payment coverage rates, participation in the New Jersey Universal Service Program, and the amount of Universal Service Program credits received.

- 9) *Section X: Energy Saving Protocols* – This section reviews the protocol calculation formulas, provides recommendations for changes to those formulas, and provides a review of protocol savings formulas for NJCP program measures that are not currently included in the Energy Saving Protocols.
- 10) *Section XI: 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.

APPRISE acknowledges the participation of subcontractors who made important contributions to this research. These contributors are Michael Blasnik & Associates, Dave Bone, MaGrann Associates, and Ken Tohinaka. These subcontractors provided valuable technical feedback and conducted the on-site observations and inspections that led to many of the findings contained in this report.

II. New Jersey Comfort Partners Program

The New Jersey Comfort Partners Program (NJCP program) provides no cost energy efficiency services to low-income 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 well-being of low-income 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 shell 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 joined together to create 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 uses, 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.

- Achieve 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.
- Improve participant comfort, health, and safety.

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 to permit utilities to collect funds for public programs through this charge. The SBC is a charge for each kWh or therm consumed that equals approximately 3.8 percent of a customer's energy bill. In 2010, there was \$698.2 million spent on SBC funded programs.

Table II-1 displays the budget for the NJCP program. The table shows that the budget was approximately \$30 million per year from 2010 through 2013.

**Table II-1
NJCP Program Budget
2010-2012**

	Admin and Program Development	Sales, Marketing, Call Centers, Web Site	Training	Rebates, Grants and Other Direct Incentives	Rebate Processing, Inspections, Other QC	Evaluation and Related Research	Total
2010	\$1,856,184	\$554,100	\$283,300	\$27,566,024	\$1,934,889	\$12,000	\$32,206,497
2011	\$1,679,788	\$460,211	\$243,362	\$26,512,212	\$1,933,736	\$0	\$30,829,308
1/2012 – 6/2013	\$2,853,576	\$868,086	\$403,292	\$42,416,969	\$2,458,076	\$1,000,000	\$50,000,000

B. Utilities

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

**Table II-2
NJ 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.

Each utility has individual arrangements with contractors with respect to sharing lists of USF customers for program outreach and providing customer usage data. While some of the utilities are able to provide direct access to their customer information system so that contractors can obtain usage data, others provide the information via email.

The utility managers were asked to provide general information about the program and areas for improvement. They noted the following strengths and accomplishments of the NJCP program.

- Health and safety corrections (6 utilities). Specifically, two utility representatives cited carbon monoxide. All utility representative believe that the health and safety benefits are understated because they are the most difficult to quantify.
- Energy saving measures and reduced energy costs (4 utilities). Specifically, one utility representative cited the thousands of customers served by the NJCP program who would otherwise not have been treated.
- Collaboration between parties involved in the program (2 utilities).
- Joint delivery of services. The delivery is seamless for the customer and better coordinated in New Jersey than in other states.
- Ability to meet production goals.
- Technical capabilities of the program.
- Quality of the contractors.
- USF subsidy reduction.
- The societal benefit of the program, which has a positive impact on the perception of the BPU.

When asked about the greatest challenges their utilities face in implementing the NJCP program, utility representatives reported the following.

- Budget flexibility or fiscal challenges (4 utilities). Specifically, three utility representatives cited the challenges their utilities face in not being able to move funding resources between budget categories. Utilities can request permission to do so, but it is a long process with the BPU.
- Enrolling USF customers.
- Ensuring that services are offered and provided consistently throughout the state.
- Obtaining landlord consent.
- Senior citizens' unwillingness to accept services.

Additionally, three utility representatives indicated challenges related to their contractors.

- Ensuring contractors are performing all possible work (2 utilities). Specifically, one utility representative reported that it is difficult to get some contractors to think outside of the box and take extra steps to do more for the customer.

- Ensuring quality work is performed by contractors.
- Ensuring contractors represent the utilities and NJCP program as best as possible.
- Finding knowledgeable and qualified contractors.

Four utility representatives indicated that they would like to make changes to the NJCP program. They indicated the following changes.

- Offer measures to renters or customers in multi-family buildings (2 utilities). Specifically, one utility representative reported that the utility would like to treat the whole building, but often times it can only treat a single apartment or unit of a multi-family building because the program requires utilities to qualify each individual unit.
- Require USF customers to have an audit performed through the NJCP program.
- Make energy savings a performance metric in the program.

One utility representative indicated that the utility does not face any barriers when attempting to make changes to the NJCP program. However, the other representatives indicated several barriers.

- The BPU's process for budgetary changes (3 utilities). Generally, the utility representatives indicated that the BPU provides utilities with a fair amount of discretion in making program changes and does not micromanage, but the process for budgetary changes is not flexible.
- Disagreements among utilities. However, the utilities are mostly able to agree on program changes.
- Funding availability. However, the utility representative noted that because funding ultimately comes from ratepayers, an increase in funding may lead to an increase in rates.
- Internal barriers from legal and procurement departments at the utility.

C. Contractors

The NJCP program works with five prime service delivery contractors, several subcontractors, and a third party quality control inspector.

The program's minimum requirements for the service delivery contractors are as follows.

- Auditors must have BPI certification and demonstrate that they have the knowledge to test the home and make recommendations based on building science principles.
- Crew/team leaders must be BPI certified as a Building Analyst Professional.
- Business must be based in NJ, have a satellite in NJ, or be willing to establish an office in NJ.
- Personnel must demonstrate the ability to communicate effectively with all types of people.
- Energy educators must have strong communication skills and expertise in personal motivation, training, and adult education methods.

- Personnel performing direct installation work must meet the following requirements.
 - Possess a minimum of 6 months hands-on field experience relative to the installation and execution of zonal pressure diagnostics using a blower door and gauges.
 - Have proof of technical competency.
 - Have prior training and experience in basic home weatherization, HVAC, water heating, and electrical systems.
- Own or be willing to purchase all diagnostic equipment needed to test and audit the home.
- Have been in business for more than one year performing energy audits and installing measures.
 - Must have completed 25 residential audits in the past year.
 - Must have completed the installation of energy saving measures for 25 homes in the past year.
 - Must be able to provide 12 customers where work was performed in NJ for inspection by utilities.

The 2009 and 2013 RFPs for service delivery stated that contractors' performance will be assessed based on factors including the following.

- Number of households treated
- Supportiveness of administrative and management teams
- Quality assurance inspection results
- Timeliness of serving customers and correcting failures
- Invoice accuracy
- Audit completeness
- Impacts on energy affordability
- Comprehensiveness of treatments
- Participant comfort, health, and safety
- Customer satisfaction

Table II-3 displays information on the prime contractors and their use of subcontractors. While Honeywell subcontracts both the audits and the measure installation work, CMC conducts the audits with their own staff and works with subcontractors on measure installation, and the other three contractors use their own staff for audits and almost all measure installation.¹⁵

Table II-3
NJ Comfort Partners Service Delivery Contractors

Prime Contractors	Subcontractor Use
CMC Energy Services	Measure Installation

¹⁵ Honeywell revised their business model in early 2014 so that most of their audits are now performed with in-house staff. Currently, only one of Honeywell's subcontractors is conducting audits.

EIC	Plumbing/Electrical
Honeywell	Audits and Measure Installation
North East Energy	Plumbing/Electrical
Optimal Energy	Plumbing/Electrical

The contractors generally felt that there was enough flexibility in the program funding to allow them to realize potential accomplishments. Contractor recommendations with respect to increased flexibility were as follows.

- Consistency between utilities and over time in terms of when contractors can exceed the spending allowance or increase spending on health and safety.
- The seasonal spending allowance limits the work that can be done. (However, the evaluation found that the contractors often do not spend the full seasonal spending guideline.)
- Allowing for treatment of multi-family buildings even if less than 50 percent of the tenants are eligible for the NJCP program. Under current rules, multi-family tenants are often not able to benefit from the full set of potential measures.

Contractor Training

Rather than directly providing regular training to contractors and their staff, the NJCP program designated monthly administrative funding for contractors that must be used for staff training. One use of the funding that is encouraged is sending contractors to the ACI Home Performance conferences. The NJCP program has trained contractors on the use of the NJCP Tracking System.

One of the process improvements that the NJCP has planned is quarterly training provided by the program's quality assurance contractor, CSG. Starting in the first quarter of 2015, CSG will begin holding a quarterly training class to provide technical guidance to contractors in areas that had been identified as weaknesses during the quality control reviews. Program auditors and crew leads will be required to attend at least two of the four training classes each fiscal year.

Contractors' comments about training included the following.

- It would be difficult in terms of lost production and lost revenue for their field staff to attend training. It would be helpful if the program could cover the labor cost for their field staff to go to training.
- The program does not provide training but the contractor provides all required training to staff members.
- There are strict guidelines about credentialing employees. This is done at the contractor level. This allows the contractor to groom their own staff in the way that they feel works.

Comments about the sufficiency of training and training budgets included the following.

- The contractor can contact utility managers if needed and the utility would provide more training.
- The contractor had needed to retrain staff because of changes to the program requirements.
- It can take six months to train an auditor to an intermediate level, so the program budget cannot cover that level of training. The contractor provides on-the-job training to groom their staff as technicians and crews.

Contractors use the following methods to train their staff and subcontractor staff.

- They provide on-the-job training and in-field mentoring (5 contractors).
- They provide program-specific training and test to ensure that the staff understand the program (2 contractors).
- After the 90-day probation period, training focuses more on building science principles and weatherization practices, OSHA training, EPA lead training, and BPI standards.
- Staff have the opportunity to receive BPI certification. Staff with HVAC experience can receive advanced certification in heating and cooling.

The following was reported with respect to on-going training.

- Opportunities to receive BPI certification or Continuing Education Units (CEUs) to maintain their BPI certifications (3 contractors).
- Training when procedural updates are made (2 contractors).
- Weekly meetings or calls with staff and/or subcontractors (2 contractors).
- Quarterly training updates on the program.
- Lunch and learns on various topics.
- Bi-annual training and procedure review meetings.
- Ongoing training with subcontractors in the field to ensure that procedural changes are complied with.

The contractors reported that they implement the following procedures to assess staff capabilities.

- Inspections of work completed, observation of work, and mentoring (5 contractors).
- Customer comments (2 contractors).
- BPI training and re-certification (2 contractors).
- Performance reviews (2 contractors).
- Internal staff testing.
- Utility checks.

While none of the managers felt that additional training was necessary, they reported that areas that could be updated were health and safety, customer service skills, and new measures and procedures.

Three auditors indicated that they did not require any further training to perform work for the NJCP program. One auditor indicated the need for BPI Heating certification and to attain education credits to maintain certification. Another auditor indicated the need for BPI Multi-family and HVAC certifications.

Among installation crew members, the following needs for additional training were indicated.

- BPI certifications (3 installation crew). One installation crew member specifically mentioned the BPI multi-family certification. Another installation crew member mentioned the BPI auditor certification.
- Heating and air conditioning.
- Infrared training if it is used in the program to verify measures.
- Leadership.

Subcontractors

Contractors use the following methods to perform quality control on the work of their subcontractors.

- Field inspections and observations of ongoing work (5 contractors). While one contractor stated that they observe or inspect 15 percent of the work, three noted that they inspect or attempt to inspect all jobs done by subcontractors.
- Calls to participating customers (2 contractors).
- The contractor almost always has staff on the job with the subcontractor.
- Information from third party quality control inspector.
- Weekly calls with the subcontractors to provide feedback on all quality control.
- Paperwork review.

Scheduling and coordinating operations were the greatest challenges noted in terms of working with subcontractors.

Internal Quality Control

All contractors described internal measures to maintain quality control. Contractor managers mentioned the following measures.

- Site visits and inspection with re-testing (3 managers).
- Reviewing contractor and subcontractor invoicing for accuracy (3 managers).
- Reviewing all audits for accuracy (3 managers).
- Verification of installed measures and work scope.
- Ensuring customer satisfaction and providing energy education.
- Conducting walk-throughs and technical reviews.
- Using a BPI-certified field supervisor dedicated to quality control.

With regards to customer satisfaction, all of the contractors reported positive feedback from customers. Three contractors reported positive feedback via surveys indicating that

customers were generally appreciative of the assistance and the positive impact on their homes. Many customers were also appreciative of the education provided by the NJCP program and the contractors. With regards to negative feedback, four contractors indicated a small minority of customer complaints, primarily related to customer expectations and education regarding the NJCP program. Customers who complained generally desired or expected more assistance in one of the following categories.

- More work than project spending budget would allow
- New HVAC equipment (specifically air conditioning)
- New window and door installations

Contractor Overview

Contractors were asked what they felt were the greatest strengths and accomplishments of the NJCP program. The strengths and accomplishments identified were as follows.

- Reducing energy use and energy bills for customers (4 managers, 2 installation crew and 2 auditors).
- Reducing late payment of utility bills by customers (1 manager).
- Assisting many low-income households (2 managers, 2 installation crew and one auditor).
- Energy education (2 installation crew).
- Improving household quality of living (1 manager and 1 installation crew).
- Identifying and resolving health and safety issues (2 managers and 3 auditors). One installation crew member and one auditor specifically mentioned saving lives of household members by identifying and correcting serious health and safety issues in homes.
- Flexible program design enabling contractors to prioritize measures based on experience and training (2 managers).
- Collaboration across utilities allowing for joint delivery of gas and electric services (2 managers).
- Comprehensive approach to home performance taken by the program (1 installation crew).
- Training provided to installation crews (1 installation crew).
- Evolution of the program since its inception (1 manager).
- Overall customer satisfaction with program benefits (1 manager, 1 installation crew and 1 auditor).

Contractors were also asked what they feel are the greatest challenges of the program. Generally, the challenges identified by the contractors related to finding customers and working with multiple utilities. Specifically, the contractors mentioned the following challenges.

- Insufficient customer base or getting enough work (3 managers and 1 auditor).
- Difficulties in contacting and scheduling customers (2 managers and 1 auditor).
- Lack of consistency among utilities (3 managers).

- Missed opportunities because of health and safety issues in the home (1 manager, 1 installation crew member and 2 auditors).
- Customers may think the program is a scam or may not trust the program (1 installation crew and 1 auditor).
- Managing the growing complexity of the program (1 manager).
- Acclimating installation crews to working conditions, e.g. working in small, cramped spaces (1 installation crew).
- Working with multi-family buildings, particularly when areas of the homes are inaccessible or access to other apartments is needed (1 auditor).

When asked about the changes they would like to see made to the program, contractors indicated the following.

- Revise program documents and streamline audit paperwork (1 installation crew and 4 auditors). One auditor requested that audit paperwork be revised to allow more space for recommendations and other notes. One installation crew member and two auditors requested that documents be made available in tablet format.
- Require Universal Service Fund customers to participate in the program (3 managers and 1 auditor).
- Expand income eligibility (1 crew).
- Changes in the marketing strategy of the program to better align customer expectations with services likely to be provided (1 manager).
- Provide contractors with more work through the program (1 manager).
- Create program signage that contractors can place on vehicles to alleviate concerns of customers who are unfamiliar with the program and/or contractor (1 auditor).
- Foster better communication between contractor management and auditors (1 auditor).
- Incorporate new methods approved by BPI and other building science programs (1 installation crew and 1 auditor).
- Provide greater flexibility to perform services for building tenants (1 installation crew).

All of the managers indicated that they have made recommendations to the utilities regarding the program, either formally or informally. Generally, managers noted that the utilities have been responsive to this feedback. One manager stated that the utilities create an empowering environment for the contractors and another manager indicated that the utilities are very open to contractor feedback.

The third party inspector was also asked these questions as related to the inspector's work. Regarding the greatest strengths and accomplishments of the program, the third party inspector indicated the following.

- The lives of many customers have been saved by contractors and third party quality control inspectors finding serious health and safety issues in homes, primarily related to high concentrations of carbon monoxide.
- The program has helped develop the skills and build a network of home performance workers in New Jersey.

- The program has resulted in high customer satisfaction.

The third party inspector indicated the following challenges in its part of the program.

- Changing program goals make it difficult to plan the number of inspections needed to be performed.
- Inconsistent inspection goals or inspection budgets between utilities involved in joint delivery of services make it challenging to meet the inspection goals of both utilities.
- Inconsistent expectations among utility managers for the contractors and the quality control inspectors.
- How decisions are made about what measures renters can receive. Some renters are living in homes with very high CO, but the program does not fix all of these issues and this can cause major problems for families.

The third party inspector has made recommendations to the utilities in the past. Generally, the third party inspector would like to see greater consistency across utilities and create a more formal process for changes to be made to the program. Specifically, the third party inspector would like to see the following changes made to the program.

- Create a consistent policy across utilities regarding when contractors should perform work and when they should not proceed with work. Currently, utilities and contractors have different policies regarding the circumstances in which work will be performed.
- Program changes by utilities should be made more carefully and formally. Currently, changes, including contractor goals and expectations for performance, are made too often and on an ad hoc basis. This causes confusion during inspections due to differing standards and expectations throughout any given time period. In particular, the program manual should be rewritten rather than updated continually in a patchwork fashion.
- Contractors should be required to use the same forms and formats for documenting and submitting completed jobs.
- The utilities should decide whether to retain or to grant authority to the third party inspector regarding when contractors should be placed on probation or no longer used.

D. Data Tracking System

This Data Tracking Analysis had the following goals.

- Identify the program's information needs.
- Review the content and quality of information in the current tracking system.
- Assess the sufficiency, accuracy, and efficiency of the system.
- Determine how the system is used by program partners to effectively manage the program.
- Develop recommendations for enhancements to and use of the system.

Data Needs

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.
 - 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.
 - Utilities
 - Service delivery contractors
 - Quality assurance contractor

They need to use the system for the following purposes.

- Reporting on job status.
 - 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.
 - Measures installed.
 - Inspection results.
 - Projected energy savings.
 - Measured impacts by customer characteristics, job characteristics, and for particular measures.

Tracking System Functions

The tracking system serves many important functions for the utilities, contractors, and the third party inspector.

- Invoice Review and Approval – The NJCP Tracking System allows the utilities to review and approve invoices submitted by each contractor.

- Messaging – The system provides a messaging function that allows parties to keep track of messages sent and received.
- Retrieving Job Data – A particularly important role of the data system is to allow utilities, contractors, or the third party inspector to look up a customer and retrieve information about the job.
- Attachments to Job Files – One of the more recent enhancements to the tracking system is the ability to attach applications, audits, work orders, digital photographs, and other customer information and associate them directly with a job. Contractors were required to upload all job information beginning in October 2012.
- BPU Reporting – JCP&L runs a batch job at the end of each month to create data transfer files that include new job information and invoices applied during that month. After the end of each quarter, the protocol savings data are generated, checked, and sent.
- Reports – Utility, Contractor, and Inspector
 - Utility reports - Many reports in the NJCP Tracking System allow the utilities to obtain a list of customers who meet certain criteria. Reports are available on the status of solicited customers, job status, inspection status and results, job invoice status, account invoice status, and production.
 - Contractors have access to the utility reports for the jobs that they are serving or have served. They also have access to job invoice status, account invoice status, and production reports.
 - The inspectors have access to inspection reports, job invoice status reports, and production reports.

Planned System Enhancements

JCP&L has been working on a new version of the NJCP Tracking System. The new system is expected to be deployed in 2014. Key features of the new system are as follows.

- Screen Appearance – Some of the current screens will have a new appearance. There will be tabs that prioritize the information that is needed for each type of user.
- Audit Form – An audit form module will be added following roll out of the new version and will perform some of the calculations that the auditors now perform by hand.
- Additional Data Fields – There will be additional fields added to the system, including how the customer heard about NJCP and email address.
- Reporting – Reporting flexibility will be increased and additional reports will be created.

- Field Auditing and Transaction Log – There will be a record of when an action was done and who added that information to the system.
- Utility Edits – Utilities will have the ability to change the seasonal spending allowance without a programmer’s involvement.
- Measure Costs – The system will calculate the mark-up on the measure, rather than the contractor performing a manual calculation.
- Data Checks – There will be additional controls on the data to prevent data entry errors and missing data. These checks would include requiring refrigerator test results when the contractor bills for a replacement refrigerator and requiring other specific data entry for particular measures.
- Users – The system will provide the ability to look up users by organization, as there are now hundreds of users on the system.
- Messages – The messaging system will be enhanced to allow users to cc others on messages and provide an email notification when a new message is created in the system.

Additional pending changes will be addressed after the new functioning system is up and running.

SharePoint

The utilities identified two additional data and information sharing needs and decided to make use of PSE&G’s SharePoint Site to meet these needs.¹⁶

- Document Sharing – Because the utilities work collaboratively on the NJCP program materials and procedures, there are often documents that are shared, repeatedly updated, and sent to the group through email. As a result, there were times when it was difficult to identify or locate the final version of a document that the utilities had collaborated on. The utilities felt it would be useful to have a shared site where they could post the final version of important documents.
- Expenditure Tracking – The contractors provide monthly invoices to individual utilities for jobs and overall administrative costs through the NJCP Tracking System. However, the utility managers can only view the invoices for their utility on the system. Managers felt that there was a need to track the budgets for the program overall, and to track all program dollars that were spent, as opposed to only those expenditures that were submitted by the implementation contractors.

¹⁶ While some utilities believe this system has proven to be an effective means to provide all of the utility representatives with access to important program documents, the system has proven challenging for other utility members of the working group. For example, there have been issues with passwords not working, difficulty in locating documents, and inability to upload documents.

On a monthly basis, the SharePoint administrator emails the utilities to request that they send reports that document contractor job expenditures, contractor administrative expenditures, Pure Energy costs, and internal utility costs. The SharePoint administrator then inputs these data into a spreadsheet that compiles a report comparing total expenditures to the overall program budget. These reports are then uploaded to the SharePoint site.

Data Tracking Findings and Recommendations

The NJCP Tracking System provides important data to manage and implement the program, to evaluate the program, and to determine how the program can be improved. Data that are available to program managers and contractors are much more comprehensive than have been seen in many other programs. Recommendations for improving the system to provide for more efficient program management and operations and to allow for a more comprehensive evaluation are summarized below. However, it can be difficult and costly to make such changes and the benefits must be weighed against the costs of the improvements.

- Management – Two utilities noted that they utilize the messaging function in the NJCP system. All utilities should use this function as it is important that critical information becomes a permanent part of the customer’s job record.
- Reporting – Many reports specifically developed and programmed for the NJCP program allow the utilities to obtain a list of customers who meet certain criteria. However, only the savings report and the inspection report provide summary information on jobs. Additional reports that provide summary statistics could provide useful information to help manage the program. For example, the following types of reports, by contractor and utility over specified time periods, may be useful for utilities and/or contractors.
 - Number of jobs audited, installed, and completed.
 - Percent of jobs deferred or partially completed due to service delivery barriers.
 - Average job cost.
 - Percent of jobs that have certain key measures installed.
 - Average measure cost for key measures installed.

For the shorter term, the utilities and contractors should develop a list of reports that would be helpful for program management. For the longer term, the working group should additionally consider developing a system to allow utilities to perform on-line queries or to download the data so that they could create customized reports that best meet their needs.

- Operations – The NJCP Tracking System should allow contractors to download data on the jobs that they served. This could allow the contractors to then upload those data into their own systems to avoid double data entry and reduce data errors. It could also allow the contractors to generate their own reports for program management.

Utility and contractor managers both had data needs that point toward a tablet system that synchronizes with the NJCP Tracking System. Utility managers noted the desire for more up-to-date information on job status, as that information is currently not available until contractors manually provide updates in the tracking system. Contractors noted the increased efficiency that would result if they did not need to manually update the data from the audit forms. Such a system could also result in increased data accuracy, as each time the data are entered there is additional possibility for error. While such a capability is beyond the currently planned system enhancements, it should be seriously considered for future upgrades.

- **Data Accuracy** – The type and amount of quality control conducted on data entered into the system varied by contractor. While two contractors had formal data validation checks and balances, the three other contractors did not. In our use of the NJCP tracking database to request usage, billing, and payment data from the utilities, we found many inaccuracies in the account numbers contained within the tracking system. In several cases, the account numbers did not follow the format that was used by the utility, indicating that quality control review could resolve these issues. We recommend that the utility managers require that the contractors develop and submit a data quality control plan and that the tracking system include, as planned, additional data quality checks.
- **Evaluation Data** – Previous research has documented the potential and actual health and safety benefits that result from energy efficiency services. Some of these impacts can be best documented using data that are collected on the audit paperwork, but that are not currently included in the tracking system data fields. Adding a few fields to the database would allow for analysis of the prevalence of these types of issues and how frequently they are resolved by the program. The NJCP program could then document the health and safety impacts of the program.

We recommend that the following additional fields are added to the tracking system.

- Ambient CO pre and post
- Flue CO pre and post
- Gas Leak detected

Additional data items that would be useful in the evaluation are described below.

- **Inspection Type** – The database allows for assessment of the percent of inspections that were done and the pass rate and problems found. However, the system does not indicate the type of inspection that was done. It would be useful for the evaluation to have a better understanding of the comprehensiveness of inspections that were undertaken.¹⁷
- **Measure Coding** – It would be useful to have the system code measures as to whether or not they are included in the seasonal spending allowance. This would

¹⁷ This is on the list of future enhancements.

allow for a clean comparison of the amount spent on seasonal measures and the seasonal allowance that was calculated.

E. Eligibility

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

- Annual household income at or below 225 percent of the Federal Poverty Guidelines, or
- Eligible for one or more of the following programs
 - Universal Service Fund (USF)
 - 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 pre-qualified.)
- 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.
 - Previous year's federal tax return.
 - W-2 forms for each income-earning member of the household over 18.
 - Last five pay stubs for each income-earning member of the household over 18.

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.

Customers are expected to know the following after participating in the program.

- How to adjust their water tank temperature.
- How to clean or replace the furnace or air conditioner filters when needed.
- How to program their thermostat, set the time, and change the batteries.
- Where to purchase additional or replacement CFLs.
- What was done in the attic, basement, or crawl space and why.
- The value of keeping second refrigerators and freezers empty and unplugged.
- Why drying clothes in the home is not a good idea.
- Why humidifiers and dehumidifiers treat the symptom and not the cause.
- How to use the anti-sweat switch on the refrigerator and why.
- Why shorter air conditioner run times may be worse than longer run times.

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.

JCP&L also provides remedial education for customers' whose electricity usage has increased since participation in NJCP. JCP&L makes lists available to the contractors to facilitate this process.

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 \$500 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 \$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 as follows.
 - \$0 if seasonal electric usage is <2,000 kWh
 - \$0.23*seasonal electric usage if 2,000-4,400 kwh
 - \$0.41*seasonal electric usage if 4,401-8,400 kwh
 - \$0.47*seasonal electric usage if >8,400 kwh
- Gas spending guidelines are calculated as follows.
 - \$0.99*annual gas usage if <800 ccf
 - \$3.51*annual gas usage if 800-1,400 ccf
 - \$5.06*annual gas usage if >1,400 ccf

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 of 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 A/C 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
- 2009 Pilot Services

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

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 five 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.

The 2013 RFP for service delivery states that contractors whose work quality is not at an acceptable level will be charged for the additional work performed by the utilities including monitoring performance and additional site inspections. If a contractor's inspection results pass rate falls below 90% of total inspections performed for 2 consecutive months, or 4 months in the calendar year, the following offset would apply.

- 85% - 89.9% pass rate – flat fee of \$100 per inspected job below the 90% requirement.
- 80% - 84.9% pass rate – flat fee of \$250 per inspected job below the 85% requirement.
- Below 80% – flat fee of \$500 per inspected job below the 80% requirement.

The inspection rate for any contractor that does not have a pass rate of at least 80 percent will increase by that percent below 80 percent until the pass rate becomes acceptable. For example, if the contractor's pass rate is 75 percent, an additional five percent of the jobs need to be inspected, for a total of 20 percent (5 percent in addition to the baseline of 15 percent). The cost of these additional inspections shall be reimbursed by the contractor to the appropriate utility.

If an 80 percent pass rate is not achieved within three months, utilities can increase the inspection rate and the cost of all inspections in excess of 15 percent will be paid by the contractor.

J. Quality Control

The NJCP Manual states that quality assurance for the program includes the following activities.

- Final inspections for installed work.
- Comprehensive diagnostics post-work in customers' homes.
- Annual QA visits with contractors to observe services, review procedures, policies, and/or records.
- Contractor performance reviews.
- Training as requested or deemed necessary.
- Customer surveys (JCP&L only).

A third party quality assurance inspector may visit a customer's home to inspect the work performed by the contractor. The final inspection is limited to measures that are reasonably visible from normal access locations. 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 includes evaluation of missed savings opportunities. The inspection attempts to confirm whether measures were properly installed.

The inspector's staff must possess the following knowledge, skills, and experience.

- Building science
- Consumer science
- Utility bill analysis
- Strong communication skills
- Strong technical skills and aptitude
- Prior training and experience in basic home weatherization, HVAC, water heating, and electrical systems
- Hands-on field experience relative to installation and execution of zonal pressure diagnostics using blower door and gauges (minimum 3 months)
- Detailed knowledge of combustion and other safety testing
- Building Performance Institute (BPI)/RESNET Certification or equivalent certification in building performance science

The final inspector is required to inspect the following issues.

- Ensure that materials were installed in a proper and professional manner to achieve long-term structural integrity.
- Ensure that materials installed improve or maintain the appearance of the structure.
- Ensure that materials installed may be expected to last their design life.
- Ensure that materials installed and the methods of installation meet the NJCP Procedures Manual.
- Verify that materials installed should not threaten the health and safety of the residents or the structural integrity of the building.
- Ensure the materials and services invoiced for were installed and performed.
- Determine if there were areas missed by the auditor or installer that could be treated to save energy or increase customer comfort, if there is remaining money in the Seasonal Guideline, or if the baseload measure is cost-effective.
- Ensure the measures installed and services performed were the highest priority measures and services for each customer and home.

- Ensure all excess material and debris were cleaned up and removed from the home.
- Reinforce the Partnership concept and make sure the customer knows how to use the NJCP measures to their fullest potential.
- Ask about the energy education session and answer any questions the customer may have.
- Ensure the customer is aware of all work that was completed and is satisfied with program work.

There are several different types of inspections that may be conducted.

- Comprehensive inspection with full health and safety diagnostics and air leakage diagnostics.
- Inspection with full health and safety diagnostics.
- Inspection with air leakage diagnostics.
- Inspection with gas leak test only.
- Inspection with no diagnostics.

Health and safety diagnostics include the following tests.

- Gas leak testing.
- Ambient air CO testing.
- CAZ baseline and worst case set up.
- CAZ depressurization measurement and comparison to maximum allowable CAZ depressurization levels for the type of combustion appliance present.
- Spillage testing on all appliances.
- Flame rollout observation.
- CO level testing in the flues of all appliances and comparison to acceptable levels.
- Draft pressure testing on all CAT 1-3 appliances and comparison to acceptable levels.
- Gas range CO level testing.

Air leakage diagnostics include the following tests.

- Blower door test.
- Zonal pressure tests.
- Pressure panning of ducts

Complete customer job files for the work scheduled to be inspected must be made available to the third party quality assurance inspector and utility representatives. When the job is complete and ready to be invoiced, the contractor must upload a complete job file to the NJCP system. The complete jobs should include the following documents.

- The NJCP invoice
- NJCP system job comments and notes section
- Complete audit form
- Combustion testing data collection sheet for each set of tests performed
- Combustion analyzer printout for each combustion testing event and for each combustion appliance required to be tested

- Blower door testing sheet for each blower door test performed
- Customer usage history for each utility
- Seasonal guideline calculation Excel spreadsheet (if applicable)
- Refrigerator order form (if applicable)
- Furnace replacement test Excel spreadsheet (if applicable)
- Hot air furnace decision tree (if applicable)
- Steam and hot water boiler replacement decision tree (if applicable)
- Heat system sizing Excel spreadsheet (if applicable)
- Subcontractor receipts, work orders, and related documentation for HVAC work (if applicable)
- Receipts for items over \$300
- Official request for additional spending (if applicable)
- Completed NJCP application (if not previously provided)
- Landlord agreement form (if applicable)
- “Account General Information” and “Account kWh Usage” screens from FirstEnergy Human Services website (JCP&L only)
- Health and safety release form
- NJCP action plan form
- NJCP partnership agreement form
- Documentation as to why a diagnostic procedure was not performed, issues not mitigated (mold, asbestos, etc.), or any other reason the job was not finished, a measure was not installed, or an action was not taken.

Contractors are asked to inform the customer that they may be receiving a call for an inspection appointment from a final inspector.

The utilities provide third party inspections on a minimum of 15 percent of completed jobs as required by the Board of Public Utilities (BPU).

Utilities revised the third party quality control inspection process in August 2012 so that jobs with “non-critical problems” passed inspections rather than failing. A new category of “Pass with Action Required” was added so that if the inspector visits the home more than 30 days after the services are delivered and finds an issue, the job would be considered “Pass with Action Required” instead of failed.

While 33 percent of the jobs in the Treatment Group failed, 20 percent of jobs in the Comparison Group failed and nine percent were classified as “Passed with Action Required”.

**Table II-4
Third Party Inspection Results**

Inspection Results	Treatment Group 9/1/2010 – 8/31/2011		Comparison Group 9/1/2011 – 8/31/2012	
	#	%	#	%
Passed with No Reservations	0	0%	4	<1%
Passed with Comments	362	31%	87	6%
Passed with Action Required	4	<1%	125	9%
Failed	380	33%	278	20%
No Result Reported	412	36%	885	64%
Total	1,158	100%	1,379	100%

The evaluation found (as a result of observations, inspections, and usage impacts) that better work quality should be demanded of the contractors. Based on initial evaluation findings, the Working Group has already refined the quality assurance plan. The program's quality assurance contractor will implement additional quality assurance procedures and contractor training beginning in 2015.

K. Referrals

As stated in the NJCP Manual, 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.

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

III. Needs Assessment

The Needs Assessment provides a profile of New Jersey's low-income households using data from the 2009-2011 American Community Survey (ACS). These data provide information on the demographic characteristics, energy assistance needs, and efficiency service needs of low-income households throughout the state and by county. The data represent the state in 2011.

A. Income Eligibility

Eligibility for LIHEAP in New Jersey has varied over the past several years based upon changes in Department of Health and Human Services (DHHS) rules and changes in LIHEAP funding. Department of Community Affairs increased eligibility to 225 percent of the poverty level in FY 2009 when the DHHS increased the maximum allowable limit to 75 percent of state median income. DCA reduced eligibility to 200 percent in FY 2011 because of expected reductions in LIHEAP funding. Eligibility for the Universal Service Fund (USF) program has remained at 175 percent of poverty since the program's inception and eligibility for the NJCP program has been set at 225 percent of poverty for the past several years.

Table III-1
2011 New Jersey Energy Program Income Eligibility Guidelines

	Poverty Level
LIHEAP	200%
NJ Comfort Partners	225%
NJ Universal Service Fund	175%

Table III-2 displays the percent of households in New Jersey eligible for the NJCP program, based on the 225 percent of poverty eligibility criteria. For 2011, the income standard for a one-person household was \$24,503 and the income standard for a four-person household was \$50,288. In 2011, 26 percent of households in New Jersey were income-eligible for the NJCP program.

Table III-2
Eligibility for NJ Comfort Partners

Poverty Group	Number of Households	Percent of Households
Income at or below 225%	812,370	26%
Income above 225%	2,364,790	74%
ALL NJ HOUSEHOLDS	3,177,160	100%

Source: 2009-2011 ACS.

B. Heating and Housing Type

Table III-3 displays the main heating fuel used by low-income households in New Jersey. The table shows that the majority of these households, 70 percent, used utility gas as their main heating fuel. Electricity was used as the main heating fuel by 16 percent of low-income households in New Jersey, and other fuels were used by 14 percent.

Table III-3
Low-Income Households
Main Heating Fuel

Main Heating Fuel	Number of Households	Percent of Households
Utility Gas	567,057	70%
Electricity	126,547	16%
Other Fuels	114,738	14%
No fuel used	4,028	<1%
ALL LOW-INCOME NJ HOUSEHOLDS	812,370	100%

Source: 2009-2011 ACS.

Table III-4 displays the percentage of low-income households that paid directly for their electric and gas bills. The table shows that 90 percent of the low-income households paid directly for their electric bill and 47 percent paid directly for their gas bill. Fewer bills were available for analysis when looking at electric and gas separately and when analyzing households that heated with electricity or gas.

Table III-4
Low-Income Households
Direct Payment for Electric and/or Gas Bill

Bill Payment	Number of Households	Percent of Households
Electric Bill – Direct Payment	727,689	90%
Electric Bill Separate from Gas	556,773	69%
Separate Electric Bill, Non-Electric Heat	463,902	57%
Separate Electric Bill, Electric Heat	92,871	11%
Gas Bill – Direct Payment	382,160	47%
Gas Heat	313,401	39%
ALL LOW-INCOME NJ HOUSEHOLDS	812,370	100%

Source: 2009-2011 ACS.

Table III-5 shows that 43 percent of low-income households lived in single family homes, while 31 percent lived in buildings with two to nine units, seven percent lived in buildings with ten to 19 units, and 17 percent lived in buildings with 20 or more units. The NJCP

program serves customers in buildings with up to 14 units, so some fraction of those in buildings with ten to 19 units were not eligible for service delivery, and all in buildings with 20 or more units were not eligible. Therefore, approximately 20 percent lived in building types that made them ineligible for the NJCP program.

Table III-5
Low-Income Households
Housing Unit Type

Housing Unit Type	Number of Households	Percent of Households
Single Family Detached	74,294	9%
Single Family Attached	274,550	34%
Building with 2-9 Units	254,489	31%
Building with 10-19 Units	56,998	7%
Buildings with 20+ Units	138,248	17%
Mobile Home	13,528	2%
Boat, RV, or Van	263	<1%
ALL LOW-INCOME NJ HOUSEHOLDS	812,370	100%

Source: 2009-2011 ACS.

Table III-6 displays the percent of low-income households that were owners and renters. The table shows that 59 percent of households in New Jersey were renters. These households were eligible for the program if they received landlord permission for service delivery.

Table III-6
Low-Income Households
Home Ownership

Housing Unit Type	Number of Households	Percent of Households
Owned	317,847	39%
Rented	476,134	59%
Other	18,389	2%
ALL LOW-INCOME NJ HOUSEHOLDS	812,370	100%

Source: 2009-2011 ACS.

C. Energy Burden

Electric burden is defined as the household's annual electric bill divided by the household's annual income. Table III-7 displays electric energy burden for low-income households in New Jersey who did not use electric heat. Electric energy burden was more than three

percent of income for 80 percent of these households, the standard for the USF Program, although not all of these households would be eligible because they had income up to 225 percent of the poverty level instead of the USF standard of 175 percent. The electric energy burden was 15 percent or more for 19 percent of these households.¹⁸

Table III-7
Low-Income Households without Electric Heat
Electric Burden

Electric Burden	Number of Households	Percent of Households
0% to less than 3%	90,358	19%
3% to less than 10%	233,039	50%
10% to less than 15%	52,253	11%
15% or more	88,252	19%
TOTAL	463,902	100%

Source: 2009-2011 ACS

Table III-8 displays electric burden for low-income households who used electricity as their main source of heat. The table shows that 32 percent had an electric burden of less than six percent, but 32 percent had an electric burden of 15 percent or more.

Table III-8
Low-Income Households with Electric Heat
Electric Burden

Electric Burden	Number of Households	Percent of Households
0% to less than 6%	29,304	32%
6% to less than 10%	18,881	20%
10% to less than 15%	15,290	16%
15% or more	29,396	32%
TOTAL	92,871	100%

Source: 2009-2011 ACS.

Table III-9 displays gas burden for low-income households. While 28 percent had a burden of less than three percent, the level targeted by the New Jersey Universal Service Program Evaluation, 20 percent had a gas burden of 15 percent or more.

¹⁸About eight percent of households had their electric usage included in their rent and 14 percent of those who had electric heat had their electric usage included in their rent. These households had a nonzero electric energy burden, since part of their rent was used to pay the electric bill. However, since there was no way to measure the share of rent used to pay the electric bill, electric energy burden was unknown for these households.

Table III-9
Low-Income Households with Gas Heat
Gas Burden

Gas Burden	Number of Households	Percent of Households
0% to less than 3%	88,081	28%
3% to less than 10%	128,087	41%
10% to less than 15%	33,640	11%
15% or more	63,593	20%
TOTAL	313,401	100%

Source: 2009-2011 ACS.

Table III-10 displays the total electric and gas burden for low-income households. The table shows that 28 percent had an energy burden of 20 percent or more and 21 percent had an energy burden of 25 percent or more.

Table III-10
Low-Income Households
Electric and Gas Burden

Electric and Gas Burden	Number of Households	Percent of Households
0% to less than 6%	120,067	21%
6% to less than 10%	119,543	21%
10% to less than 15%	104,061	18%
15% to less than 20%	64,720	11%
20% to less than 25%	37,448	7%
25% or more	121,029	21%
TOTAL	566,868	100%

Source: 2009-2011 ACS.

D. Need for Energy Efficiency Programs

Table III-11 displays an eligibility analysis for households in New Jersey for the NJCP program. The table shows the percent of households that were income eligible, that heated with electric or gas, that had direct payment of their electric or gas bill, and that lived in an eligible housing type. We estimated that 62 percent of low-income households in New Jersey were eligible for the NJCP program, based on these criteria.

Table III-11
NJ Comfort Partners Eligibility Analysis

	Number of Households	Percent of Low-Income Households
Income at or below 225%	812,370	100%
Heat with Gas or Electric	693,604	85%
Direct Payment of Electric or Gas Bill	730,725	90%
Eligible Housing Type*	631,109	78%
Meet All Eligibility Criteria	503,242	62%

Source: 2009-2011 ACS.

*Eligible housing type is defined as single family attached or detached, building with 2-9 units, 25% of those in buildings with 10-19 units, and mobile homes.

Some households have difficulty meeting their energy needs because their income is too low, but some households have difficulty because of high energy usage and need for weatherization services. We used an estimated price for electricity and gas and household reports on dollars spent on these bills to estimate annual usage. We then determined there was a need for service if baseload usage was above 8,000 kWh, electric heating usage was above 16,000 kWh, or gas usage was above 1,200 ccf. Table III-12 shows that 50 percent had high baseload electric usage, 24 percent had high electric heating usage, and 55 percent had high gas heating usage.

We then looked at whether these households were eligible for the NJCP program based on the eligibility criteria shown above. The table shows that 41 percent had high electric baseload bills and were eligible, 19 percent with electric heat had high electric heating bills and were eligible, and 53 percent with gas heat had high gas heating bills and were eligible.

Table III-12
Need for Energy Efficiency Programs

Service Type	Number of Households with Bills	Number of Households with High Bills	Percent of Households with High Bills	Percent of Households with High Bills Who Meet all Eligibility Criteria
Electric Baseload Services ¹⁹	623,382	313,335	50%	41%
Electric Heating Services	92,871	22,417	24%	19%
Gas Heating Services	462,013	255,523	55%	53%

Source: 2009-2011 ACS.

¹⁹ For households that reported electric and natural gas expenditures as one bill, half of the cost was allocated to electricity and half of the cost to natural gas.

E. Regional Differences

While it is important to understand the needs of low-income households in the state overall, it is also important to assess how those needs differ around the large and diverse state of New Jersey. This section provides an analysis by county.

Table III-13 shows that while 26 percent of households were income-eligible for NJCP in the state as a whole, the percent eligible varied from 14 percent in Hunterdon County to 36 percent in Cumberland and Passaic Counties. Five counties had less than 20 percent income-eligible and five counties had 30 percent or more income-eligible for NJCP.

Table III-13
Eligibility for Comfort Partners
By New Jersey County

Poverty Group	NJ	Atlantic	Bergen	Burlington	Camden	Cape May	Cumberland
Income at or below 225%	26%	34%	21%	18%	29%	28%	36%
Income above 225%	74%	66%	79%	82%	71%	72%	64%

Poverty Group	Essex	Gloucester*	Hudson	Hunterdon	Mercer	Middlesex	Monmouth
Income at or below 225%	35%	23%	34%	14%	24%	22%	21%
Income above 225%	65%	77%	66%	86%	76%	78%	79%

Poverty Group	Morris	Ocean	Passaic	Salem*	Somerset	Sussex	Union	Warren
Income at or below 225%	15%	29%	36%	25%	15%	16%	27%	22%
Income above 225%	85%	71%	64%	75%	85%	84%	73%	78%

Source: 2009-2011 ACS.

*Part of Gloucester County is included in Salem County based on the Census breakdown.

Table III-14 displays the main heating fuel by New Jersey county for low-income households. While the majority of households in most counties used natural gas as the main heating fuel, this was not the case in Cape May, Hunterdon, Sussex, and Warren Counties. Low-income households in Hunterdon and Sussex Counties were most likely to use a fuel other than utility gas or electricity as their main heating fuel.

Table III-14
Main Heating Fuel
By New Jersey County

Main Heating Fuel	NJ	Atlantic	Bergen	Burlington	Camden	Cape May	Cumberland
Utility Gas	70%	63%	80%	62%	69%	44%	52%
Electricity	16%	22%	12%	22%	19%	31%	13%

Main Heating Fuel	NJ	Atlantic	Bergen	Burlington	Camden	Cape May	Cumberland
Other Fuels	14%	14%	8%	16%	12%	24%	34%
No fuel used	<1%	2%	<1%	<1%	1%	1%	1%

Main Heating Fuel	Essex	Gloucester*	Hudson	Hunterdon	Mercer	Middlesex	Monmouth
Utility Gas	74%	70%	75%	28%	63%	77%	72%
Electricity	13%	16%	14%	19%	23%	13%	18%
Other Fuels	13%	14%	11%	53%	14%	10%	10%
No fuel used	1%	0%	1%	<1%	1%	<1%	<1%

Main Heating Fuel	Morris	Ocean	Passaic	Salem*	Somerset	Sussex	Union	Warren
Utility Gas	58%	67%	84%	52%	74%	15%	76%	41%
Electricity	16%	22%	8%	17%	12%	24%	10%	13%
Other Fuels	25%	10%	7%	31%	14%	61%	13%	46%
No fuel used	<1%	1%	<1%	<1%	<1%	0%	<1%	<1%

Source: 2009-2011 ACS.

*Part of Gloucester County is included in Salem County based on the Census breakdown.

Table III-15 displays the housing unit type for low-income households by county. The table shows differences across the state.

The majority of low-income households in Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Hunterdon, Mercer, Morris, Ocean, Salem, Somerset, Sussex, and Warren Counties lived in single family homes.

The majority of low-income households in Bergen, Essex, Hudson, Middlesex, Passaic, and Union Counties lived in multi-family buildings.

While fewer than five percent of low-income households lived in mobile homes in most counties, nine percent of low-income households in Cumberland County and eight percent in Salem County lived in mobile homes.

Table III-15
Housing Unit Type
By New Jersey County

Housing Unit Type	NJ	Atlantic	Bergen	Burlington	Camden	Cape May	Cumberland
Single Family Detached	9%	9%	4%	15%	23%	7%	10%
Single Family Attached	34%	44%	34%	48%	33%	52%	48%
Building with 2-9 units	31%	21%	34%	18%	19%	23%	19%
Building with 10-19 Units	7%	7%	6%	8%	6%	3%	3%

Housing Unit Type	NJ	Atlantic	Bergen	Burlington	Camden	Cape May	Cumberland
Building with 20+	17%	15%	20%	9%	17%	9%	11%
Mobile Home	2%	4%	1%	3%	1%	5%	9%
Boat, RV, or Van	<1%	0%	0%	0%	0%	0%	0%

Housing Unit Type	Essex	Gloucester*	Hudson	Hunterdon	Mercer	Middlesex	Monmouth
Single Family Detached	6%	6%	5%	9%	25%	10%	6%
Single Family Attached	16%	50%	6%	60%	26%	35%	44%
Building with 2-9 units	46%	19%	51%	19%	21%	31%	19%
Building with 10-19 Units	7%	7%	11%	9%	7%	9%	8%
Building with 20+	25%	16%	27%	4%	19%	14%	19%
Mobile Home	<1%	2%	<1%	<1%	1%	1%	3%
Boat, RV, or Van	<1%	0%	<1%	0%	0%	<1%	0%

Housing Unit Type	Morris	Ocean	Passaic	Salem*	Somerset	Sussex	Union	Warren
Single Family Detached	7%	15%	4%	7%	12%	5%	4%	12%
Single Family Attached	49%	60%	21%	56%	42%	60%	29%	48%
Building with 2-9 units	17%	13%	54%	16%	25%	20%	42%	23%
Building with 10-19 Units	10%	4%	6%	6%	7%	6%	5%	3%
Building with 20+	17%	5%	15%	7%	15%	6%	19%	10%
Mobile Home	1%	4%	<1%	8%	<1%	2%	<1%	2%
Boat, RV, or Van	0%	0%	<1%	0%	<1%	0%	<1%	0%

Source: 2009-2011 ACS.

*Part of Gloucester County is included in Salem County based on the Census breakdown.

Demographic characteristics and related requirements for contractors to provide good service also varied by county. Low-income households can have difficulty participating in the program if outreach staff are not multi-lingual. Table III-16 shows that 87 percent of low-income households in Hunterdon County spoke English at home, but only 32 percent in Hudson County spoke English at home. While only seven percent of low-income households in Hunterdon County and five percent in Sussex County spoke Spanish at home, 52 percent in Hudson County and 49 percent in Passaic County spoke Spanish at home.

Table III-16
Language Spoken at Home
By New Jersey County

Language Spoken	NJ	Atlantic	Bergen	Burlington	Camden	Cape May	Cumberland
English	61%	68%	52%	83%	71%	85%	67%
Spanish	24%	20%	19%	5%	20%	10%	29%

Language Spoken	NJ	Atlantic	Bergen	Burlington	Camden	Cape May	Cumberland
Indo-European	9%	8%	15%	7%	5%	5%	3%
Other	5%	5%	14%	5%	4%	<1%	1%

Language Spoken	Essex	Gloucester*	Hudson	Hunterdon	Mercer	Middlesex	Monmouth
English	61%	87%	32%	87%	68%	53%	76%
Spanish	23%	4%	52%	7%	19%	26%	12%
Indo-European	12%	6%	9%	6%	9%	13%	8%
Other	4%	3%	7%	1%	4%	8%	3%

Language Spoken	Morris	Ocean	Passaic	Salem*	Somerset	Sussex	Union	Warren
English	66%	81%	40%	89%	61%	86%	50%	86%
Spanish	18%	7%	49%	6%	20%	5%	35%	8%
Indo-European	10%	9%	6%	3%	12%	5%	12%	4%
Other	5%	3%	4%	1%	7%	3%	3%	2%

Source: 2009-2011 ACS.

*Part of Gloucester County is included in Salem County based on the Census breakdown.

Table III-17 displays an eligibility analysis for households in New Jersey for the NJCP program by county. We estimated that 62 percent of low-income households in New Jersey were eligible for the NJCP program, but this percentage varied from 30 percent of low-income households in Sussex County to 79 percent in Ocean County.

Table III-17
NJ Comfort Partners Eligibility Analysis
By New Jersey County

Eligibility	NJ	Atlantic	Bergen	Burlington	Camden	Cape May	Cumberland
Gas or Electric Heat	85%	85%	92%	84%	87%	75%	65%
Direct Bill Payment	90%	91%	93%	96%	91%	86%	90%
Eligible Housing Type*	78%	79%	75%	85%	78%	88%	86%
Meet All Criteria	62%	62%	66%	68%	66%	57%	47%

Eligibility	Essex	Gloucester*	Hudson	Hunterdon	Mercer	Middlesex	Monmouth
Gas or Electric Heat	87%	86%	89%	46%	85%	89%	90%
Direct Bill Payment	84%	96%	85%	96%	89%	93%	88%
Eligible Housing Type*	70%	79%	65%	91%	76%	80%	75%
Meet All Criteria	56%	65%	54%	37%	61%	68%	62%

Eligibility	Morris	Ocean	Passaic	Salem**	Somerset	Sussex	Union	Warren
Gas or Electric Heat	75%	89%	92%	68%	86%	39%	87%	54%
Direct Bill Payment	93%	96%	89%	93%	93%	91%	90%	89%
Eligible Housing Type*	75%	93%	81%	88%	79%	89%	77%	87%
Meet All Criteria	50%	79%	70%	53%	63%	30%	64%	37%

Source: 2009-2011 ACS.

*Eligible housing type defined as single family attached or detached, building with 2-9 units, 25% of those in buildings with 10-19 units, and mobile homes.

**Part of Gloucester County is included in Salem County based on the Census breakdown.

F. Summary

The Needs Assessment provided data and analysis to assess the characteristics of low-income households in New Jersey who were eligible for the NJCP program. It focused on households with income at or below 225 percent of the poverty level, the income-eligibility standard for the program.

Several key facts about this population are important for analyzing program need and eligibility for NJCP program services, and how this varies throughout the diverse state.

- 26 percent of households in New Jersey had income at or below 225 percent of the poverty level.
- About 62 percent of the low-income households had housing and energy bill characteristics that made them eligible for the NJCP program.
 - 85 percent of these households heated with natural gas or electricity.
 - About 78 percent lived in a housing type that is eligible (single family or multi-family buildings with no more than 14 units).
 - 90 percent paid directly for gas or electric.
- Some demographic characteristics can make it more difficult to serve segments of the population.
 - Only 39 percent owned their homes, and renters can be more difficult to serve, as landlord permission must be obtained.
 - 39 percent did not speak English in the home and may have the need for service provided in another language if a family member or friend is not available to interpret.
- Many of these households had usage at a level that indicates a need for energy efficiency services.
 - 50 percent of those who did not heat with electricity were estimated to have annual electric usage over 8,000 kWh.
 - 24 percent of those who heated with electricity were estimated to have annual electric usage over 16,000 kWh.

- 55 percent of those with gas heat were estimated to have annual gas usage above 1,200 ccf.

Another key finding from this analysis is the extent of diversity across the state.

- *Poverty level:* While 26 percent of households were income-eligible for NJCP in the state as a whole, the percent eligible varied from 14 percent in Hunterdon County to 36 percent in Cumberland and Passaic Counties. Five counties had less than 20 percent income-eligible and five counties had 30 percent or more income-eligible for NJCP.
- *Main Heating Source:* The majority of households in most counties used natural gas as the main heating fuel, but this was not the case in Cape May, Hunterdon, Sussex, and Warren Counties.
- *Home Type:* The majority of low-income households in Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Hunterdon, Mercer, Morris, Ocean, Salem, Somerset, Sussex, and Warren Counties lived in single family homes, and the majority of low-income households in Bergen, Essex, Hudson, Middlesex, Passaic, and Union Counties lived in multi-family buildings.
- *Language:* While 87 percent of low-income households in Hunterdon County spoke English at home, only 32 percent in Hudson County spoke English at home. While only seven percent of low-income households in Hunterdon County and five percent in Sussex County spoke Spanish at home, 52 percent in Hudson County and 49 percent in Passaic County spoke Spanish at home.
- *Eligibility for the NJCP program:* We estimated that 62 percent of low-income households in New Jersey were eligible for the NJCP program, but this percentage varied from 30 percent of low-income households in Sussex County to 79 percent in Ocean County.

These factors should be reviewed when thinking about the challenges, possibilities, and strategies for the NJCP program in different parts of the state.

IV. Procedures Review

The New Jersey Comfort Partners Program provides procedures, specifications, and guidelines in two documents.

- The New Jersey Comfort Partners Procedures Manual (Manual)
- The New Jersey Comfort Partners Building Performance Field Guide (Field Guide)

This section provides key recommendations for changes to the NJCP program procedures based upon review of the Manual and Field Guide, as well as findings from the on-site observation of service delivery, the inspections of completed jobs, and the usage impact analysis. Some of these recommendations relate to changes in current procedures but many relate to increased emphasis or clarity on the most important areas for service delivery.

The team of technical reviewers discussed and came to agreement on the most important issues and the order of priority for those issues explained below.

1. Testing – Use testing results to guide work and affirm continuous thermal boundary.

The observation and inspection work found that while extensive testing was conducted, that testing was not used in most cases to inform the process and perform air sealing work in a way to achieve the best results for each individual home.

We recommend the following changes in procedures to align the work with audit and testing results.

- Continuous thermal boundary – In many of the observed houses, contractors failed to identify and create a continuous thermal boundary, resulting in unchanged (or even increased) air leakage. The continuous thermal boundary is especially critical to ensure effective work in crawlspaces and knee wall attics. Contractors should be required to identify the thermal boundary, use testing for verification, and document this assessment in the audit write-up.²⁰
- Air sealing targets – The auditor should be required to develop air sealing targets that are based on the condition of the home and not the Building Tightness Limit (BTL). The blower door should be used by installers as a guide and reduction measurement tool during the air sealing process, and not to just generate numbers. All too often, minimal reductions are achieved, but the installers do not use the information to improve the

²⁰It may be useful to create form sections that force the auditors to identify the existing and proposed thermal boundaries for knee wall attics and crawlspaces. For example, they could be required to state whether the existing thermal boundary for knee wall attics is (1) the rafters, or (2) the knee wall and attic floors. Then they would be required to state where the proposed thermal boundary should be. A similar approach for crawl spaces would require them to state whether that space will be (1) vented and isolated from the house, or (2) unvented and connected to the house.

quality of their work. Proper zone testing could help determine the potential and assess the effectiveness of the air sealing work.²¹

- Prioritize air sealing work in the most important areas of the home – Establish a clear priority for air sealing activities, and require the following steps to ensure this priority is followed.
 - Run blower door.
 - While running the initial blower door test, the contractor should complete zonal testing on the attic(s), garage, and basement/crawlspace to determine the as-found conditions. In addition, the ducts should be tested.²²
 - Seal at top of envelope.
 - Run blower door to assess air leakage reduction, and continue air sealing if targeted reduction is not achieved or if zone pressure to attic indicates it is still significantly connected to the house. This is important to ensure that minimal moisture migrates to the attic. Zone pressure targets can be established for highly vented, moderately vented, and unvented attics.
 - Retest with blower door.
 - Seal ducts with highest pressure pan readings and returns in CAZ.
 - Repeat duct tests to assure pressure pan readings less than 2 Pa.
 - Seal and retest as needed.
 - Seal connections to attached garages based on zone testing.
 - Repeat zone testing to ensure that garage is isolated from house.
 - Seal basement if CAZ testing indicates that this area is not near the depressurization limit.
 - Run blower door to assess air leakage reduction.
 - Run blower door to identify other areas of major leakage.
 - Seal these major leakage areas.
 - Retest to ensure effective sealing.
 - In some cases, it may be impossible or impractical to seal all of the leaks, and in these cases it should be documented. This may be due to spending limits or the Building Tightness Limit (BTL).

Consider linking payment to contractors for air sealing measures on air leakage reduction. Using a performance-based financial incentive could help incent contractors to find the most cost-effective method for achieving results rather than installing measures that do not achieve the targeted results. However, such a payment structure

²¹Experts disagree on the most effective procedures. Some state that zone diagnostics should not be a single pressure measurement between the house and zone but should be a zone pressure measurement with reference to the outside, adding a hole in the plane with the greatest pressure differential, followed by another zone pressure measurement with reference to outside. Others believe that doing this test correctly and properly interpreting the results is too challenging to require of the contractors and can result in comfort/debris issues in the houses. Therefore, other experts recommend that it would be better to continue the single pressure tests and give the auditors better training and guidelines on how to use the results.

²²During the observations and inspections, we routinely found that the contractors performed testing and recorded the data on the program forms, but they did not effectively use the data to target problem areas and verify that the work they did was effective at significantly improving the conditions in the houses.

would need to be tied to the approach above, with measurements recorded at various steps, to ensure that the leakage reduction resulted from changes in the most important zones.

- Use zonal testing to determine when insulation can be installed and attics left unventilated – Keeping moist air from flowing into attics from the house is the most important factor in minimizing condensation issues. Zonal testing can confirm a complete pressure boundary. Only after that is confirmed should insulation be installed. Some attics are very difficult to ventilate. Proper zonal test results can indicate that it is acceptable to leave a knee wall attic without ventilation.²³
- Target comfort issues noted by customer - The Audit Form should have an additional entry to capture how the work scope affects comfort issues. These may not be immediately solvable, but documenting an auditor's good faith effort to address the customer's comfort and linking it to the scope of work performed in the home is reasonable. Additionally, when the auditor really hears the customer and targets the noted comfort issues, the work can lead to better savings results.²⁴

2. Duct Sealing - Use pressure testing to guide duct sealing, and focus work on areas with the greatest potential for savings.²⁵

The pressure pan testing should be used to ensure that leak sealing focuses on ducts that are outside the thermal barrier. Duct leakage to attics and crawlspaces results in moisture issues and significant heat loss. Duct sealing should focus on leakage in these areas, as identified

²³Ideally, every attic should have ventilation installed. Installing insulation in a ceiling without ventilating the attic above presents a risk of moisture condensation. However, there are cases where it is impractical to install effective low and high ventilation, such as knee wall attics, houses with no eave overhang, and row houses with parapet walls.

In these cases, it may still be desirable to install insulation, but the contractors should have clear guidelines about completing pressure testing to ensure that the attic has been thoroughly air-sealed from the living space. This testing can be difficult because the readings will be difficult to interpret due to the lack of existing ventilation.

One viable approach is to have the program QA contractor complete a study on program houses. They can measure the house-to-attic pressure, note whether the attics are vented and apply a qualitative assessment of the air sealing work. Once adequate data has been collected, a minimum allowable attic-to-house pressure threshold can be established for both vented and unvented attics. Additional detail on the importance of attic ventilation is available at: <http://www.buildingscience.com/documents/digests/bsd-102-understanding-attic-ventilation>

²⁴This was not emphasized by the auditors in our observations. In many cases, the auditor asked the customer about comfort issues and wrote the information down on the data collection form, but did not use that information when developing the proposed work scope. It was rare to see insulation, air sealing, or distribution modifications specifically targeted at comfort complaints. It was also rare for an auditor to follow up with the customer at the end of the audit and explain what the program might be able to do to help resolve the comfort issues that were noted by the customer.

²⁵This is not what was observed. The auditors and crews routinely took pressure pan readings. It was clear that they knew that they had to collect the data and write it down on the forms. However, in many cases, they didn't use that information to ensure effective work. For example, auditors were observed measuring low pressure pan readings on first floor registers, but still specifying sealing of basement supply ducts in the work scopes. And crews were observed getting (post-duct sealing) pressure pan readings nearly identical to those on the audit report, but not investigating to see why their work had not resulted in an appreciable performance improvement.

using the pressure pan test results. Leakage into basements and other conditioned zones should not be a focus unless visual inspection and CAZ testing indicate there is return leakage that is creating substantial depressurization of the CAZ. Post testing should be used to confirm the leaks have been sealed.

3. Work Order - Require use of a work order that provides clear direction on work to be done.

The current manual contains a data collection form that is also used as a work order. The program should develop and require the use of a work order that provides clear directions to the installers on what measures are to be installed and where they should be installed. The work order should also include air sealing and duct sealing targets.

4. Health and Safety – Provide clear guidance to contractors on work to be done.

A judgment call is required when determining whether work should proceed if there are existing Health and Safety issues in a home, but the program should provide better guidance in this area and should collect information to provide more complete and consistent tracking of these issues. Homes seem to be deferred too often because of asbestos, mold/moisture, or knob and tube wiring issues that are not serious enough to prevent all work.

- Provide a stand-alone worksheet for health and safety items where the auditor and installers will inspect, and repair or replace any item on that checklist. This could be the Health and Safety Condition and Findings form with moisture, asbestos, and other appropriate sections added.²⁶
- Provide a systematic way to address minor health and safety issues, such as removing or encapsulating small amounts of asbestos and treating small regions of mold-like substances. Perhaps this can be done cost-effectively using existing or other pre-approved contractors with set rates for small work scopes. This process should increase the productivity of contractors by reducing “unable to proceed” conditions and increase the useful work that can be done for customers.

The NJCP Working Group has already identified a plan to address these issues. Honeywell will now request a price quote for one of their approved vendors when they identify a home with moisture or mold that needs to be remediated prior to NJ CP work

²⁶We recommend that NJCP develop a checklist that is part of the project documentation that gets passed along from the auditor to the installers and final inspector. The current health and safety protocols are resulting in confusion throughout the process that results in major measures not being installed, installers having to abort installation visits, and homes deferred in the past reentering the program with the problems still existing. Having a checklist will allow the decision process to be clear and should be monitored to see that everyone has the same view of a home so that missed opportunities and disruptions to measure installations can be reduced. Deferred customers should be flagged, allowing those that resolve the problem back into the program before five years and stopping deferred customers that still have problems from reentering. The current NJCP list of health and safety issues is good. The checklist should show whether an issue exists and if it does the location(s) should be indicated.

being performed. Following approval from the utility, this work will be implemented and then the NJ CP energy conservation work will proceed. The Working Group has also hired an additional contractor that will address health and safety issues. GreenLife Energy Solutions will eliminate moisture problems that are the source of the mold growth and then proceed with energy efficiency measures.

- Develop a systematic means for tracking issues that are not addressed so that deferred homes are not again treated by the program unless the issue(s) have been resolved.

5. Spending Guidelines – Refine the guidelines to provide better relation to savings opportunities.

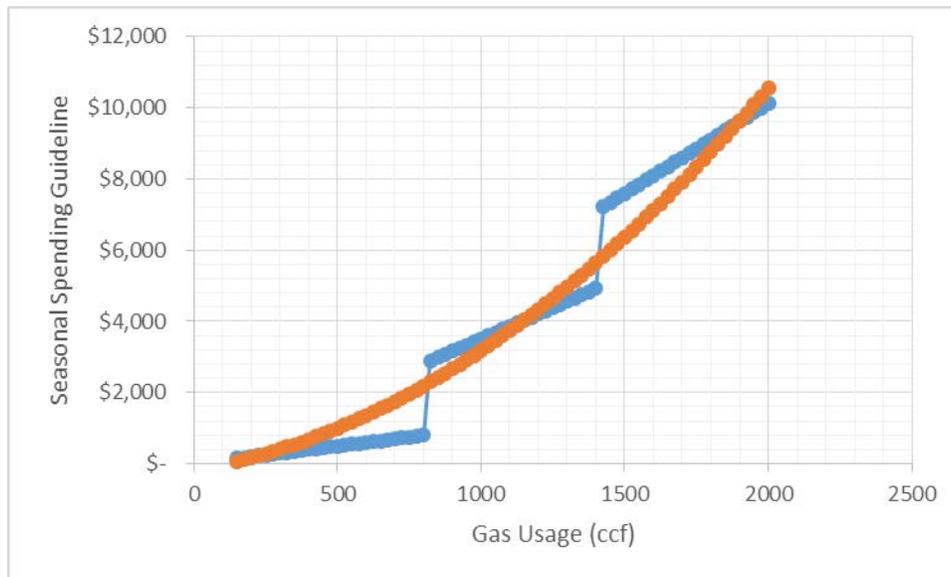
Usage-based spending guidelines can be an excellent tool for focusing program resources on retrofits that are likely to provide the most cost-effective energy savings. The guidelines have several advantageous characteristics.

- **Structure:** Ramping up spending at an increasing rate (i.e., more than linear) as usage increases is a good approach.
- **Flexibility:** The guidelines are appropriately flexible by their presentation as an average target and the allowance for spending to exceed the guideline by \$500 on any given home without any advance permission.

However, the guidelines exhibit some features that have potential for improvement.

- **Large Fluctuations at Discrete Points:** Figure IV-1 below (blue line) shows the gas spending guideline as a function of annual usage. There are large jumps at specific ccf values. For example, the spending guideline increases by more than \$2000 as gas usage increases from 1400 to 1401 ccf/year. While this structure has the advantage of simplicity, a smoother structure may produce better results. We have provided a proposed spending guideline (in a separate Excel document) that approximates the current guideline but provides a smoother structure. This guideline is shown in the orange curve below. A separate electric curve was also provided.

Figure IV-1
Spending Guideline Relationship to Annual Gas Usage



- For attic air sealing and insulation, the guidelines have similar sharp cutoffs to the spending guidelines. Consider allowing all accessible attics to be air sealed and insulated to current Code levels (IECC 2009). This is a ten year plus (potentially lifetime) measure and occupancy can radically change over that time period, so even if the current shell allowance does not support the measures, the next occupant's usage may. This will also provide some assistance to customers who have low usage because they maintain their homes at extreme or uncomfortable temperatures to reduce their utility costs.²⁷

The evaluation included an analysis of the savings from the installation of attic insulation when there were various levels of existing insulation prior to the NJCP treatment. The analysis showed that homes with existing insulation R-values of less than five, five to 15, 15 to 19, and greater than 19 had very similar cost-effectiveness levels.

- Only Usage-Adjusted: The spending guidelines are currently based on absolute annual usage levels and do not vary by the size of the home. The usage should be weather normalized, and the size of the home should be taken into account.

²⁷The current guidelines only allow attics to be addressed if usage is high enough to create a seasonal spending allowance large enough to cover the cost. Attic air sealing and insulation is a long life measure that has both comfort and energy saving benefits. We are suggesting that the program consider bypassing the spending limits to install this measure even in cases where the current usage is low. We recommend that the NJCP utilities implement a pilot process whereby contractors are not required to request permission from utilities for this measure. The utilities should review the costs of this change after one quarter and determine if the pilot should be continued as a regular program procedure.

- **Default Values:** The spending guideline approach instructs contractors to use default values if twelve months of customer usage history is not available. However, if usage data are available for most of the year, these data can provide a more accurate estimate.

The PSE&G method identifies circumstances under which average bill data can be used. We agree that this method will produce more accurate billing history than default values without placing an undue burden on the contractors and should be adopted for use by all utilities and contractors. The method is to substitute for missing data as follows.

- If one month is missing in the four highest months for gas usage, average out the three months with data and use that average number for the month that is missing.
- If one month is missing in the four highest months of electric usage, average out the three months with data and use that average number for the month that is missing.
- If two or more months of heating season data are missing, request to use defaults for gas usage. This is a usage of 1,200 ccf resulting in a seasonal spending guideline of \$4,212.
- If two or more months of cooling season data are missing, request to use defaults for electric usage. This is as follows.
 - All electric with air conditioning: 8,000 kWh = \$3,280 spending guideline
 - All electric without air conditioning: 6,000 kWh = \$2,460 spending guideline
 - Gas heat with air conditioning: 3,200 kWh = \$736 spending guideline
 - Gas heat without air conditioning: 1,200 kWh = \$0 spending guideline
- If there is one month of baseload only usage data, use that data for each of the missing baseload only months. If there are two or more months of baseload only usage data, average those months together and use that average number to populate the missing baseload months.
- **End Usage Breakout:** the disaggregation of electric and gas bills, and the assignment of usage by end use, i.e. heating, cooling, water heating and baseload, would allow the spending to be more closely aligned with the savings opportunities. For example, determining whether a home with a high gas bill has a high heating load or a high water heating load (or both) would allow the spending to address the appropriate need.

There seemed to be a significant number of homes using electric space heaters and this was rarely directly addressed. Disaggregating electric into both heating and cooling seasonal usage could be helpful if it is used, as the current procedure lumps them together.

6. Manual Organization – Reformat the procedures manual and provide laminated information sheets to use in the field.

Modify the Procedures Manual to make it more useful. The manual has been modified over time and is in need of an overhaul to be useful.

- Simplify and align the Procedures Manual with the data collection form.
- Devise an overall page numbering scheme that includes section and page number and identifies the topic in the footer for reference.
- Organize and relocate worksheets to an Appendix.
- Simplify complex decision making processes to make them useful in the field. Provide a limited number of laminated sheets with critical information for the field work.
- Reference third party standards, where possible, for work and audit scopes to allow for the updating of ‘best practices’.
- Use a consistent format for each section and include key information. This will improve the understanding of the expectations at all steps in the process and increase accountability.

7. Wall Insulation and Kneewalls – Require insulation work to be encapsulated.²⁸

Insulation on vertical surfaces is fully effective only if it is protected from air movement. For fiberglass insulation, it must be enclosed on all six sides (encapsulated). Program contractors often leave the exterior side of insulation exposed to attics.

We recommend that any wall insulation installed by the program be required to be encapsulated. An air barrier of house-wrap, bubble-wrap, or rigid foam on the exterior side of wall insulation would greatly improve the effectiveness of the wall insulation.

Kneewall insulation (exposed to attic space) installed as a program measure must be encapsulated at minimum with house wrap, preferably with rigid insulation, and sealed at the edges. Existing exposed kneewall insulation must be encapsulated as part of any attic air sealing or insulation measure.

²⁸Insulation on vertical surfaces is fully effective only if it is protected from air movement. For fiberglass insulation, it must be enclosed on all six sides (encapsulated). During the evaluation, we frequently saw program contractors leave the exterior side of insulation exposed to attics. We recommend that any wall insulation installed by the program be required to be encapsulated. If cost-control is a concern, the use of house-wrap is the most affordable option.

This treatment is already included in BPI retrofit standards. The Envelope Professional Standard states “Insulation installed in kneewalls or other exposed vertical areas must be covered on the cold side with an air barrier such as plywood or housewrap to protect the insulation from wind-washing and free convection within the insulation. This measure is not necessary if rigid foam insulation is used.” The 2009 IECC also requires in Table 402.4.2 that “Air-permeable insulation is inside of an air barrier.”

This treatment is already included in BPI retrofit standards. The Envelope Professional Standard states “Insulation installed in kneewalls or other exposed vertical areas must be covered on the cold side with an air barrier such as plywood or housewrap to protect the insulation from wind-washing and free convection within the insulation. This measure is not necessary if rigid foam insulation is used.” The 2009 IECC also requires in Table 402.4.2 that “Air-permeable insulation is inside of an air barrier.”

8. Programmable Thermostat – Provide guidance on installation determination and models to install.

Too many setback thermostats are installed in homes where the occupants don’t understand and can’t learn how to program them. A decision tree should be developed so the auditor can determine if a setback thermostat is appropriate. The contractor should be required to assess the following.

- Is the customer currently practicing setback with the thermostat that is in place?
- Does the customer have regular times away from the home?
- Is the customer willing to have the home colder in the winter and/or warmer in the summer at night?
- Does the customer appear to have the ability to program the thermostat and make changes as needed?

Additionally, the thermostats that we observed during installation were not user-friendly. The program should review the June 2014 *Consumer Reports* list of recommended models and approve satisfactory models submitted by contractors for review.²⁹

9. Water Heater Wrap – Provide guidance on assessment and installation.

Tank wraps are installed with high frequency (the program database analysis showed that 28 percent of the treatment group and 13 percent of the comparison group received these wraps). The impact is limited, in part because they are installed on tanks that don’t need them³⁰ and in part because the materials are not installed properly. Reflective insulation requires that an air gap exist between the insulation and the tank. The program should provide guidelines for when to install and require that the installation be done in this manner or remove this type of insulation from the list of acceptable materials.³¹

²⁹This is a product category that is currently undergoing considerable market transformation. The NJCP program should periodically review the available models and adjust the program requirements accordingly.

³⁰They don’t need them because they were manufactured with adequate insulation or because they are installed in conditioned spaces.

³¹The NJCP manual already states “Install supplemental insulation jackets on electric water heaters if the heater has a manufacturer’s insulation that is less than R-12.” The form should require the auditor to document this rating. It doesn’t specify what to do with gas models, on which the insulation is less useful because most of the heat loss is up the flue. It also states to “Wrap water heaters whether in heated or non-heated areas.” This should be reconsidered.

10. Windows and Doors – Provide clear specification on how to address.

Problems with windows and doors related to operation and energy efficiency are common. We recommend the following program changes to better address these issues.

- Perform selective window and door replacement to address performance issues that have a significant impact on comfort, energy use, and/or health and safety. A window that has deteriorated to the point that it no longer keeps out wind, rain or insects would be an example that meets all three criteria.
- The window sealing work scope should be guided by blower door tests and explicitly describe where to seal. A window schematic in audit form would achieve this purpose. The current work order description “caulk windows” is insufficient direction to a work crew.
- Evaluate cost-effective alternatives to window replacement, such as interior storm products (Quanta Panel is one such product).
- Standardize door weather-stripping, such as Q-lon, to ensure quality, ease of installation and use, and uniformity. It is evident that Q-lon is often inappropriately or incorrectly installed, minimizing its impact on energy consumption. We have seen it installed where it is not needed, such as on an interior door leading to a conditioned basement. Incorrect installation can result in the misalignment of door locks, difficult operation, or weather-stripping that does not touch the door.
- Complaints about drafty windows can be an opportunity for energy education by the auditors. Window drafts may be caused by internal air currents rather than leaks. The auditors should use the blower door and smoke to evaluate leakage and demonstrate to the customer whether the window is or is not drafty.

V. Participant Characteristics and Program Services

This section provides a review of participant characteristics and program services delivered based on the data in the NJCP tracking system as of March 31, 2013.

Customers who were defined as the Treatment and Comparison Groups for the analysis period used in the usage and payment impact analyses were analyzed. The Treatment and Comparison Groups were defined as follows.

- Treatment Group: Customers who received NJCP audits between September 2010 and August 2011
- Comparison Group: Customers who received NJCP audits between September 2011 and August 2012

A. Production

Table V-1 displays the number of audits completed during these time periods by job type. The table shows that 6,437 audits were completed during the Treatment Period and 9,780 audits were completed during the Comparison Period. Approximately 85 percent were gas and electric jobs, nine percent were electric only, and two percent were gas only. The job type assignments were based on whether there was a gas invoice, an electric invoice, or both.

**Table V-1
Audits Completed
By Job Type**

Job Type	Treatment Group 9/1/2010 – 8/31/2011		Comparison Group 9/1/2011 – 8/31/2012	
	#	%	#	%
Gas and Electric	5,615	87%	8,344	85%
Electric Only	596	9%	842	9%
Gas Only	142	2%	135	1%
No Invoice Data Available	84	1%	459	5%
Total	6,437	100%	9,780	100%

Table V-2 displays the number of audits completed by gas utility during the Treatment and Comparison Periods. The table shows that 46 percent of the Treatment Period customers audited had PSE&G as their gas company and 58 percent of the Comparison Group audits had PSE&G as their gas company. The table also shows that 22 percent in the Treatment Group and 14 percent in the Comparison Group were NJNG, 14 percent in the Treatment Group and 12 percent in the Comparison Group were ETG, and eight percent in both groups

were SJG. In each period, about ten percent of homes audited did not have a natural gas company.

Table V-2
Audits Completed
By Gas Utility

Gas Utility	Treatment Group 9/1/2010 – 8/31/2011		Comparison Group 9/1/2011 – 8/31/2012	
	#	%	#	%
PSE&G	2,960	46%	5,627	58%
NJNG	1,418	22%	1,364	14%
ETG	903	14%	1,157	12%
SJG	540	8%	732	8%
None	616	10%	900	9%
Total	6,437	100%	9,780	100%

Table V-3 displays the audits completed by electric utility. The table shows that 55 percent of jobs in the Treatment Period and 68 percent of jobs in the Comparison Period had PSE&G as the electric company, 35 percent in the Treatment and 22 percent in the Comparison Group had JCP&L as the electric utility, and eight percent in both time periods had ACE as the electric utility.

Table V-3
Audits Completed
By Electric Utility

Electric Utility	Treatment Group 9/1/2010 – 8/31/2011		Comparison Group 9/1/2011 – 8/31/2012	
	#	%	#	%
PSE&G	3,527	55%	6,644	68%
JCP&L	2,231	35%	2,172	22%
ACE	530	8%	822	8%
REC	64	1%	41	<1%
MUNI	43	1%	61	1%
None	42	1%	40	<1%
Total	6,437	100%	9,780	100%

Table V-4 displays the number of audits completed by contractor. The table shows that Honeywell completed 63 percent of the audits in the Treatment Period and 52 percent in the Comparison Period. The three other contractors that performed a significant percentage of the audits were EIC, CMC, and Northeast Energy. CMC's share of the jobs increased from 13 percent during the Treatment Period to 25 percent during the Comparison Period.

**Table V-4
Audits Completed
By Contractor**

Contractor	Treatment Group 9/1/2010 – 8/31/2011		Comparison Group 9/1/2011 – 8/31/2012	
	#	%	#	%
Honeywell	4,082	63%	5,059	52%
EIC – Comfort Home	985	15%	1,326	14%
CMC Energy	812	13%	2,404	25%
Northeast Energy	527	8%	858	9%
Optimal Energy	31	<1%	133	1%
Total	6,437	100%	9,780	100%

B. Demographics

Table V-5 displays the percent of jobs that had a child, an elderly household member, a disabled household member, or a member of any of the three vulnerable groups in the household. The table shows that 72 percent of households treated had at least one vulnerable household member.

**Table V-5
Vulnerable Household Members**

Vulnerable Status	Treatment Group 9/1/2010 – 8/31/2011		Comparison Group 9/1/2011 – 8/31/2012	
	#	%	#	%
Child <18	2,843	44%	4,074	42%
Elderly >62	1,881	29%	2,614	27%
Disabled	346	5%	799	8%
Any Vulnerable	4,624	72%	6,627	68%

Table V-6 displays the distribution of household poverty level. The table shows that about half of the customers served had household income below the poverty level. However, these data were missing for about 26 percent of the Treatment Group and 17 percent of the Comparison Group. This is due to the fact that income verification is not required for USF participants and categorically eligible participants such as SSI recipients.

Table V-6
Household Poverty Level Distribution

Poverty Level	Treatment Group 9/1/2010 – 8/31/2011		Comparison Group 9/1/2011 – 8/31/2012	
	#	%	#	%
≤100%	3,483	54%	4,695	48%
101% - 150%	304	5%	582	6%
151% - 200%	867	13%	2,730	28%
>200%	97	2%	123	1%
Missing	1,686	26%	1,650	17%
Total	6,437	100%	9,780	100%

Table V-7 displays the occupancy type. The type shows that 67 percent owned their homes and 31 percent rented.

Table V-7
Occupancy Type

Occupancy Type	Treatment Group 9/1/2010 – 8/31/2011		Comparison Group 9/1/2011 – 8/31/2012	
	#	%	#	%
Own	4,343	67%	6,737	69%
Rent	2,014	31%	2,647	27%
Other	4	<1%	3	<1%
Missing	76	1%	393	4%
Total	6,437	100%	9,780	100%

C. Home Characteristics

Table V-8 shows that 70 percent were single family homes and 28 percent were multi-family homes.

Table V-8
Structure Type

Structure Type	Treatment Group 9/1/2010 – 8/31/2011		Comparison Group 9/1/2011 – 8/31/2012	
	#	%	#	%
Single Family	4,506	70%	7,308	75%
Multi-Family (condo or apt. up to 14 units)	1,787	28%	1,981	20%
Other	68	1%	98	1%

Structure Type	Treatment Group 9/1/2010 – 8/31/2011		Comparison Group 9/1/2011 – 8/31/2012	
	#	%	#	%
Missing	76	1%	393	4%
Total	6,437	100%	9,780	100%

Table V-9 displays the primary heating fuel. The table shows that 89 percent were utility gas heat and 9 percent were electric heat.

**Table V-9
Primary Heating Fuel**

Primary Heating Fuel	Treatment Group 9/1/2010 – 8/31/2011		Comparison Group 9/1/2011 – 8/31/2012	
	#	%	#	%
Utility Gas	5,754	89%	8,449	86%
Electric	574	9%	899	9%
Other	33	1%	39	<1%
Missing	76	1%	393	4%
Total	6,437	100%	9,780	100%

Table V-10 displays air conditioning type. The table shows that 46 percent had window units, 42 percent had central air conditioning, and six percent had wall units.

**Table V-10
Air Conditioning Type**

Air Conditioning Type	Treatment Group 9/1/2010 – 8/31/2011		Comparison Group 9/1/2011 – 8/31/2012	
	#	%	#	%
Window Units	2,954	46%	4,293	44%
Central System	2,696	42%	4,079	42%
Wall Units	392	6%	475	5%
Heat Pump	29	<1%	39	<1%
None	274	4%	481	5%
Other	16	<1%	20	<1%
Missing	76	1%	393	4%
Total	6,437	100%	9,780	100%

Table V-11 displays information on refrigerator ownership. The NJCP program does replace refrigerators that belong to the landlord, and in that case, the landlord would own the replacement refrigerator. The table shows that the customer owned the refrigerator in 71 percent of the cases, the landlord in 18 percent, and the tenant in 10 percent.

**Table V-11
Refrigerator Ownership**

Refrigerator Ownership	Treatment Group 9/1/2010 – 8/31/2011		Comparison Group 9/1/2011 – 8/31/2012	
	#	%	#	%
Customer	4,597	71%	7,293	75%
Landlord	1,168	18%	1,447	15%
Tenant	660	10%	893	9%
Missing	12	<1%	147	2%
Total	6,437	100%	9,780	100%

D. Spending Guidelines and Expenditures

Table V-12 displays the sum of the gas and the electric seasonal spending allowances. Additional work that is not included in the allowances includes audits and education, blower door diagnostics, baseload measures, HVAC repairs and replacements, combustion safety measures, health and safety measures, and window or wall air conditioning units. The mean total allowance for jobs with gas heat and hot water was \$4,316, it was \$3,206 for jobs with electric heat and electric hot water, and it was \$3,012 for jobs with gas heat and electric hot water.

**Table V-12
Total Spending Allowance
By Detailed Job Type**

Job Type	Treatment Group 9/1/2010 – 8/31/2011					Comparison Group 9/1/2011 – 8/31/2012				
	#	Mean	Percentile			#	Mean	Percentile		
			25	50	75			25	50	75
Gas Heat & Gas DHW	5,486	\$4,316	\$1,397	\$3,967	\$5,445	8,163	\$4,029	\$1,441	\$4,212	\$4,948
Electric Heat & Electric DHW	515	\$3,206	\$2,124	\$2,993	\$4,209	804	\$3,097	\$2,186	\$2,970	\$4,004
Gas Heat & Electric DHW	218	\$3,012	\$772	\$1,647	\$4,212	296	\$3,459	\$1,110	\$3,683	\$4,948
Electric Heat & Other DHW	25	\$3,761	\$2,615	\$3,407	\$5,287	25	\$3,184	\$1,256	\$2,780	\$4,212
Other	86	\$1,656	\$0	\$736	\$2,887	62	\$2,645	\$615	\$3,017	\$4,212
Missing	0					6	\$3,731	\$2,984	\$4,212	\$4,844
Subtotal with Allowance	6,330	\$4,142	\$1,363	\$3,801	\$5,167	9,356	\$3,919	\$1,454	\$4,114	\$4,948
Allowance Missing	107					424				
Total	6,437					9,780				

Table V-13 displays detailed statistics on the sum of the gas and electric invoiced amounts by job type. The table shows that the mean total invoice for homes with gas heat and hot water was \$3,757, it was \$2,922 for jobs with electric heat and electric hot water, and it was \$3,644 for jobs with gas heat and electric hot water. While 25 percent of jobs had total costs of more than \$4,965, 25 percent had costs of under \$1,462.

Table V-13
Total Job Costs – Gas and Electric Invoiced Amount Detailed Statistics
By Job Type

Job Type	Treatment Group 9/1/2010 – 8/31/2011					Comparison Group 9/1/2011 – 8/31/2012				
	#	Mean	Percentile			#	Mean	Percentile		
			25	50	75			25	50	75
Gas Heat & Gas DHW	5,495	\$3,757	\$1,569	\$2,868	\$5,110	8,121	\$3,277	\$1,295	\$2,376	\$4,385
Electric Heat & Electric DHW	526	\$2,922	\$809	\$2,111	\$4,271	817	\$3,018	\$1,282	\$2,579	\$4,456
Gas Heat & Electric DHW	218	\$3,644	\$1,300	\$2,734	\$5,024	295	\$3,006	\$1,226	\$2,143	\$3,898
Electric Heat & Other DHW	26	\$2,357	\$791	\$2,061	\$3,924	25	\$2,674	\$1,427	\$2,023	\$2,945
Other	88	\$1,252	\$466	\$1,287	\$1,643	63	\$1,656	\$483	\$1,111	\$1,694
Subtotal with Invoice	6,353	\$3,643	\$1,462	\$2,757	\$4,965	9,321	\$3,233	\$1,280	\$2,364	\$4,362
Invoice Missing	84					459				
Total	6,437					9,780				

E. Testing Results

Table V-14 displays the distribution of pre-treatment blower door readings. The table shows that the mean reading was 3,171. While ten percent had readings under 1,510 CFM50, ten percent had readings of over 5,061 CFM50.

Table V-14
Pre-Treatment Blower Door Results – Detailed Statistics

Group	Obs.	Pre-Treatment Blower Door Results (CFM50)					
		Mean	Percentile				
			10	25	50	75	90
Treatment Group	4,414	3,171	1,510	2,048	2,966	3,970	5,061
Comparison Group	6,509	3,252	1,526	2,102	3,026	4,114	5,220

*2,023 Cases from the Treatment Group and 3,271 cases from the Comparison Group missing Pre-Treatment Blower Door Readings were excluded from this table.

Table V-15 displays the distribution of post-treatment blower door readings. The table shows that the mean reading was 2,681 CFM50. While ten percent had readings under 1,387 CFM50, ten percent had readings of over 4,227 CFM50.

Table V-15
Post Treatment Blower Door Results – Detailed Statistics

Group	Obs.	Post Treatment Blower Door Results (CFM50)					
		Mean	Percentile				
			10	25	50	75	90
Treatment Group	3,097	2,681	1,387	1,788	2,454	3,276	4,227
Comparison Group	4,478	2,701	1,301	1,769	2,506	3,391	4,334

*3,340 Cases from the Treatment Group and 5,302 cases from the Comparison Group missing Post Treatment Blower Door Readings were excluded from this table.

Table V-16 displays the distribution of the reduction in blower door readings. The table shows that the mean reduction was 601 CFM50. While ten percent had a reduction of less than 65 CFM50, ten percent had a reduction of more than 1,348 CFM50. However, previous research has found that there is not a correlation between such reductions in blower door readings and the amount of energy saved, as air leakage reductions must result from sealing at the top and bottom of the envelope in order to achieve significant impacts on energy usage.

Table V-16
Reduction in Blower Door Reading – Detailed Statistics

Group	Obs.	Reduction in Blower Door Reading					
		Mean	Percentile				
			10	25	50	75	90
Treatment Group	3,075	601	65	200	436	830	1,348
Comparison Group	4,455	557	54	182	404	750	1,241

*3,362 Cases from the Treatment Group and 5,325 cases from the Comparison Group missing Pre or Post Treatment Blower Door Readings were excluded from this table.

Table V-17 displays the distribution of the percent reduction in blower door readings. The table shows that the mean reduction was 17 percent. While ten percent had a reduction of less than three percent, ten percent had a reduction of more than 35 percent.

Table V-17
Percentage Reduction in Blower Door Reading – Detailed Statistics

Group	Obs.	Reduction in Blower Door Reading					
		Mean	Percentile				
			10	25	50	75	90
Treatment Group	3,075	17%	3%	8%	15%	25%	35%
Comparison Group	4,455	16%	2%	7%	15%	23%	33%

Table V-18 displays the number of refrigerators monitored per home. The table shows that one refrigerator was metered in 69 percent of the jobs and two were metered in 12 percent of the jobs. There were 18 percent of the jobs where no refrigerators were metered.

Table V-18
Refrigerators Monitored

Refrigerators Monitored	Treatment Group 9/1/2010 – 8/31/2011		Comparison Group 9/1/2011 – 8/31/2012	
	#	%	#	%
0	1,175	18%	1,948	20%
1	4,440	69%	6,745	69%
2	822	12%	1,087	11%
Total	6,437	100%	9,780	100%

Table V-19 displays detailed statistics on the metering results for the first refrigerator. The table shows that while 25 percent had usage of less than 613 kWh, 50 percent had usage of more than 1,139 kWh.

Table V-19
First Refrigerator Metering Results –Detailed Statistics

Group	Obs.	Refrigerator Metering Results (kWh)					
		Mean	Percentile				
			10	25	50	75	90
Treatment Group	5,262	1,195	412	613	1,139	1,454	2,015
Comparison Group	7,832	1,044	403	561	964	1,340	1,778

*1,175 Cases from the Treatment Group and 1,948 cases from the Comparison Group with no refrigerator metering information were excluded from this table.

F. Measures

Table V-20 displays the percent of jobs with one or more measures in each protocol savings category. The table shows that 79 percent had CFL's installed, 65 percent had air sealing, and 61 percent had hot water measures. Other categories where about one third or more of the jobs had measures were HVAC, refrigerators, thermostats, duct sealing, and insulation.

Table V-20
Percent of Jobs with Each Protocol Savings Category

Protocol Savings Category	Treatment Group 9/1/2010 – 8/31/2011		Comparison Group 9/1/2011 – 8/31/2012	
	#	%	#	%
CFL	5,100	79%	6,760	69%
Air Sealing	4,201	65%	5,202	53%
Hot Water	3,926	61%	5,214	53%
HVAC	2,991	46%	4,260	44%
Refrigerator	2,797	43%	3,622	37%
Thermostat	2,436	38%	3,140	32%
Duct Sealing	2,061	32%	3,080	31%
Insulation	2,029	32%	2,611	27%
No Savings Protocol Followed	189	3%	413	4%
No measure level data	84	1%	459	5%

The NJCP program database provided a detailed list of 406 different measures. APPRISE combined these into measure categories for the purposes of analysis. Table V-21 displays the percent of jobs that had one or more measures in each of these categories. The most common measures, with penetration of over 85 percent, were the audit, energy education, and combustion testing. Health and safety measures were provided in 78 percent of homes, air sealing was done in 60 percent, and attic insulation in 27 percent.

Table V-21
Percent of Jobs with Each Measure Type

Measure Group	Treatment Group 9/1/2010 – 8/31/2011		Comparison Group 9/1/2011 – 8/31/2012	
	#	%	#	%
Audit	6,249	97%	9,244	95%
Energy Education	6,211	96%	9,235	94%
Combustion Testing	5,657	88%	8,176	84%
Refrigerator Metering	5,322	83%	7,901	81%
Health And Safety	4,995	78%	7,409	76%

Measure Group	Treatment Group 9/1/2010 – 8/31/2011		Comparison Group 9/1/2011 – 8/31/2012	
	#	%	#	%
CFL	5,100	79%	6,760	69%
Blower Door Test	4,388	68%	6,448	66%
Air Sealing	3,832	60%	4,848	50%
Door	3,378	52%	3,968	41%
HVAC Repair	2,843	44%	3,999	41%
Attic Preparation	2,488	39%	3,679	38%
Water Saving	2,638	41%	3,417	35%
Refrigerator	2,635	41%	3,389	35%
Thermostat	2,436	38%	3,140	32%
Air Leakage Reduction	2,335	36%	3,048	31%
Home Repair	1,960	30%	2,886	30%
Ducts	1,957	30%	2,752	28%
Dryer	1,552	24%	2,847	29%
Attic Insulation	1,717	27%	2,296	23%
Ventilation	1,400	22%	2,413	25%
HVAC Tune-Up	1,256	20%	2,242	23%
Pipe Insulation	1,736	27%	1,668	17%
Water Heater Wrap	1,779	28%	1,289	13%
Tstat Accessory	1,338	21%	1,253	13%
Filter Clean/Replace	929	14%	1,143	12%
Perimeter Insulation	721	11%	1,244	13%
Refrigerator/Appliance Removal	452	7%	1,478	15%
Window	792	12%	750	8%
Moisture Reduction	563	9%	903	9%
Service	529	8%	922	9%
Insulation	245	4%	962	10%
Hot Water Tank Replacement	479	7%	559	6%
Freezer	479	7%	502	5%
DHW Repair	348	5%	433	4%
Floor Insulation	352	5%	426	4%
Sidewall Insulation	359	6%	360	4%
HVAC Replace	292	5%	370	4%
Unsuccessful Home Visit	203	3%	378	4%
Efficiency Testing	520	8%	0	0%
Wall Insulation	232	4%	239	2%

Measure Group	Treatment Group 9/1/2010 – 8/31/2011		Comparison Group 9/1/2011 – 8/31/2012	
	#	%	#	%
Miscellaneous	32	0%	316	3%
Mold Pilot	44	1%	95	1%
Electrical Repair Pilot	39	1%	58	1%
Other: AC Replacement, Asbestos Pilot, And Clothes Line	59	1%	31	<1%
No Measure Level Data	84	1%	459	5%

The most expensive measures and costs per home were as follows.

- HVAC replacement - \$6,108
- Sidewall insulation - \$2,191
- Hot water tank replacement - \$1,687
- Attic insulation - \$1,441
- Refrigerator replacement - \$1,091

Table V-22 provides data on the percent of jobs and costs for health and safety measures. The table shows that while 98 percent of jobs with gas heat and gas water heat had a health and safety measure, 61 percent of those with electric heat and electric hot water had a health and safety measure. The mean cost for health and safety measures for gas heat and hot water jobs was \$462, compared to a mean cost of \$428 for homes with electric heat and electric hot water.

Table V-22
Health and Safety Measures – Percent with Measures and Cost Statistics
By Detailed Job type

Job Type	Treatment Group 9/1/2010 – 8/31/2011						Comparison Group 9/1/2011 – 8/31/2012					
	#	% H&S	Mean Cost	Spending Percentile			#	% H&S	Mean Cost	Spending Percentile		
				25	50	75				25	50	75
Gas Heat & Gas DHW	5,495	98%	\$462	\$170	\$292	\$543	8,121	99%	\$479	\$194	\$348	\$600
Electric Heat & Electric DHW	526	61%	\$428	\$75	\$275	\$552	817	72%	\$523	\$159	\$362	\$611
Gas Heat & Electric DHW	218	98%	\$350	\$131	\$202	\$395	295	97%	\$371	\$170	\$245	\$456
Electric Heat & Other DHW	26	92%	\$253	\$139	\$191	\$285	25	92%	\$350	\$170	\$286	\$486
Other	88	88%	\$195	\$120	\$131	\$202	63	94%	\$262	\$96	\$170	\$327
Missing	0											
All with measure-level data	6,353	95%	\$452	\$170	\$284	\$535	9,321	96%	\$477	\$184	\$343	\$594
No measure level data	84						459					
Total	6,437						9,780					

G. Third Party Inspections

Table V-23 shows that 18 percent of jobs in the Treatment Group had a third party inspection.

Table V-23
Third Party Inspection Completed

Third Party Inspection	Treatment Group 9/1/2010 – 8/31/2011		Comparison Group 9/1/2011 – 8/31/2012	
	#	%	#	%
Yes	1,158	18%	1,379	14%
No	5,279	82%	8,401	86%
Total	6,437	100%	9,780	100%

Table V-24 displays the results of the inspections. While 33 percent of the jobs in the Treatment Group failed, 20 percent of jobs in the Comparison Group failed. Utilities revised the third party quality control inspection process in August 2012 so that jobs with “non-critical problems” passed inspections rather than failing. A new category of “Pass with Action Required” was added so that if the inspector visits the home more than 30 days after the services are delivered and finds an issue, the job would be considered “Pass with Action Required” instead of failed.³²

Table V-24
Third Party Inspection Results

Inspection Results	Treatment Group 9/1/2010 – 8/31/2011		Comparison Group 9/1/2011 – 8/31/2012	
	#	%	#	%
Passed with No Reservations	0	0%	4	<1%
Passed with Comments	362	31%	87	6%
Passed with Action Required	4	<1%	125	9%
Failed	380	33%	278	20%
No Result Reported	412	36%	885	64%
Total	1,158	100%	1,379	100%

Table V-25 displays the percent of jobs with each failure reason. The most common reasons for failure were health and safety problems, followed by missed opportunities.

³² This change was made to allow for the fact that circumstances can change over time and the inspection should relate to the condition of the home at the time that the work was completed.

Table V-25
Third Party Failure Reason

Inspection Results	Treatment Group 9/1/2010 – 8/31/2011		Comparison Group 9/1/2011 – 8/31/2012	
	#	%	#	%
Health and Safety Problem	185	49%	86	31%
Important Opportunity Missed	115	30%	88	32%
Poor Installation Quality	77	20%	79	28%
Incorrect Invoice	72	19%	37	13%
Incomplete Documentation	67	18%	26	9%
Gas Leak	38	10%	25	9%
Wrong Material Used	30	8%	7	3%
Debris Left on Job Site	3	1%	0	0%
Return/replace Burnt-out Bulbs	3	1%	0	0%
Customer Request	2	1%	1	<1%
Future Consideration	0	0%	1	<1%
Dirty Filter or Coil	0	0%	1	<1%

*One case listed Health and Safety Problems twice as a reason for failure. This case is only represented once in the data above.

H. Summary

The NJCP program tracking database provides rich information to examine the population of households served by the program, their home and job characteristics, program spending and measures, and inspection results. These data add greatly to the understanding of who the program is able to serve and how these services are delivered.

Data were analyzed for the periods that will be covered in the impact evaluation. In almost all cases, results are displayed separately for the two analysis periods.

- Treatment Group: Customers who received NJCP audits between September 2010 and August 2011
- Comparison Group: Customers who received NJCP audits between September 2011 and August 2012
- *Production:* While 6,437 homes were audited in the Treatment Period, 9,780 homes were audited in the Comparison Period. In both periods, approximately 85 percent were gas and electric jobs, nine percent were electric only, and two percent were gas only.

Honeywell completed 63 percent of the audits in the Treatment Period and 52 percent in the Comparison Period. The three other contractors that performed a significant percentage of the audits were EIC, CMC, and Northeast Energy. CMC's share of the

jobs increased from 13 percent during the Treatment Period to 25 percent during the Comparison Period.

- *Demographics:* Most of the households served by the NJCP program, about 70 percent, had at least one vulnerable household member who was a child, elderly, or disabled.

While the Needs Assessment found that 59 percent of income-eligible households rented their homes, the tracking database analysis showed that only 30 percent of those served were renters. However, some low-income renters would not be eligible because they lived in buildings with over 14 units or did not pay directly for electricity or gas.

- *Home Characteristics:* About 70 percent of the homes treated were single family and most of the rest were multi-family homes. Row homes were about ten percent of those served, and mobile homes were only about three percent.

About 90 percent of treated homes had natural gas heat and about ten percent had electric heat. Supplemental heating was used in a large percentage, 38 percent, of homes. Almost all of the supplemental heating was electric heating.

While 45 percent had window air conditioning units, 42 percent had central air conditioning.

- *Expenditures:* Total job costs averaged \$3,757 for homes with gas heat and gas hot water and averaged \$2,922 for homes with electric heat and electric hot water.
- *Testing Results:* There are many barriers to conducting blower door tests in the housing stock served by the NJCP program. Contractors reported that they were not able to perform blower door tests due to health and safety issues, such as mold, asbestos, vermiculite insulation, use of breathing apparatuses or other medical equipment, and customer refusals. On-site observations and inspections confirmed the frequency of such issues.

One third of the jobs did not have a pre-treatment blower door test, and 52 percent did not have a post-treatment blower door test.

When examining the half of the homes that had pre- and post-treatment blower door test results, the analysis shows that 19 percent had a reduction of 1,000 CFM50 or more, and eight percent had a reduction of 1,500 CFM50 or more. The mean reduction was about 600 CFM50.³³

Refrigerators were monitored in about 80 percent of the treated homes. The metering results showed that about 56 percent of the metered refrigerators had usage over 1,000 kWh, most of which would be eligible for replacement under the program.

³³ This is not an indicator of savings, as reductions in air leakage must be accomplished in the top of the envelope to achieve usage reduction.

- *Measures:* Measure installation was examined both by protocol savings category and by detailed measure group. The protocol savings category analysis showed that 79 percent had CFL's installed, 65 percent had air sealing, and 61 percent had hot water measures. Other categories where about one third or more of the jobs had measures were HVAC, refrigerators, thermostats, duct sealing, and insulation.

The NJCP program database provided a detailed list of 406 different measures. APPRISE combined these into measure categories for the purposes of analysis. The most common measures, with penetration of over 85 percent, were the audit, energy education, and combustion testing. Air sealing was done in 60 percent, and attic insulation in 27 percent.

The analysis showed that health and safety measures are one of the most common treatments performed by the program. These services were provided in 78 percent of homes.

The most expensive measures and costs per home were as follows.

- HVAC replacement - \$6,108
- Sidewall insulation - \$2,191
- Hot water tank replacement - \$1,687
- Attic insulation - \$1,441
- Refrigerator replacement - \$1,091

While 98 percent of jobs with gas heat and gas water heat had a health and safety measure, 61 percent of those with electric heat and electric hot water had a health and safety measure. The mean cost for health and safety measures for gas heat and hot water jobs was \$462, compared to a mean cost of \$428 for homes with electric heat and electric hot water.

- *Third Party Inspections:* 18 percent of jobs in the Treatment Group had a third party inspection, and 33 percent failed the inspection. The most common reasons for failure were health and safety problems, followed by missed opportunities.

VI. Customer Feedback

The evaluation included telephone interviews with program participants to assess program understanding, energy education, perceived impact of services, and satisfaction with the program. This section provides a description of the research that was conducted, a summary of the findings, and recommendations for the program based upon this research.

A. Introduction

APPRISE conducted 977 telephone interviews with customers who participated in the NJCP program and had their installations completed between October 2012 and January 2013, approximately one year prior to the survey.

Customers served during this time period were selected for the survey with the following goals in mind.

- Customers experienced summer and winter weather following service delivery.
- Customers did not receive services too far in the past. This was important to ensure that customers remembered service delivery.
- The period for selection was long enough to provide enough sample cases for each contractor and utility.

The survey covered the following research topics.

- Reasons for participation in the NJCP program.
- Contractor review and customer understanding of energy bills.
- Action plan and behavioral changes made by the customer to reduce energy usage.
- Satisfaction with installed measures.
- Perceived impact of energy services on home comfort, energy usage, and energy bills.
- Overall satisfaction with the program and the service providers.
- Demographic data not included in tracking database, including years in home, veteran status, income sources, and unemployment.
- Willingness to participate in upcoming inspections of completed work.

B. Methodology

This section describes the methodology for the customer surveys, including sample design, survey implementation, and survey response.

Sample Design

The sample was stratified to provide an adequate sample for analysis for each utility and for each implementation contractor. Table VI-1 displays the number of installations completed during the target period by contractor, the number of customers to be selected, and the goal

for the number of survey completes. The sample assumed a 35 percent completed interview rate, consistent with recent experience with surveys of low-income energy efficiency program participants.

**Table VI-1
Survey Sample and Survey Complete Goal
By Contractor**

Contractor	Installations Completed 10/1/2012 – 1/31/2013 Phone Number Available		Survey Sample	Survey Complete Goal	
	#	%	#	#	%
Honeywell	1,456	46%	1110	388	43%
CMC Energy	738	23%	600	210	23%
EIC – Comfort Home	538	17%	500	175	19%
Northeast Energy	372	12%	320	112	12%
Optimal Energy	45	1%	45	15	2%
Total	3,149	100%	2575	900	100%

The survey data were analyzed by contractor, gas utility, and electric utility. Therefore, it was important to ensure that sample sizes were sufficient for the contractors and utilities.

Table VI-2A displays the expected and actual number of completes by contractor. The table shows that all contractors except Optimal Energy had a sufficient number of observations for a comparative analysis. Because Optimal Energy only completed 45 installations during the defined period, only 20 interviews were completed with customers who were served by this provider.

**Table VI-2A
Expected and Actual Completes By Contractor**

Contractor	Percent of Sample Frame	Survey Complete Goal		Survey Completes Realized	
		#	%	#	%
Honeywell	56%	388	43%	459	47%
CMC Energy	20%	210	23%	203	21%
EIC – Comfort Home	14%	175	19%	194	20%
Northeast Energy	9%	112	12%	101	10%
Optimal Energy	1%	15	2%	20	2%
Total	100%	900	100%	977	100%

Table VI-2B displays the expected and actual number of completes by electric utility. Each electric utility had enough observations for analysis.

**Table VI-2B
Expected and Actual Completes By Electric Utility**

Electric Utility	Percent of Sample Frame	Survey Complete Goal		Survey Completes Realized	
		#	%	#	%
PSE&G	63%	555	62%	574	59%
JCP&L	27%	176	20%	244	25%
ACE	8%	113	13%	128	13%
Municipal	2%	56	6%	31	3%
Total	100%	900	100%	977	100%

Table VI-2C displays the expected and actual number of completes by gas utility. All gas utilities had at least 100 completes, sufficient for the comparative analysis.

**Table VI-2C
Expected and Actual Completes By Gas Utility**

Gas Utility	Percent of Sample Frame	Survey Complete Goal		Survey Completes Realized	
		#	%	#	%
PSE&G	53%	463	51%	492	50%
NJNG	17%	134	15%	175	18%
ETG	13%	125	14%	140	14%
SJG	8%	80	9%	104	11%
None	9%	42	5%	66	7%
In Other Group	0%	56	6%	0	0%
Total	100%	900	100%	977	100%

The tables above showed that a sufficient number of completes was achieved for each contractor and utility except Optimal Energy because of the small number of jobs completed by this contractor during the time period studied.

Survey Implementation

APPRISE retained a telephone center to conduct the telephone survey through its call center. A researcher from APPRISE trained telephone center employees on the survey instrument and monitored survey implementation. The telephone center manager in charge

of the survey instructed interviewers how to use the computerized version of the survey to record customer responses.

Interviewer training provided interviewers with an overview of the project, purpose behind questions asked, and strategies to provide accurate clarification and elicit acceptable responses through neutral probing techniques.

Interviewer monitoring allowed APPRISE researchers to both listen to the way interviewers conducted surveys and see the answers they chose on the computerized data entry form. The telephone center manager facilitated open communication between the monitors and interviewers, which allowed the monitors to instruct interviewers on how to implement the survey and accurately record customer responses.

Telephone interviews were conducted in October and November 2013. During the six-week field period, 915 surveys were completed in English and 62 were completed in Spanish, for a total of 977 completes. While the English surveys averaged 20 minutes, the Spanish surveys averaged 23 minutes.

Response Rates

Table VI-3 details the number of customers selected to complete the survey, the number of completed interviews, cooperation rates, and response rates for each group. The tables present the following information for the sample.

- *Number Selected:* A total of 2,570 participants were selected for the survey sample. There were 2,575 participants originally targeted for this survey sample, and of these cases five were found to be duplicate records, yielding a sample of 2,570.
- *Completed Interviews:* The completed interviews are households that were reached and that answered the full set of survey questions. There were 977 interviews completed.
- *Cooperation Rate:* The cooperation rate is the percent of eligible households contacted who completed the survey. This is calculated as the number of completed interviews divided by the completed interviews plus the number of non-interviews (refusals plus non-completed call backs³⁴). Overall, this survey achieved an 85 percent cooperation rate.
- *Response Rate:* The response rate is the number of completed interviews divided by the number of completed interviews plus the number of non-interviews (refusals plus non-completed call backs) plus all cases of unknown eligibility (due to answering machines and language barriers). This survey attained a 52 percent response rate.

³⁴ Non-completed callbacks include respondents who asked the interviewer to call back at a later time to complete the interview, but did not complete the interview by the end of the field period.

**Table VI-3
Sample and Response Rates**

	All Respondents	
Selected	2,570	
	#	%
Unusable	534	21%
Non-Interviews	430	17%
Unknown Eligibility	629	24%
Completed Interviews	977	38%
Cooperation Rate	85%	
Response Rate	52%	

C. Findings

This section provides a summary of the key survey findings.

Respondent Characteristics

The customer survey collected information on program participants that was not available in the NJCP Tracking database. This information demonstrates that the program is serving a group of customers who have need for assistance.

- 15 percent of customers served by the NJCP program had one or more veterans in the home.
- 22 percent received employment income, 47 percent received retirement income, 27 percent received cash assistance, and 40 percent received non-cash assistance. The high percentage of households receiving assistance demonstrates the needs of this population.
- 37 percent of respondents reported that someone in the home was unemployed in the past year.

**Table VI-4
Respondent Characteristics
By Implementation Contractor**

Including yourself, how many people who normally live in this household are veterans? In the past 12 months, did you or any member of your household receive employment income from wages and salaries or self-employment income from a business or farm; Social Security or pensions or other retirement funds; TANF, SSI, or general or public assistance; receive food stamps or live in public or subsidized housing? In the past 12 months, was any member of your household unemployed and looking for work?						
	All Respondents	Implementation Contractor				
		HW	CMC	EIC	NE	OPT
Completes	977	459	203	194	101	20
	Percent of Respondents					
Veteran	15%	15%	16%	13%	13%	15%
Employment	22%	20%	24%	23%	23%	35%
Retirement	47%	53%	43%	40%	39%	50%
Cash Assistance	27%	27%	23%	31%	24%	45%
Non-Cash Assistance	40%	36%	38%	53%	36%	45%
Unemployed in Past Year	37%	30%	40%	44%	49%	50%

Reasons for Participation

This section explores the participation decision. Table VI-5 displays the customers' responses to how they found out about the NJCP program. Customers were most likely to report that they had learned about the program through a friend or relative, followed by the utility, an agency, and the contractor. Spanish speaking interview respondents were more likely to report that they heard about the program through contractors and less likely to report that they heard about the program through the utility.

**Table VI-5
How Customer Learned about Comfort Partners
By Implementation Contractor**

How did you find out about the Program?						
	All Respondents	Implementation Contractor				
		HW	CMC	EIC	NE	OPT
Completes	977	459	203	194	101	20
	Percent of Respondents					
Friend/Relative	27%	29%	24%	23%	37%	10%
Utility	18%	21%	14%	15%	20%	20%
Govt. or Comm. Agency	16%	19%	15%	16%	10%	20%
Contractor	15%	12%	17%	18%	14%	40%
Program Flyer	8%	6%	9%	15%	7%	5%

How did you find out about the Program?						
	All Respondents	Implementation Contractor				
		HW	CMC	EIC	NE	OPT
Bill Insert	2%	3%	3%	2%	1%	5%
Internet	2%	1%	5%	2%	0%	5%
Other	5%	5%	4%	5%	4%	0%
Don't Know	14%	14%	17%	11%	12%	10%

When asked whether their main reason for participation was to reduce energy bills, reduce the amount of energy used, to improve home comfort, or some other reason, customers were most likely to report that it was to reduce energy bills.

**Table VI-6
Main Reason for Comfort Partners Participation
By Implementation Contractor**

What was the main reason that you wanted to receive Comfort Partners services, was it to reduce your energy bills, reduce the amount of energy you use, improve the comfort of your home, or some other reason?						
	All Respondents	Implementation Contractor				
		HW	CMC	EIC	NE	OPT
Completes	977	459	203	194	101	20
		Percent of Respondents				
Reduce Energy Bills	61%	64%	53%	61%	63%	45%
Improve Home Comfort	18%	17%	18%	18%	19%	20%
Reduce Energy Use	16%	14%	20%	17%	14%	30%
Free Services	4%	3%	7%	2%	4%	5%
Other	1%	2%	1%	2%	0%	0%
Don't Know	<1%	<1%	1%	1%	0%	0%
Total	100%	100%	100%	100%	100%	100%

Understanding of Energy Bill

This section explores customers' understanding of their energy bill and the energy bill education furnished by the providers. Table VI-7 displays the percent of customers who reported that the provider reviewed the energy bill, explained how energy use is measured, and the customers' understanding of the energy bill.

- While 43 percent of Honeywell customers reported that the provider reviewed the bills, 35 percent of CMC customers, 34 percent of Northeast Energy customers, and 24 percent of EIC customers reported that the service provider reviewed the energy bills.³⁵
- 48 percent of the respondents said that the contractor had furnished an explanation of how energy use is measured. EIC customers were less likely than other customers to report that they received such an explanation.
- 78 percent of respondents reported that they felt they had a good understanding of how to review their energy bill. Spanish interview respondents were less likely than English interview respondents to report that they felt they had a good understanding of how to read their bill.

Table VI-7
Energy Bill Review and Understanding
By Implementation Contractor

Did any of the service providers review your energy bills with you? Did any of the service providers explain how your energy use is measured? Do you feel that you have a good understanding of how to review your energy bill?						
	All Respondents	Implementation Contractor				
		HW	CMC	EIC	NE	OPT
Completes	977	459	203	194	101	20
	Percent of Respondents					
Provider Reviewed Energy Bill	37%	43%	35%	24%	34%	45%
Provider Explained how Energy Use is Measured	48%	50%	50%	40%	47%	45%
Customer Reported Good Understanding Of Energy Bill	78%	81%	79%	74%	70%	80%

Action Plan and Actions Taken

This section explores the use of the action plan and customer reports on actions they had taken to save energy as a result of the program. Table VI-8 provides information on energy saving action education and actions taken by customers.

- 54 percent of the respondents stated that the provider furnished them with a written plan of actions that they could take to save energy. Honeywell and CMC customers were more likely than other customers to report that the provider furnished such a plan.³⁶
- 27 percent said that the provider had furnished information on how much money they could expect to save by taking the energy-saving actions on their action plan.

³⁵This is consistent with the on-site observation findings. Observers found that natural gas bills were reviewed in 35 percent of applicable cases and electric bills were reviewed in 38 percent of applicable cases.

³⁶However, evaluation observers found that a higher 77 percent of the auditors used the action plan when discussing the customers' ability to take energy-saving actions. Some customers may not recall this discussion or the survey may have been conducted with a household member other than the one home at the time of the NJCP visit.

- 60 percent reported that they had been able to take energy-saving actions since the providers came to their home. Honeywell customers were more likely than EIC and Northeast Energy customers to report this. Note that this is a very positive finding that such a large percentage of customers reported that they had taken at least one action to save energy.

**Table VI-8
Provider Gave Customer a Written Action Plan
By Implementation Contractor**

Did any of the service providers give you a written plan of actions that you could take to save energy? Did any tell you how much money you could expect to save by taking those energy-saving actions? Have you been able to take any energy-saving actions since the providers came to your home?						
	All Respondents	Implementation Contractor				
		HW	CMC	EIC	NE	OPT
Completes	977	459	203	194	101	20
	Percent of Respondents					
Written Action Plan	54%	58%	58%	44%	46%	45%
Estimate of Money Savings from Actions	27%	27%	32%	18%	27%	30%
Customer Took Energy Saving Actions	60%	64%	60%	56%	52%	70%

Customers were asked about actions that targeted specific types of energy use. Table VI-9 shows that 47 percent said that they had reduced their heating use, 36 percent reported that they reduced their hot water use, 10 percent reported that they reduced their space heating use, and 38 percent reported they reduced their air conditioning use as a result of participating in the program. CMC and Honeywell customers were more likely to report that they reduced their heating, hot water, and air conditioning use than EIC and Northeast Energy customers.

**Table VI-9
Customer Reduced Specific Energy Use
By Implementation Contractor**

Have you reduced the heat setting on your thermostat or reduced how often you use your heat/ reduced the amount of hot water you use/ use space heater less as a result/reduced the amount of air conditioning you use as a result of participating in the Program?						
	All Respondents	Implementation Contractor				
		HW	CMC	EIC	NE	OPT
Completes	977	459	203	194	101	20
	Percent of Respondents					
Heat	47%	48%	51%	40%	38%	65%
Hot Water	36%	38%	41%	32%	28%	50%
Space Heater	10%	8%	14%	11%	7%	20%

Have you reduced the heat setting on your thermostat or reduced how often you use your heat/ reduced the amount of hot water you use/ use space heater less as a result/reduced the amount of air conditioning you use as a result of participating in the Program?						
	All Respondents	Implementation Contractor				
		HW	CMC	EIC	NE	OPT
Air Conditioning	38%	42%	38%	31%	27%	50%

Program Measures

This section examines customers' satisfaction with insulation, air sealing, and heating system work. Table VI-10 shows that most customers were very or somewhat satisfied with this work and with the condition of their home following the work.

Table VI-10
Percent Very or Somewhat Satisfied with Measures
By Implementation Contractor

How satisfied were you with the insulation/air sealing/heating work? How satisfied were you with the condition in which the provider left your home?						
	All Respondents	Implementation Contractor				
		HW	CMC	EIC	NE	OPT
Percent of Respondents						
Insulation (N=616)						
Work Completed	94%	95%	90%	93%	97%	94%
Home Condition Following Work	94%	94%	99%	88%	96%	94%
Air Sealing (N=593)						
Work Completed	93%	95%	94%	91%	85%	94%
Home Condition Following Work	95%	97%	96%	89%	95%	94%
Heating Repair/Replace (N=198)						
Work Completed	93%	93%	94%	92%	96%	83%
Home Condition Following Work	95%	97%	95%	97%	92%	83%

*Only respondents who reported that they had the specific type of work completed are included in that row of the table.

Home Comfort

When asked about changes in home comfort after receiving NJCP program services, 50 percent said that the winter temperature in their home improved and 39 percent said that their summer temperature had improved. Northeast Energy respondents were more likely than other respondents to report that their winter temperature had improved.

**Table VI-11
Change in Winter Temperature
By Implementation Contractor**

Has the winter/summer temperature in your home improved, worsened, or stayed the same since receiving Comfort Partners services?						
	All Respondents	Implementation Contractor				
		HW	CMC	EIC	NE	OPT
Completes	977	459	203	194	101	20
Percent of Respondents						
Winter Temperature Improved	50%	47%	50%	49%	59%	65%
Summer Temperature Improved	39%	40%	38%	34%	44%	55%

Understanding, Impact, and Usage

This section addresses customers' understanding of the benefits of the NJCP program. Table VI-12 shows that 89 percent of respondents said that they felt they had a good understanding of the benefits provided by the program.

**Table VI-12
Customer Understands Benefits of Comfort Partners
By Implementation Contractor**

Do you feel that you have a good understanding of the benefits provided by the Comfort Partners Program?						
	All Respondents	Implementation Contractor				
		HW	CMC	EIC	NE	OPT
Completes	977	459	203	194	101	20
Percent of Respondents						
Yes	89%	90%	88%	89%	90%	75%
No	8%	8%	8%	9%	9%	25%
Don't Know	3%	2%	4%	2%	1%	0%
Total	100%	100%	100%	100%	100%	100%

When asked whether they felt the main benefit of the program was lower energy bills, lower energy use, energy education, a safer or more comfortable home, or something else, customers were most likely to report that lower energy bills, followed by a safer or more comfortable home was the main benefit. However, most customers agreed that all of these were benefits of the program. Honeywell customers were more likely than others to report that lower energy bills were the main benefit and CMC customers were more likely to report that the main benefit was a safer or more comfortable home.

Table VI-13
Customer Perception of the Benefits of Comfort Partners
By Implementation Contractor

What do you feel is the main benefit of the program, is it lower energy bills, lower energy use, energy education, a safer or more comfortable home, or something else? Do you feel that lower energy bills/ lower energy use/ energy education/ safer or more comfortable home are a benefit of the Program?						
	All Respondents	Implementation Contractor				
		HW	CMC	EIC	NE	OPT
Completes	977	459	203	194	101	20
	Percent of Respondents					
Lower Energy Bills						
Main Benefit	43%	50%	35%	39%	42%	45%
Benefit	93%	92%	93%	92%	96%	90%
Lower Energy Usage						
Main Benefit	21%	20%	20%	23%	24%	35%
Benefit	95%	96%	94%	93%	96%	95%
Energy Education						
Main Benefit	9%	7%	9%	11%	11%	0%
Benefit	89%	88%	92%	90%	88%	75%
Safer/More Comfortable Home						
Main Benefit	22%	18%	29%	22%	20%	15%
Benefit	93%	93%	93%	93%	94%	95%

Satisfaction

Customers were asked several questions to assess their satisfaction with the NJCP program. Table VI-14 shows that most customers provided high ratings for all aspects of the program.

**Table VI-14
Satisfaction with Comfort Partners
By Implementation Contractor**

<ul style="list-style-type: none"> • How important has the Program been in helping you to meet your needs? • How satisfied were you with the energy education that you received? • How helpful was the Program in teaching you about energy use and ways to reduce energy costs? • Do you feel that the provider who came to your home was very knowledgeable about energy usage, somewhat knowledgeable, or not at all knowledgeable? • Do you feel that the provider who came to your home was friendly and polite? • Was all of the work that you were promised done very soon after it was promised, somewhat soon after, or not at all soon after? • Overall, how satisfied were you with the Comfort Partners Program? 						
	All Respondents	Implementation Contractor				
		HW	CMC	EIC	NE	OPT
Completes	977	459	203	194	101	20
	Percent of Respondents					
Program Was Very/Somewhat Important	84%	82%	88%	85%	86%	80%
Very/Somewhat Satisfied with Energy Education	87%	89%	84%	84%	87%	80%
Very/Somewhat Helpful Teaching about Energy	85%	86%	83%	84%	86%	75%
Very/Somewhat Knowledgeable about Energy Use	93%	95%	92%	91%	94%	85%
Provider Was Friendly and Polite	98%	99%	98%	95%	95%	100%
Work Done Very/Somewhat Soon	82%	81%	84%	83%	82%	80%
Overall Very/Somewhat Satisfied	90%	91%	89%	89%	92%	85%

Last, customers were asked if they had recommendations for the NJCP program. Table VI-15 displays the responses to this question. The most common recommendation was to provide more measures, to follow up or follow through on work, and to improve the quality of the materials, crews, or work completed. However, the majority of customers did not have recommendations.

**Table VI-15
Recommendations for Comfort Partners
By Implementation Contractor**

Do you have any recommendations for improvements to the Program?						
	All Respondents	Implementation Contractor				
		HW	CMC	EIC	NE	OPT
Completes	977	459	203	194	101	20
	Percent of Respondents					
More Approved Measures	11%	10%	14%	11%	11%	10%
Follow Up/Follow Through	9%	10%	9%	10%	6%	10%

Do you have any recommendations for improvements to the Program?						
	All Respondents	Implementation Contractor				
		HW	CMC	EIC	NE	OPT
Improve Quality of Materials/Crew/Work	6%	5%	4%	9%	8%	15%
More Education	4%	2%	6%	5%	1%	10%
Better Communication	3%	2%	4%	5%	2%	0%
Faster Process	2%	2%	2%	2%	2%	5%
More Outreach	2%	2%	3%	2%	1%	5%
Other	5%	4%	8%	5%	5%	5%
Don't Know	2%	2%	1%	2%	4%	0%
No Recommendations	62%	64%	57%	60%	67%	50%
Total	100%	100%	100%	100%	100%	100%

D. Summary

This section provides a summary of the key findings from the NJCP customer survey.

- Respondent Characteristics – The customer survey collected information on program participants that was not available in the NJCP Tracking database. This information demonstrates that the program is serving a group of customers who have need for assistance.
 - The survey found that 15 percent of customers served by the NJCP program had one or more veterans in the household.
 - The most common income source was retirement income. While 47 percent reported that they received retirement income in the past year, 27 percent received cash assistance, and 22 percent received employment income. In addition, 40 percent received non-cash assistance.
 - Thirty-seven percent reported that someone in the household had been unemployed and looking for work in the past year.
- Reasons for Participation
 - The most common source of information for the program was a friend or relative. While 27 percent learned about the NJCP program through a friend or relative, 18 percent learned about the program through the utility, 16 percent through a government or community agency, and 15 percent through the contractor.
 - The majority of customers, 61 percent, reported that the main reason they wanted to participate in the NJCP program was to reduce their energy bills.
- Understanding of Energy Bill
 - While 43 percent of Honeywell customers reported that the provider reviewed their energy bills, 35 percent of CMC customers, 34 percent of Northeast Energy

- customers, and 24 percent of EIC customers reported that the service provider reviewed the energy bills.
- Forty-eight percent reported that the provider explained how energy use is measured. EIC respondents were less likely to report that they received such an explanation.
- Most customers, 78 percent, reported that they felt they had a good understanding of how to review their energy bill.
- Action Plan and Actions Taken
 - Overall, 54 percent reported that the service provider gave them a written plan of actions to save energy. While 58 percent of Honeywell and CMC customers reported that their provider furnished a plan, 44 percent of EIC and 46 percent of Northeast Energy customers reported this.
 - Twenty-seven percent reported that the service provider told them how much money they could expect to save by taking the actions on their plan.
 - Sixty percent reported that they had taken energy-saving actions, and when asked what they did, 48 percent reported at least one action.
 - When asked about specific actions, 47 percent said they reduced their heating use, 36 percent said they reduced their hot water use, ten percent said they reduced their space heating use, and 38 percent said they reduced their air conditioning use. CMC and Honeywell customers were more likely to report that they reduced their heating, hot water, and air conditioning use than EIC and Northeast Energy customers.
- Program Measures
 - Most customers, 92 to 95 percent, reported that they were very or somewhat satisfied when asked specifically about insulation, air sealing, and heating system work.
- Home Comfort
 - When asked about changes in home comfort after receiving NJCP program services, 50 percent said that the winter temperature in their home improved and 39 percent said that their summer temperature had improved. Northeast Energy respondents were more likely than other respondents to report that their winter temperature had improved.
- Understanding, Impact, and Usage
 - Eighty-nine percent of respondents reported that they felt they had a good understanding of the benefits of the NJCP program.
 - When asked whether they felt the main benefit of the program was lower energy bills, lower energy use, energy education, a safer or more comfortable home, or something else, customers were most likely to report that lower energy bills, followed by a safer or more comfortable home was the main benefit. However, most customers agreed that all of these were benefits of the program.
- Satisfaction
 - Most customers provided high ratings for all aspects of the program.

- Eighty-four percent stated that the program was very or somewhat important in helping the customer to meet his or her needs.
- Eighty-five percent said that the program was very or somewhat helpful in teaching about energy.
- Ninety percent said they were very or somewhat satisfied overall with the program.
- The majority of customers did not have recommendations for improving the program. Those who did have recommendations were most likely to ask for the program to provide more measures, to follow up or follow through on work, and improved quality of refrigerators, or additional contractor training.
- Recommendations
 - Customer need
 - Veterans – The survey found that 15 percent of customers who received NJCP program services had a veteran in the home.
 - Other Assistance – A significant percent of participants received other types of cash and non-cash assistance.
 - Unemployment – Thirty-seven percent reported that someone in the household had been unemployed in the past year.
 - *Recommendation – The NJCP program should assert that one important program benefit is that they are helping customers in the state who are very much in need of assistance.*
 - Program information source
 - Friends and relatives – The most common source of information for the program was a friend or relative. While 27 percent learned about NJCP through a friend or relative, the next largest source reported was the utility, as 18 percent reported that they learned about the program through the utility.
 - *Recommendation – The prevalence of “word of mouth” marketing is an important reason to ensure that participants understand the program purpose, benefits, and customer role.*
 - Energy education
 - Education provided – The survey found that Honeywell and CMC provide more successful energy education than EIC and Northeast Energy. Honeywell and/or CMC customers were more likely to report that the provider reviewed their energy bills, explained how energy use is measured, and provided a written plan of actions to save energy.
 - Energy saving actions – The survey found that Honeywell and CMC customers were more likely to report that they took actions to save energy. CMC and Honeywell customers were more likely to report that they reduced their heating, hot water, and air conditioning use than EIC and Northeast Energy customers.
 - *Recommendation – The utilities should provide additional guidance to EIC and Northeast Energy on providing energy education to customers.*

- Customer actions
 - Motivation for participation – The majority of customers, 61 percent, reported that the main reason they wanted to participate in the NJCP program was to reduce their energy bills.
 - Monetary savings from energy usage behavior change – Twenty-seven percent reported that the service provider told them how much money they could expect to save by taking the actions on their plan.
 - *Recommendation – Providers should be trained to furnish education on potential dollar savings from energy actions, as customers are most interested in reducing their energy bills.*

- Program Satisfaction
 - Most rated highly – Most customers said they were very or somewhat satisfied with key aspects of the program and the providers.
 - *Recommendation – There is room for improvement in the percent of customers who say they are very or somewhat satisfied with the program and providers should work on improved customer communication.*

VII. Service Delivery Assessment

The Service Delivery Assessment consisted of on-site observations and inspections of completed jobs. Eighteen weeks of on-site observation were conducted on audits, installations, and third party final inspections. Two hundred eighty-eight inspections of completed NJCP program jobs were conducted. This section describes the methodology for the research and provides a summary of the findings.

A. Methodology

This section reviews the methodology for the on-site observations and the inspections of completed jobs.

1. On-Site Observations

APPRISE conducted 18 weeks of on-site observation of audits, measure installation, and third party inspections between October 2013 and January 2014. Observations were conducted across the state to observe all contractors and work done for all electric and gas utilities.

A detailed data collection system was developed to assess whether key steps and tests were conducted and to rate the quality and comprehensiveness of service delivery.

APPRISE provided the observers with data collection forms and an Access database in which to enter the data. The following aspects of the audit were assessed.

- Audit Introduction and Home Walk-Through
- Assessments
 - Heating, Ventilation, and Air Conditioning
 - Water Heating
 - Diagnostic Testing
 - Refrigerators and Lighting
 - Other Baseload Measures
- Customer Interaction and Education
- Professionalism
- Exit Interview
- Audit Write-up

The following aspects of both the measure installation and the third party final inspection were assessed.

- Introduction
- Window and Door Work
- Air Sealing
- Insulation

- Ventilation
- Heating and Cooling
- Hot Water System
- Other Measures – Refrigerator, Dryer, Lighting, Low-Cost Measures
- Professionalism
- Communication and Education

Observation Procedures

Observation staff were trained on the NJCP program and procedures as well as on the procedures for conducting observation of service delivery and entering data into the ACCESS database. One of the challenges anticipated based on work in other studies was the requirement for the observers to refrain from interfering in the visit unless a serious safety issue was not handled correctly by the contractor.

The following points were emphasized.

- The purpose of the visit was to observe and record the process.
- Observers should not train, advise, recommend, correct, or otherwise influence the process.
- Observers should only intervene if they see serious safety issues.

Observers affirmed that they did face challenges in following these procedures, especially because contractor staff members sometimes asked the observers for advice in how to approach the jobs.

Observers were informed of the following requirements.

- Arrive at the home prior to the contractor to observe the initial interaction between the contractor and the customer.
- Be prepared to access attics, crawlspaces, or other confined areas.
- Hold questions for contractors about actions taken until after leaving the home.
- Come prepared with personal protective equipment.

Observers were instructed to meet with the contractor at the end of the observation day if they needed to discuss any of the following issues.

- Clarifying information about what was observed and program guidelines.
- The decision process that was followed.
- Reasons why certain work may not have been addressed.

Observations Conducted

Table VII-1 shows that 80 audits, 41 installations, and 13 final inspections were observed.

**Table VII-1
Observations Conducted**

	Number of Observations By Contractor					Total
	HW	EIC	CMC	NECI	OPT	
Audit	33	16	24	7	0	80
Measure Installation	17	6	10	8	0	41
Final Inspection	6	4	0	1	2	13
Total	56	26	34	16	2	134

Rating Scales

Table VII-2 provides the general guidelines for how the rating scales were designed. The table shows the number of points needed for each rating based on the total number of items rated.

- All items completed for a rating of 5.
- Between 90 and 99 percent of items completed for a rating of 4.
- Between 75 and 89 percent of items completed for a rating of 3.
- Between 50 and 74 percent of items completed for a rating of 2.
- The rating was 1 if less than half of the required items were completed.

**Table VII-2
Rating Design**

Rating	1	2	3	4*	5*
% of Points Needed	0%-49%	50%-74%	75%-89%	90%-99%	100%
Total Points	Number of Points Needed for Each Rating				
3	0-1	--	2	--	3
4	0-1	2	3	--	4
5	0-2	3	4	--	5
6	0-2	3-4	--	5	6
7	0-3	4	5	6	7
8	0-3	4-5	6	7	8
9	0-4	5-6	7	8	9
10	0-4	5-7	8	9	10
11	0-5	6-7	8-9	10	11
12	0-5	6-8	9-10	11	12
13	0-6	7-9	10-11	12	13
14	0-6	7-9	10-12	13	14

Rating	1	2	3	4*	5*
% of Points Needed	0%-49%	50%-74%	75%-89%	90%-99%	100%
Total Points	Number of Points Needed for Each Rating				
15	0-7	8-10	11-13	14	15

*In several cases, bolded items must be checked to receive a rating of 4 or 5. The bold items are displayed in specific rating tables included later in this report.

2. Inspections of Completed Jobs

APPRISE conducted 288 inspections of homes that had their NJCP program installations completed between October 2012 and January 2013. The 772 customers (a subset of the 977 who completed the telephone survey) who said they were interested in a home inspection during the survey were used as a recruitment list for the study. This sample had the following advantages.

- **Appropriate Population**
 - The customer survey sample was selected to be representative of the NJCP program population.
 - Following the survey, we knew that the customer was in the same home where services were delivered.
- **Participation**
 - Customers who were not willing to participate in a survey would be unlikely to agree to an inspection, so the survey provided an initial screening for willingness to participate in an inspection.
 - At the end of the survey, we informed customers about the inspection, the \$50 incentive that would be offered to inspection participants, and assessed interest in participation in the inspection.
- **Findings**
 - The survey included customers who had NJCP program service delivery completed between 10/1/2012 and 1/31/2013. By inspecting these homes, we were able to determine if the measures held up for a year after service delivery and if there were any long-term impacts for customer education.

Sample

We contacted, screened, and recruited survey respondent households who said they were interested in the on-site inspection. The screening only confirmed that the customer was still in the same home where services were provided and that the customer would be available for the visit. We provided a \$50 incentive at the time of the visit in recognition of the time and effort required to keep the inspection appointment.

Goals were set for number of inspections conducted by contractor, utility, and county. Completions were reviewed on a weekly basis and inspections were then targeted to reach these goals and provide a completed sample that was representative of the state.

Table VII-3 displays the distribution of inspected homes by contractor. The table shows that the distribution of completed inspections matches the goal very closely. Overall, 288 inspections were completed instead of the initial target of 300 due to an exceptionally difficult winter and the need to cancel and re-schedule many days of inspections due to hazardous driving conditions.

**Table VII-3
Contractor for Inspected Homes**

Contractor	Installations Completed 10/1/2012 – 1/31/2013	Inspection Complete Goal		Inspections Completed	
		#	%	#	%
Honeywell	46%	129	43%	125	43%
CMC Energy	23%	70	23%	61	21%
EIC – Comfort Home	17%	58	19%	58	20%
Northeast Energy	12%	37	12%	36	13%
Optimal Energy	1%	6	2%	8	3%
Total	100%	300	100%	288	100%

Table VII-4 displays the goals and inspections completed by electric utility. Again, the completed inspections were distributed very closely to the goals.

**Table VII-4
Electric Utility for Inspected Homes**

Electric Utility	Installations Completed 10/1/2012 – 1/31/2013	Inspection Complete Goal		Inspections Completed	
		#	%	#	%
PSE&G	63%	185	62%	180	63%
JCP&L	27%	58	19%	66	23%
ACE	8%	39	13%	39	14%
Other	3%	18	6%	3	1%
Total	100%	300	100%	288	100%

Table VII-5 displays the goals and inspections completed by gas utility. The gas utility completed inspections also matched the goals.

**Table VII-5
Gas Utility for Inspected Homes**

Gas Utility	Installations Completed 10/1/2012 – 1/31/2013	Inspection Complete Goal		Inspections Completed	
	%	#	%	#	%
PSE&G	53%	154	51%	151	52%
NJNG	17%	45	15%	50	17%
ETG	13%	42	14%	48	17%
SJG	8%	28	9%	30	10%
None	9%	31	10%	9	3%
Total	100%	300	100%	288	100%

Visit Protocol

The inspection protocol included the following elements.

- Data Retrieval – We extracted all relevant service delivery data for each sampled home, including pre and post diagnostics, installed measures, and costs. This included the following information.
 - NJCP Tracking Database
 - Main job page
 - Job invoice/debit memo page
 - All Uploaded Documents
 - Application
 - Partnership agreement
 - Audit forms
 - Work order
 - Subcontractor invoices
- On-Site Inspection – We sent a senior technician and a technician assistant (all with BPI certification) to conduct an inspection that included the following.
 - Diagnostics – Implementation of diagnostic tests relevant to each home, including blower door testing, duct testing, safety testing, IR inspection, and appliance metering.
 - Measures – Inspection of all installed measures for final quality and completeness using appropriate diagnostic procedures.
 - Missed Opportunities – Identification of any measures that could have been installed, but were not.
 - Client Interview – Discussion of health, comfort, and safety issues, as well as any client-related factors that may have led to exclusion of certain measures.
- Post-Inspection Analysis – The data for each home were analyzed in terms of Measure Selection, Installation Quality, and Health and Safety Issues.

Implementation

Inspections were completed between November 2013 and April 2014. Many cancellations were experienced over the field period. Thirty-six customers called, usually the day of the visit, or just were not home at the time of the appointment. Additionally, over 30 visits had to be cancelled and re-scheduled due to severe winter weather. However, APPRISE schedulers were able to reschedule or find replacements for all of those visits. Because the paperwork for the replacement jobs had not been printed out in advance, field workers found an office supply store in the area where they could access the file located on a secure site and print out the information so they would have the measure and testing details for the visit.

B. Observations – Audit Findings

Table VII-6 displays the number of assessments conducted by type of work based on what was relevant in the observed audits.

**Table VII-6
Audit Assessment Observations Conducted**

	Number of Observations
Heating, Ventilation, and Air Conditioning	75
Water Heating	74
Diagnostic and Combustion Testing	77
Refrigerators and Lighting	74
Other Baseload Measures	40
Total	80

1. Audit Introduction and Home Walk-Through

While the auditor usually had the natural gas and electric usage available if applicable to the observed job, they often did not have the seasonal spending guidelines or the end use breakout. These data should be on hand, as they can provide important information for the assessment of the home. Additional training on program requirements could help with this issue.

Most auditors provided clear and concise explanations, discussed comfort, discussed health and safety, and explained the audit process. However, they were much less likely to address the partnership or review energy bills with the customer. Only 34 percent of the auditors discussed the partnership during the audit introduction. As a result, they only averaged 2.36 out of 5 on the audit introduction rating scale, indicating that they met slightly more than 75 percent of the expected audit introduction actions. A review of the expectations for the audit appears to be needed.

Table VII-7 displays the rating design for the audit introduction. The table shows that there were ten actions included and three were necessary (bolded) for the auditor to receive a rating of 4 or 5 on the 5-point scale.

**Table VII-7
Audit Introduction Rating Design**

Action	Audit Introduction
1	Auditor introduced self
2	Auditor explained purpose of visit
3	Auditor explained NJCP process
4	Auditor explained Partnership concept
5	Auditor explained the auditor's responsibility
6*	Auditor reviewed energy bills with customer
7	Auditor asked about comfort issues
8	Auditor asked about energy issues
9	Auditor asked about health and safety issues
10	Auditor assessed customer's desired outcomes

*Action 6 in this scale was determined using two variables from the audit observation form. This action was satisfied when either the auditor reviewed gas bills or the auditor reviewed electric bills with the customer.

Table VII-8 displays the ratings for the audit introduction for all observations and for the three contractors with enough observations to provide an individual assessment. The table shows that the mean overall rating was 2.36 out of a possible score of 5, indicating that the auditors were generally only meeting slightly more than 75 percent of the listed tasks. CMC scored lower than HW and EIC, averaging 1.77 compared to 2.7 for the other contractors.

**Table VII-8
Audit Introduction Ratings**

Contractor	N	Full Scale Ratings			
		Mean	% With Each Score		
			1-2	3	4-5
HW	30	2.70	63%	13%	23%
CMC	22	1.77	77%	18%	5%
EIC	12	2.75	50%	17%	33%
All*	66	2.36	67%	15%	18%

Ratings are not shown separately for NEC because of the small number of observations.

*2 observations did not have ratings for this scale because over 50% of the variables in the scale had missing values.

Auditors usually did a complete and thorough walk-through of the home and customers were likely to be somewhat engaged in the audit. However, the auditors were less likely to discuss energy usage, energy saving actions, and potential savings from such actions during the home walk-through or even at a later point in the visit.

2. Heating, Ventilation, and Air Conditioning

Auditors usually inspected the heating system and assessed combustion venting, but were less likely to inspect the filters. While most spoke to customers about whether parts of the home were too cold and about thermostat settings, auditors were unlikely to discuss programmable thermostat installation and efficient use of supplemental heat. This finding also points to the need for auditor training on customer education.

3. Water Heating

Table VII-9 shows that while 95 percent of the auditors inspected the water heater, only 49 percent checked the hot water temperature at the faucet. Additionally, one observer noted that auditors did not instruct the customer on how to adjust or check the hot water temperature. There was only one out of 73 applicable cases where the auditor measured the shower water flow. While measuring the water flow is not a current NJCP procedure, we recommend that this step be added to the procedures, as the program does not otherwise know if the new showerhead will increase or reduce usage.

**Table VII-9
Water Heater Assessment**

	Applicable Number	Action Taken	
		#	%
Inspected water heater	73	69	95%
Checked hot water temperature at faucet	73	36	49%
Hot water temperature needs adjustment	43	13	30%
Adjusted hot water temperature	41	15	37%
Measured shower water flow	73	1	1%
Discussed efficient hot water usage	69	44	64%
Discussed hot water system health and safety problems	31	27	87%

4. Diagnostic Testing

Table VII-10 shows that while most auditors inspected all accessible attics and measured the insulation, they were less likely to measure surfaces and to use the blower door while inspecting for leaks. There were several unsafe tests, where gas furnaces and hot water heaters were not shut off prior to blower door testing. All auditors should be provided with detailed training on testing purpose, procedures, and safety precautions.

**Table VII-10
Air Leakage and Insulation Diagnostics**

	Applicable Number	Action Taken	
		#	%
Measured surfaces	75	57	76%
Inspected all accessible attics	62	61	98%
Measured insulation in all accessible attics	60	57	95%
Created access to inaccessible attics	23	0	0%
Measured insulation in exterior walls	74	12	16%
Measured insulation in basement/crawl space	38	31	82%
Inspected for all typical bypasses	75	67	89%
Visual inspection for air sealing opportunities	76	71	93%
Used blower door while inspecting for leaks	51	32	63%
Explained purpose of blower door test	51	44	86%

Table VII-11 shows that combustion safety tests were done safely and any immediate safety issues were appropriately addressed.

**Table VII-11
Combustion Safety Test Actions**

	Applicable Number	Action Taken	
		#	%
Explained why tests were done	66	51	77%
All tests done safely	71	71	100%
Customer health conditions directed appropriate tests	38	38	100%
Addressed any immediate safety issues	46	46	100%

5. Appliances and Lighting

Analysis of the program data showed that some contractors did not consistently meter refrigerators, and the usage impact analysis showed that these contractors had lower replacement rates and lower savings than the others. Table VII-12 shows that one or more refrigerators were metered in only 78 percent of homes and all refrigerators were metered in only 66 percent of observed homes.³⁷ Observers noted that the auditors often did not have enough meters on hand to meter each individual refrigerator and freezer. Of those that were not metered, 75 percent were assessed in some other way. Freezers were less likely to be metered. The table shows that only 35 percent of separate freezers were metered.

³⁷There can be risks involved with moving the refrigerator and online databases are available to provide refrigerator usage. Refrigerators are only tested if they are over five years old and landlord approval is required for renters.

Contractors should be instructed that these appliances must be metered and additional meters must be purchased to do so. Two for one swap opportunities were rarely investigated, another important issue for training.

**Table VII-12
Refrigerator and Freezer Assessment**

	Applicable Number	Action Taken	
		#	%
One or more refrigerators plugged in	73	73	100%
One or more refrigerators metered	73	57	78%
All refrigerators metered	73	48	66%
Refrigerator(s) assessed another way*	20	15	75%
At least one refrigerator metered or assessed	72	69	96%
One or more separate freezers plugged in	74	20	27%
One or more separate freezers metered	20	8	40%
All separate freezers metered	20	7	35%
If not metered, freezer(s) assessed another way**	9	3	33%
Opportunity for 2 for 1 swap explored	24	2	8%
Explained why tests were done	57	51	89%

*3 observations involved small refrigerators and 3 additional observations were missing this action when all refrigerators were not metered.

**1 observation involved a small chest freezer that was not eligible for consideration and 3 additional observations were missing this action when all freezers were not metered.

Auditors did not always discuss how customers used their lighting prior to replacement and usually did not ask the customers if they were satisfied with the installed lighting. Costs for lighting replacements add up to significant amounts, and customer habits and preferences should be taken into account to make sure that expected savings are achieved.

6. Exit Interview

Table VII-13 displays the rating design for the quality of the exit interview. There are 13 actions included in this scale that address information that the auditor reviewed and discussed, including the use of the action plan and the partnership agreement form. “Auditor explained next steps” is in bold indicating that the auditor must have taken this action to have received a 4 or 5 on the exit interview rating scale.

Table VII-13
Quality of Exit Interview Rating Design

Action	Quality of Exit Interview
1	Auditor explained next steps
2	Auditor reviewed and discussed behavior changes
3	Auditor discussed potential monetary savings from behavior changes
4	Auditor explained customer actions with the greatest impact
5	Auditor assessed customer's desired outcomes
6	Auditor obtained customer commitments for energy saving actions
7	Customer was asked if they have any concerns
8	Auditor explained the work proposed
9	Auditor reviewed energy bills with customer
10	Auditor provided context for usage to customer
11	Auditor used Action Plan when discussing ability to take energy saving actions
12	Auditor discussed most important behavioral issues for home
13	Auditor used Partnership Agreement Form to discuss most important behavioral changes

Table VII-14 displays the exit interview ratings for all observed jobs and for the contractors with enough cases to analyze separately. Most auditors summarized findings for the customer, explained the proposed work, provided information on next steps, and provided contact information. Auditors were unlikely to review energy bills with the customer and obtain a customer commitment for energy saving actions.

The table shows that the mean score across all observations was 1.85 indicating that on average contractors addressed fewer than 50 percent of expected actions. Ratings were similar across all three contractors. Only four percent received a 4 or a 5 rating on this scale. The program may benefit by providing a list of topics for auditors to review at the exit interview.

**Table VII-14
Exit Interview Ratings**

Contractor	N	Ratings			
		Mean	% Scoring		
			1-2	3	4-5
HW	31	1.81	87%	6%	6%
CMC	22	1.86	95%	5%	0%
EIC*	15	1.80	80%	13%	7%
All*	72	1.85	86%	10%	4%

*1 observation was not given a rating for this scale because over 50% of the variables in the scale have missing values.

7. Professionalism

Auditors scored higher on professionalism, as they arrived on time, only conducted necessary tests, cleaned up the site, asked about restricted areas, and took appropriate precautions if children were present. However, they were less likely to use containment, recognize when a home required lead safe work, and disable combustion appliances prior to blower door testing. Mean scores ranged from 4.46 to 4.75 for efficiency, professionalism, and respect of the customers' homes. However, the mean safety score was only 2.92 on the 5 point scale.

8. Customer Engagement and Education

Auditors averaged 2.16 to 2.65 on the customer engagement and education scales and slightly higher, averaging 3.31, on their communication skills. While auditors were likely to provide basic information about the program and the audit, they were less likely to tailor education to the customer, review energy bills, and to engage the customer to identify energy saving actions. Auditors did not address the essence of the partnership. It appeared that the jobs were billed for two hours of education, but the full two hours of education was not provided.

9. Audit Write-up

The information transfer from auditors to installers is an important part of effective work. This assessment found that the auditors usually provided basic customer and home information, testing data, and lighting and refrigerator replacement information. However, they were less likely to document the air sealing assessment, insulation assessment, furnace and boiler replacement trees, and cooling assessment.

The NJCP program audit form does not include tables in each section to provide information on estimated costs for air sealing as the Honeywell forms do. The NJCP program forms should be revised to include this information.

The audit write-up quality was rated a 2.75 on the 5 point scale because many of these items were often missing. These missing items likely contributed to the lack of connection between the audit findings and the work that is implemented.

10. Summary Audit Ratings

Tables VII-15 through VII-17 display the rating scales for the completeness of inspections, completeness of testing, and the quality of testing. Results for these scales are shown in Table VII-18.

**Table VII-15
Completeness of Inspection Rating Design**

Action	Completeness of Inspection
1	Auditor inspected every accessible room
2	Auditor measured and recorded dimensions of building
3	Auditor did outside home walk-around
4*	Auditor physically checked existing insulation levels in the attic(s), walls, and basement/crawl space
5	Auditor talked with customer about comfort issues
6	Auditor talked with customer about energy issues
7	Auditor talked with customer about health and safety issues
8	Auditor assessed all accessible attics
9	Auditor assessed all accessible basement/crawl space areas
10	Auditor inspected the garage
11	Auditor conducted blower door test

*Action 4 in this scale was determined using three variables from the audit observation form. One variable indicated whether the auditor measured insulation levels in the attic, another variable indicated whether the auditor measured insulation levels in the walls, and the third variable indicated whether the auditor measured insulation levels in the basement or crawl space. All three of these criteria needed to be met (if applicable) for this action to be satisfied.

**Table VII-16
Completeness of Testing Rating Design**

Action	Completeness of Testing
1	Conducted blower door test
2	Conducted a worst case draft heating system test
3	Conducted a worst case draft water test
4*	Conducted combustion appliance safety testing
5	Checked for combustible gas leaks
6	Conducted zonal pressure diagnostics
7	Conducted combustion appliance efficiency testing
8	Auditor assessed ducting for mechanical ventilation
9	Checked bathroom ventilation fan air flow

Action	Completeness of Testing
10**	Metered refrigerator or freezer

*Action 4 in this scale was determined using eight pairs of variables from the audit observation form, each related to a different combustion appliance safety test. The eight tests were ambient CO level in CAZ, ambient CO level outside CAZ, spillage testing on all atmospheric furnaces, boilers and water heaters, heating system CO level, water heating system CO level, measuring CAZ for sufficient volume for combustion air, gas oven CO level, and gas burner CO level. All of these tests needed to be performed only when they should have been performed for this action to be satisfied.

**Action 10 was determined using two variables from the audit observation form. The action was satisfied when at least one refrigerator or freezer was metered when applicable.

**Table VII-17
Quality of Testing Rating Design**

Action	Quality of Testing
1	Combustion appliances disabled during blower door and duct testing
2*	All tests done correctly
3**	All tests done safely
4	Customer health conditions directed appropriate tests
5	Auditor addressed any immediate safety issues

*Action 2 in this scale was determined using 15 pairs of variables from the audit observation form, each related to a different test. The 15 tests were the blower door test, zonal pressure test, steady state efficiency testing, pressure pan test, hot water zone valve test, ambient CO level inside CAZ, ambient CO level outside CAZ, gas leaks test, spillage testing, heating system CO level, water heating system CO level, worst case draft test on heating system, measuring CAZ for sufficient volume for combustion air, oven CO level, and burner CO level. This action was taken when all tests that should have been performed were performed correctly.

**Action 3 in this scale was determined using two variables. One variable indicated whether diagnostic tests were done safely while the other variable indicated whether combustion safety tests were done safely. Both criteria had to be met to consider this action to be taken.

Table VII-18 displays the ratings for audit completeness, testing completeness, and testing quality. Auditors scored well on the testing quality, averaging 4.17. However, the completeness of the audit and the completeness of testing averaged 3.25 and 3.32, indicating that the auditors did about 90 percent of the expected actions. The contractors scored about the same in terms of audit completeness, but EIC scored higher on testing completeness and testing quality.

**Table VII-18
Audit Summary Ratings**

Rating Scale Contractor	N	Ratings			
		Mean	% Scoring		
			1-2	3	4-5
Inspection completeness*	75	3.25	9%	57%	33%
HW	33	3.15	12%	58%	30%
CMC	22	3.41	0%	59%	41%
EIC*	15	3.33	7%	60%	33%
Testing completeness*	76	3.32	11%	61%	29%
HW	33	3.27	12%	61%	27%
CMC	22	3.09	14%	73%	14%
EIC*	15	3.73	7%	33%	60%
Testing quality	77	4.17	14%	19%	66%
HW	33	4.06	15%	24%	61%
CMC	22	3.91	23%	18%	59%
EIC	16	4.56	6%	13%	81%

*1 observation was not given a rating for this scale because more than 50% of the variables have missing values.

C. Observations – Measure Installation Findings

Table VII-19 displays the number of assessments conducted by type of work based on relevant measures in the observed installations.

**Table VII-19
Measure Installation Observations Conducted**

	Number of Observations
Window and door	16
Air sealing	26
Attic insulation	18
Wall insulation	2
Basement and crawl space insulation	10
Ventilation	9
Heating and cooling	8
Duct improvement	13
Hot water system	6
Other measures	18

1. Introduction and Preparation

While most of the installers explained the purpose of the visit, they were less likely to explain the planned measures, and were unlikely to explain the program or reinforce the partnership concept. One of the observers noted that the installers do not seem to understand the partnership concept.

In terms of the installation preparation, there is not a clear work order associated with the jobs that provides specific information on the measures to be installed and where they are to be installed. While 98 percent of jobs had some sort of work order, the observers noted that there was rarely a single document that provided a clear list of measures and instructions specific to the home. More often there was a list of generic measures based on a program contract document.

Some of the observers noted that the work order was limited, confusing or inaccurate. In one case, the home was a fill-in customer and the installers were given the information verbally. In another case the customer's file was in another truck that had been at the home the previous day so the installers just had a few handwritten notes. In other cases the work order was confusing or inconsistent.

This is a shortcoming that should be resolved, as a more clearly defined work scope could improve the quality of the measure installation work and have great benefits for the program.

2. Window and Door Work

Window work was only observed in a small number of jobs, so it cannot be quantitatively assessed. However, the qualitative findings from these observations were that the window caulking was installed neatly and the materials were integrated with existing finishes, but the old caulking was only removed in two of five cases. The one window repair job that was observed was done well. The one window replacement job that was observed had some issues in that lead safe practices were not used and the flashing was not integrated with a weather resistant barrier.

In all observed cases the weather stripping was mechanically fastened, the work area was cleaned up, and the material and packaging were removed from the home. Materials were integrated with existing finishes in 93 percent of observed cases, but the old weather stripping was removed in only 58 percent and the weather stripping was backed with caulk in only 79 percent of observed jobs. Workers were unlikely to take personal protective safety precautions (although not required by the NJCP program.)

The average usage impact score for the door weather stripping was 3.21 on the 5 point scale. Workers did not always back the weather stripping with caulk, remove old weather stripping, or clean surfaces prior to installing the new weather stripping.

3. Air Sealing

Several weaknesses were found with the air sealing work and many of the expected actions were not taken. For example, Table VII-20 shows that the blower door was only

used to guide air sealing in 2 of the 26 applicable cases, zonal pressure testing to affirm the appropriate pressure boundary was done in 52 percent, and attic floor penetrations were sealed in 50 percent. All major opportunities were observed to be sealed in only 48 percent of observed cases. Recessed lights were not effectively air sealed and bath fans were not air sealed. The auditor should pressure pan test recessed lights and bath fans as part of standard procedures.

Table VII-20
Air Sealing Work

	Applicable Number	Action Taken	
		#	%
Blower door used to guide air sealing	26	2	8%
Zone pressure testing done to affirm appropriate pressure boundary	23	12	52%
Sealing at top and bottom of envelope prioritized	21	13	62%
Attic floor penetrations sealed	22	11	50%
Knee walls sealed	17	6	35%
Second floor rim joist sealed	17	1	6%
Basement penetrations to the outside sealed	19	13	68%
Basement penetrations to conditioned space sealed	18	10	56%
Crawl space penetrations to conditioned space sealed	16	4	25%
Crawl space penetrations to the outside sealed	16	1	6%
Garage penetrations to conditioned space sealed	14	2	14%
All major opportunities sealed	25	12	48%

Table VII-21 displays the rating scale design for air sealing quality. Three scales were used to assess air sealing work; the full scale, the scale that excludes worker safety issues, and the impact usage scale for items that would have an effect on the usage impact of the measures. The items included in the three scales are shown in the table below.

Table VII-21
Quality of Air Sealing Rating Design

Action	Quality of Air Sealing	Full Scale	Excluding Safety Issues	Impact Usage Scale
1	Fire rated materials used around chimneys, flue pipes, recessed lighting, etc.	✓	✓	
2	Materials integrated with existing finishes	✓	✓	
3	Used supply-air respirators when using two-part foams	✓		
4	Blower door used to target air sealing	✓	✓	✓
5*	Blower door and smoke used to verify air sealing effectiveness	✓	✓	✓

Action	Quality of Air Sealing	Full Scale	Excluding Safety Issues	Impact Usage Scale
6	Caulk not used to seal gaps larger than 1/8"	✓	✓	✓
7	Large holes and gaps covered with rigid materials	✓	✓	✓
8	Area cleaned before caulk or foam applied	✓	✓	✓
9	All material scraps and packaging removed from home	✓	✓	
10	Materials installed consistently and are uniform in appearance	✓	✓	
11*	Gloves and eye protection used when cutting, or using caulk or foam	✓		
12*	Used hard hats when working in confined spaces	✓		

*Not required by NJCP program.

Table VII-22 displays air sealing ratings for work done in the attic, basement, other locations, and all locations. The table shows that the overall average score across all locations was about 2.25, indicating a fairly low quality of work. None of the air sealing work received a score of 4 or 5 when using the full scale. The table shows slightly higher ratings, averaging 2.47, when excluding worker safety related aspects, and slightly lower ratings, averaging 2.06, when only including aspects that impact usage.

Table VII-22
Air Sealing Ratings

Location**	N	Full Scale Ratings				Excluding Safety Ratings				Impact Usage Ratings			
		Mean	% Scoring			Mean	% Scoring			Mean	% Scoring		
			1-2	3	4-5		1-2	3	4-5		1-2	3	4-5
Attic*	18	2.22	78%	22%	0%	2.56	44%	56%	0%	2.00	100%	0%	0%
Basement*	17	2.24	76%	24%	0%	2.24	76%	24%	0%	1.94	100%	0%	0%
Other locations*	12	2.25	75%	25%	0%	2.67	50%	33%	17%	2.33	83%	0%	17%
All locations*	47	2.23	77%	23%	0%	2.47	57%	38%	4%	2.06	96%	0%	4%
Overall†	25	2.20	76%	24%	0%	2.44	56%	40%	4%	1.48	96%	4%	0%

*The unit of observation for these ratings is air sealing work that was done in a specific place in a house. As a result, some houses may have had air sealing done in more than one place and therefore result in more than one observation in these rating scales.

**The full scale includes a variable for whether the installation contractor used blower door and smoke to verify air sealing and whether the installation contractor used hard hats when working in confined spaces, which are not NJCP program requirements.

†This rating uses each home visit as a single observation. As a result, ratings for homes that had air sealing work in more than one location were determined using multiple variables for each action corresponding to each place where air sealing was done in the home. In order for an action to be satisfied, the action had to be taken in each place where air sealing work was done in the home.

4. Insulation

While the proper insulation material was chosen, the insulation was level and of consistent depth, and contractors checked for knob and tube wiring, they often did not add ventilation where appropriate. Observers noted that the installers did not use

procedures to stabilize the insulation and often did not have proper equipment to effectively complete the work. This work was rated to be of higher quality however, averaging 4 on the 5 point usage impact scale.

Attic hatch and walk-up attic work quality were rated 2.73 and 3.6 on the quality scale. Installers missed aspects of the work including mechanically fastening the weather stripping, properly using caulking, and using the blower door to test effectiveness.

Fewer jobs with basement insulation were observed, but these jobs were generally assessed to be of higher quality, averaging 4.67 on the usage impact scale.

5. Heating and Ventilation

The observed ventilation work was generally of good quality. All of the observed jobs had several of the best practices followed, including ventilation installed before insulation and materials integrated with existing finishes. These jobs averaged a 4.50 on the impact usage scale.

Several of the observations showed that best practices were not followed for the heating system work, including conducting worst case draft testing (seen in four of seven observations), testing equipment for CO production (seen in four of seven observations), and testing ducts for leakage (seen in one of two observations). These jobs averaged a 3.00 on the usage impact scale.

6. Duct Sealing and Insulation

While contractors generally used appropriate materials for sealing and integrated materials with existing finishes, they did not do a complete job of sealing areas that were out of sight, did not consistently use duct testing to target leaks or measure effectiveness, and they did not always clean the duct surfaces prior to sealing. Ducts were not tested for leakage before insulation was installed.

Tables VII-23 and VII-24 display the rating designs for duct sealing quality and duct insulation quality.

**Table VII-23
Quality of Duct Sealing Work Rating Design**

Action	Quality of Duct Sealing	Full Scale	Excluding Safety Issues	Impact Usage Scale
1	Appropriate precautions taken if suspected asbestos	✓	✓	
2	Sealing materials are durable and appropriate for location	✓	✓	✓
3	No duct tape used	✓	✓	✓
4	Duct testing done to target leaks	✓	✓	✓
5	Duct testing done to measure effectiveness	✓	✓	✓
6	Duct surfaces cleaned before sealing	✓	✓	✓
7	Materials integrated with existing finishes	✓	✓	

Action	Quality of Duct Sealing	Full Scale	Excluding Safety Issues	Impact Usage Scale
8*	Workers wore gloves and safety glasses	✓		

*Not required by the NJCP program.

Table VII-24
Quality of Duct Insulation Work Rating Design

Action	Duct Insulation Quality	Full Scale	Excluding Safety Issues	Impact Usage Scale
1	Appropriate precautions taken if suspected asbestos	✓	✓	
2	Ducts tested for leakage before insulation installed	✓	✓	✓
3	Correct R-value of insulation installed	✓	✓	✓
4	Seams sealed with tape or mechanical fasteners (no duct tape)	✓	✓	✓
5*	Workers wore gloves, safety glasses and respirators	✓		
6	Insulation securely fastened to ducts	✓	✓	✓
7	Vapor retarder in correct location	✓	✓	✓

*Not required by the NJCP program.

Table VII-25 displays the duct improvement ratings. The table shows that the duct sealing quality averaged 2.83 and the duct insulation quality averaged 3.40.

Table VII-25
Duct Improvement Ratings

Rating Scale	N	Full Scale Ratings			Excluding Safety Ratings			Impact Usage Ratings					
		Mean	% Scoring			Mean	% Scoring			Mean	% Scoring		
			1-2	3	4-5		1-2	3	4-5		1-2	3	4-5
Sealing quality*	12	2.83	50%	33%	17%	3.33	17%	50%	33%	2.67	50%	33%	17%
Insulation quality**	5	3.40	0%	80%	20%	3.40	0%	80%	20%	3.40	0%	80%	20%

*The full scale includes a variable for whether the installation contractor wore gloves and safety glasses, which is not a New Jersey Comfort Partners requirement.

**The full scale includes variables for whether the installation contractor wore gloves, safety glasses, and respirators while insulating ducts, which is not a NJCP program requirement.

7. Dryer Venting

Several of the expected actions were taken in all cases, including the use of appropriate tape and minimizing elbows, but the damper penetration was not always air sealed and the lint was not always cleaned from the rear of the dryer. The usage impact rating scale had a mean of 3.38.

8. Communication and Exit Interview

While the contractors generally had good communication skills, averaging 4.03 on the scale, their ratings for customer engagement and education were lower, with mean scores

ranging from 1.61 for education quality to 3.00 for customer engagement and 3.31 for education quantity.

Contractors almost never addressed behavior change opportunities³⁸ and provided information on next steps during the exit interview in only 75 percent of observed cases. The average exit interview quality rating was only 1.12.

D. Observations – Final Inspection Findings

Final inspection findings are summarized below.

- Home Walk-Through – The inspectors generally conducted complete inspections and had systematic inspection methods. However, they did not always note the presence or absence of a CO detector or conduct an outside home walk around.
- Heating System – The inspector usually discussed heating system work, programmable thermostats and satisfaction with the customer, but was less likely to discuss filter replacement.
- Water Heater – The inspector completely examined the water heaters, but did not always discuss the work with the customer and did not verify the hot water temperature.
- Ventilation – The ventilation work was inspected, but the operation was not discussed with the customer and the missed opportunities were not identified.
- Refrigerators and Freezers – The inspector examined the new units and checked that the old units were removed and usually discussed satisfaction with the customer.
- Low Cost – The inspector examined lighting opportunities and discussed replacement with the customer in less than half of the observations, and did not always inspect and discuss low cost measures.
- Air Sealing – The inspector did not always determine that the thermal boundary decisions were clearly documented, that the bypasses were properly sealed, or discuss work with the customer.
- Attic Insulation – The inspector usually verified that the attic insulation matched the invoiced amount, but rarely discussed the work with the customer.
- Diagnostic Tests – All of the tests were appropriate. While the zonal pressure testing was done according to the NJCP program procedures, it was not done in a way to provide the most complete information on the home and the work performed.

³⁸Contractors discussed behavior change opportunities in only one of 25 observed homes. While this is usually done during the audit, the measure installation visit is a time when the information can be reinforced.

- Combustion Safety Tests – These tests were conducted where appropriate and performed correctly in almost all cases. The one test not always conducted when appropriate was measuring the CAZ in a confined space.
- Summary Ratings – The final inspections averaged a 3.62 on the testing quality, 4.69 on the testing completeness, and 4.23 on the inspection completeness.
- Professionalism Ratings – The inspectors scored high in this area, averaging 5 on the efficiency scale, 4.69 on the professionalism scale, 4.85 on the cleanliness scale, and 4.31 on the safety scale.
- Communication and Education – Inspectors scored an average of 3.23 to 3.46 on their communication skills, attempt to engage the customer, and education quantity. They received average scores of 2.54 and 2.38 on their customer engagement and education quality.
- Exit Interview – The third party inspector always reviewed the work with the customer and almost always provided contact information. However, the inspector was unlikely to discuss operation of new equipment or to reinforce a commitment to customer actions. The average rating for the exit interview was 2.55 and none of the inspections were rated a 4 or a 5. This indicates that better exit tools may be needed.

E. Inspections of Completed Jobs

This section provides a summary of findings from the inspections of completed jobs.

1. Customer Interview and Home Information

Some issues were found during the customer interviews about removed measures and comfort issues.

The most commonly removed measure was CFLs, followed by the showerheads and faucet aerators. Overall, 25 percent of customers visited reported that they removed or altered one or more measures. Additional customer education, lighting demonstration, discussion, and a wider variety of bulb types could reduce the number of cases where these items are installed and removed and increase the return on these investments.

An unexpectedly high percentage of customers reported that they had comfort problems one year after service delivery. While 42 percent said that parts of the home were too cold, 19 percent said that parts of the home had drafts or air leakage. This is potentially related to missed opportunities and incomplete air sealing and insulation work.

Table VII-26 displays comfort issues by contractor. The table shows that the percent of customers who said that the home was too cold was fairly similar across contractors. NECI had a lower percentage report that the home was drafty than the other contractors.

**Table VII-26
Comfort Issues by Contractor**

Comfort Issues	HW		CMC		EIC		NECI	
	#	%	#	%	#	%	#	%
Parts of the home are too cold	47	38%	27	44%	24	41%	17	47%
Parts of the home have drafts/air leakage	28	23%	11	18%	13	22%	2	6%
Parts of the home are too hot	8	6%	3	5%	3	5%	1	3%
Other comfort issues	4	3%	3	5%	3	5%	1	3%
Any comfort issues	75	60%	39	64%	36	61%	19	53%

Data on the inspected homes was compared to all NJCP program jobs where the same data were available in the program tracking database. The analysis showed that inspections were conducted on a wide variety of home types and that the homes inspected were comparable to the homes served by the program overall.

2. Refrigerators and Freezers

Virtually all old refrigerators and freezers were removed when replacements were made. Other findings were as follows.

- Usage – The inspectors metered the appliances and found that 52 percent of the refrigerators and 60 percent of the freezers that were replaced had annual usage of less than 500 kWh.
- Missed Replacement Opportunities – 11 percent of homes had one or more missed opportunities for refrigerator replacements, and 13 percent had missed opportunities for freezer replacements.
- Missed Two-For-One Swap Opportunities – Two-for-one swaps were offered to customers in two percent of the inspected homes, and there was an additional 28 percent where there was a potential two-for-one swap opportunity. The inspectors determined that the customer would have agreed to a swap and there was a missed opportunity in ten percent of inspected homes.

3. Lighting

Inspectors found that 75 percent of homes had one or more replacements. Twenty-three percent had more than 15 CFLs installed.

- CFL Use – The majority of CFLs were reported to be used two or more hours per day and only two percent were reported to be used less than one hour per day.
- Illumination – 83 percent of replacements were assessed to provide the correct level of illumination and 15 percent to be under the desired level.

- Appropriateness – All CFL replacements were assessed to be appropriate in 70 percent of homes and most in 19 percent of inspected homes.
- Missed Opportunities – There were one or more missed opportunities for CFLs in 43 percent of observed homes.

4. Programmable Thermostats

Thirty-four percent of the inspected thermostats had been replaced by the NJCP program with programmable thermostats.

- Thermostat Reading – 95 percent had an accurate reading.
- Reprogramming – 59 percent of customers had reprogrammed the thermostat since service delivery.

5. Testing Results

The inspectors assessed the leakage that was present in the home and that should have been addressed by the NJCP program. This assessment shows that there was a great deal of missed air sealing opportunities, some in very important locations of the home.

Table VII-27 shows that in 45 percent of the cases, there were duct leaks to the outside where all or most should have been addressed by the NJCP program and in 33 percent there were duct leaks to zones where all or most should have been addressed by the NJCP program.

**Table VII-27
Leakage and Pressure Testing
Leaks Found and Missed**

	All	Most	Some	None	Only Minor Remain	Total
Duct Sealing – Leakage to Outside (N=144)						
Leaks Identified on Audit Paperwork ¹	10%	18%	29%	20%	22%	100%
Leaks Identified on Work Order ²	8%	14%	27%	27%	23%	100%
NJCP Should Have Addressed Leaks	15%	30%	15%	9%	31%	100%
Duct Sealing – Leakage to Zones (N=103)						
Leaks Identified on Audit Paperwork ³	9%	18%	19%	29%	26%	100%
Leaks Identified on Work Order ²	9%	16%	23%	29%	24%	100%
NJCP Should Have Addressed Leaks	10%	23%	13%	21%	33%	100%

¹This information is missing for 10 observations. ² This information is missing for 1 observation. ³ This information is missing for 9 observations.

Table VII-28 displays information on air leakage points that were found to be present in the homes at the time of the inspection. The table provides the following key information.

- 40 percent of inspected homes had air leaks through the ceiling where all or most of those leaks should have been addressed by the program.
- 27 percent of inspected homes had air leaks through the floors where all or most of those leaks should have been addressed by the program.
- 19 percent of inspected homes with attached garages had air leaks between the house and the garage where all or most of those leaks should have been addressed by the program.
- 19 percent of inspected homes had air leaks through the walls where all or most of those leaks should have been addressed by the program.
- 15 percent of inspected homes had air leaks through the windows where all or most of those leaks should have been addressed by the program.
- 32 percent of inspected homes had air leaks through the exterior doors where all or most of those leaks should have been addressed by the program.

Table VII-28
Air Leakage and Pressure Testing
Air Sealing - Leaks Found and Missed

	All	Most	Some	None	Only Minor Remain	Total
Leakage Through Ceiling (N=227)						
NJCP Should Have Addressed Leaks ¹	14%	26%	17%	15%	28%	100%
Leakage Through Floors (N=199)						
NJCP Should Have Addressed Leaks ²	8%	19%	13%	25%	34%	100%
Leakage To Attached Garage (N=85)						
NJCP Should Have Addressed Leaks ³	5%	14%	26%	15%	39%	100%
Leakage Through Walls (N=253)						
NJCP Should Have Addressed Leaks ⁴	5%	14%	22%	19%	40%	100%
Window Leakage (N=224)						
NJCP Should Have Addressed Leaks ⁵	6%	9%	10%	24%	51%	100%
Exterior Door Leakage (N=259)						
NJCP Should Have Addressed Leaks ⁶	22%	10%	10%	12%	45%	100%
Misc. Leakage (N=90)						
NJCP Should Have Addressed Leaks	8%	7%	21%	12%	52%	100%

¹This information is missing for 2 observations. ²This information is missing for 2 observations. ³This information is missing for 1 observation. ⁴This information is missing for 1 observation. ⁵This information is missing for 1 observation. ⁶This information is missing for 1 observation.

6. Insulation

Most of the insulation work that was done was rated as excellent or good, but there were often missed opportunities for insulation work. This was especially true for the insulation in the attic, in the walls, and in the kneewalls. There were missed opportunities for insulation in the first open attic in 35 percent of inspected homes and in the open walls in 61 percent of inspected homes. When the work was done, it was very likely to be rated as being of excellent or good quality.

Table VII-29 displays the findings overall and by contractor. Over all of the insulation measures assessed, there were missed opportunities in 52 percent of the measures and the work was rated to be excellent or good in 36 percent of the measures. The table shows that Honeywell had missed opportunities in 65 percent of the inspected homes, more than for the other contractors. This finding is consistent with the lower gas heating savings achieved by Honeywell. Optimal was most likely to have their work rated as excellent, but there were much fewer inspections of their work.

Table VII-29
Insulation Quality and Missed Opportunities
By Contractor

Contractor	Measures Rated	Quality of Work				Missed Opportunity
		Excellent	Good	Fair	Poor	
HW	149	10%	15%	6%	3%	65%
CMC	62	16%	23%	8%	5%	48%
EIC	86	6%	37%	14%	3%	40%
NECI	45	13%	40%	2%	2%	42%
OPT	22	32%	9%	14%	5%	41%
Total	364	12%	24%	8%	4%	52%

7. Attic and Crawl Space

Overall, 24 percent of the attic access work was rated as excellent and 45 percent was rated as good. Overall, the crawl space work was rated as excellent in 39 percent of homes and was rated as good in 32 percent.

- The attic hatch work was rated as excellent or good in 67 percent of inspected homes and the attic walk-up work was rated as excellent or good in 73 percent of inspected homes.
- CMC's and EIC's attic access work was less likely to be rated as excellent than the other contractors.

- The vapor barrier work was less likely to be rated as excellent than the perimeter wall insulation.

8. Ventilation and HVAC

Table VII-30 displays the ventilation work quality findings. The table shows that of the 60 measures inspected, 12 percent were rated to be excellent quality and 35 percent were rated to be of good quality.

**Table VII-30
Ventilation Work Quality**

	Measures Rated	Quality of Work			
		Excellent	Good	Fair	Poor
Existing fans ducted to outside	41	12%	34%	37%	17%
Kitchen ventilation installed	1	0%	0%	100%	0%
Bathroom ventilation installed	18	11%	39%	17%	33%
All Ventilation Work	60	12%	35%	32%	22%

Table VII-31 displays the assessment of the primary heating system work quality. The table shows that the tune-ups and repairs were rated as lower quality than the replacements. Overall, about 14 percent of the tune-up and repair work was rated to be of excellent quality compared to about 25 percent of the replacement work.

**Table VII-31
Primary Heating System Work Quality**

	Measures Rated	Quality of Work			
		Excellent	Good	Fair	Poor
Heating system tune-up	48	13%	54%	23%	10%
Heating system repair	72	14%	57%	22%	7%
Heating system replacement	19	26%	58%	11%	5%
90+% heating unit installed	21	24%	62%	10%	5%
System vent problem corrected	30	27%	40%	7%	27%

9. Water Measures

Across all water heater measures, 16 percent were rated to be of excellent quality and 48 percent were rated to be of good quality. Hot water heater replacements were most likely to be rated as excellent quality and temperature adjustments and heater wraps were rated to be of lower quality.

- 42 percent of heater replacements were rated to be excellent quality and 46 percent were rated to be of good quality. This measure was more consistently done well than many of the other measures inspected.
- 22 percent of heater venting work was rated to be excellent quality and 52 percent was rated to be of good quality.
- 10 percent of temperature adjustments were rated to be excellent quality and 59 percent were rated to be of good quality.
- 2 percent of heater wraps were rated to be excellent quality and 44 percent were rated to be of good quality. The wraps were often rated poorly because a low-e wrap was installed without an air gap.
- Optimal and Honeywell's measures were more likely to be rated as excellent quality, but CMC's measures were least likely to be rated as poor quality.

10. Dryer Venting

Table VII-32 shows that 21 percent of the dryer venting work was rated as fair quality and 12 percent was reported to be of poor quality. There were many opportunities for improvement in this area.

**Table VII-32
Dryer Venting Work Quality**

	Jobs Rated	Quality of Work			
		Excellent	Good	Fair	Poor
Dryer Venting	102	13%	55%	21%	12%

11. Windows and Doors

Across all window and door measures, 13 percent were rated as excellent and 49 percent were rated as good.

- 15 percent of door weather stripping was rated to be excellent quality and 51 percent was rated to be of good quality.
- 5 percent of window sealing work was rated to be excellent quality and 40 percent was rated to be of good quality.
- CMC and NE had somewhat higher ratings for window and door work than the other contractors.

12. Health and Safety

The most common problems on the audit reports were moisture, high CO in combustion appliances, and combustion appliances not properly vented to the outside. These issues

were each found on at least 25 percent of the audit reports. Other fairly common problems were mold, gas leaks, and asbestos.

- With respect to unsafe electrical wiring, asbestos, clutter, and structural issues, most of the problems on the audit report were found at the time of the inspection, as they are not typically addressed by the program.
- Moisture and mold were also likely to still be seen at the time of the inspection, but 43 percent of the mold issues were resolved by the customer. There were rare cases where the customer could not get the contractor to return to the home to complete the NJCP program work after the issue was no longer present. The utilities should continue to emphasize to contractors that they are required to return to these homes and complete this work, as these represent significant missed opportunities.
- The NJCP program resolved most of the gas leak, combustion appliance venting, and high CO problems.

13. Work Quality and Appropriateness

The inspectors were provided with a list of installed measures and costs and asked to rate the quality of each measure and assess whether there were missed opportunities in each area. While some cases of missed opportunities relate to the spending guidelines, many related to missing key areas for air sealing or lack of the correct work prioritization. The following results, shown in Table VII-33, were found across all measure spending and estimated costs for missed opportunities.³⁹

- 51 percent of dollars spent were good quality.
- 10 percent were mixed quality.
- 4 percent were poor quality.
- 1 percent should not have been installed.
- 34 percent were missed investment opportunities.

³⁹ Many of these missed opportunities would not result in greater expenditures, as they would require re-prioritizing or better quality work done, for example performing blower-door guided air sealing to ensure that the most important leaks in the attic were sealed. However, the analysis also found that in over 70 percent of the cases where there were missed opportunities, the contractors did not spend up to the seasonal guideline, and could have done a more thorough job.

**Table VII-33
All Measures by Contractor**

All Measures						
	Appropriateness & Quality				Missed Opportunity	Total
	Appropriate			Not Appropriate		
	Good Quality	Mixed Quality	Poor Quality			
# Measures						
HW	745	147	65	22	441	1,420
CMC	345	80	22	9	219	675
EIC	272	82	33	9	177	573
NE	307	62	28	29	98	524
OPT	59	16	13	0	31	119
Total	1,728	387	161	69	966	3,311
% of \$ Spent & Missed						
HW	52%	8%	4%	1%	36%	100%
CMC	48%	11%	2%	1%	38%	100%
EIC	49%	13%	4%	1%	34%	100%
NE	52%	15%	3%	5%	25%	100%
OPT	53%	6%	10%	0%	31%	100%
Total	51%	10%	4%	1%	34%	100%

F. Summary and Recommendations

This section provides a summary of the findings from the observations and inspections. A general finding with respect to the observations was that the auditors did not appear to see the connection between the tests they conducted, and how those findings should guide the work scope. This appears to be a significant training opportunity.

Additionally, some observers noted that the two audits per day requirement, imposed by contractors on their staff, was not always realistic in complicated homes with long travel time, data entry, and work order development. Auditors were required to work long days and complete data entry work in the evenings.

Key areas for improvement in the audit were customer education, diagnostic testing, use of testing results to inform the work scope, and baseload assessments (refrigerators, lighting, and hot water heating.)

There appeared to be a mindset among the contractors that they needed to complete all of the installation work in one day. This led to work at the end of the day being very haphazard, and the quality of this work suffering. Additionally, staff members installed certain measures when they were not appropriate. Examples include door weather stripping (removing good quality door weather strips and installing new ones), programmable thermostats, and excess insulation (wall insulation in a fully insulated wall).

Both the observations and inspections found that while the installers were likely to do the work that they did correctly, they often did not do the work that would have the greatest impact on energy usage. Key areas for improvement in terms of measure installation were using the blower door to guide air sealing work and general use as a diagnostic tool, duct sealing quality, safety procedures, and customer education.

The information from the observations and inspections included in this section inform the recommendations for procedures, training, and quality control.

Currently, the NJCP program relies on BPI BA certification for general competency, but the program rules and goals are far more detailed and specific than what the BPI certifications cover. Additional NJCP-specific training is left to the individual contractors. This results in workers with significantly different levels of understanding of the program details. It also results in differences in priorities and measure emphasis among the various contractors.

The program should develop courses that outline the program goals and requirements. These courses could require BPI certification as a prerequisite and therefore assume a base level of technical competency. They could then focus on program specifics, but confirm that program contractors have mastered the basic concepts.

Specific recommendations for training are summarized below.

1. Basic building science – Contractors appear to need review of basic building science, the “house as a system”, why the work is being done, and how the measures work.
2. Using testing results to guide work and affirm continuous thermal boundary.
3. Use of pressure pan testing to guide duct sealing.
4. Writing a clear and comprehensive work order that effectively passes information from the auditor to the installation team.
5. Customer education, partnership development, action plan, thermostats, and lighting. Working with the customer to obtain and use information to improve service delivery and effective measure installation.
6. Diagnosing and addressing high electric baseload usage.
7. BPI Credentials - Currently, the primary credential held by the contractors is BPI Building Analyst Professional (BA). It is required for all auditors and installation crew leads.

Given that much of the work done by the contractors is insulation and air sealing, and that the program evaluation found that this work often fell short of expectations, it may be sensible to also require auditors to attain BPI Envelope Professional certification.

Envelope Professional (EP) addresses moisture and thermal boundary issues in more detail than BA does, requiring a deeper understanding of the appropriate materials and methods for solving problems. (Both BA and EP are required for contractors who participate in the NJ Home Performance with Energy Star program).

In some cases, the contractors encounter unusual issues with heating systems that require knowledge beyond what a BA must know. It would be useful for each contractor to have one certified BPI Heating Professional on staff who could serve as a resource for their other staff members.

VIII. Usage Impacts and Realization Rates

The usage impact analysis provides estimates of the amount of energy saved by participating customers and by the program as a whole based on analysis of customers' actual energy usage data obtained from the six utilities.

This section provides a detailed discussion of the research methodology, a summary of savings by job type across the program, and a summary of savings by implementation contractor and measures installed. The cost-effectiveness of the program is also analyzed.

A. Methodology

Customers were defined to be included in Treatment and Comparison Groups as follows.

- Treatment Group: Customers who received NJCP audits between September 2010 and August 2011
- Comparison Group: Customers who received NJCP audits between September 2011 and August 2012

Usage data were requested and received from the electric and gas utilities for August 2009 through October 2012. Table VIII-1 displays the data attrition for the electric baseload analysis. The table shows that across the electric utilities, 57 percent of the treatment group and 52 percent of the comparison group could be included in the analysis. Customers were excluded from the analysis because usage data were not obtained, customers did not have enough pre- or post-treatment data, or customers were usage or savings outliers.

**Table VIII-1
Attrition Analysis
Electric Baseload**

	All Utilities		PSE&G		JCP&L		ACE	
	Treat	Comp.	Treat	Comp.	Treat	Comp.	Treat	Comp.
Treated	5,702	8,682	3,389	6,360	1,843	1,624	470	698
Usage Data	5,427	7,587	3,189	6,102	1,843	908	404	577
330-390 Days	3,581	5,063	1,958	4,004	1,314	621	309	438
Outliers Removed	3,277	4,508	1,790	3,682	1,203	421	284	405
Number Included	3,277	4,508	1,790	3,682	1,203	421	284	405
Percent Included	57%	52%	53%	58%	65%	26%	60%	58%

Table VIII-2 displays the data attrition for the electric heating analysis. The table shows that across the electric utilities, 58 percent of the treatment group and 29 percent of the

comparison group could be included in the analysis. However, PSE&G and ACE were able to include about 50 percent of their electric heating comparison group in the analysis.

**Table VIII-2
Attrition Analysis
Electric Heating**

	All Utilities		PSE&G		JCP&L		ACE	
	Treat	Comp.	Treat	Comp.	Treat	Comp.	Treat	Comp.
Treated	574	899	133	248	381	533	60	118
Usage Data	552	451	124	235	378	114	50	102
330-390 Days	383	323	81	173	267	79	35	71
Outliers Removed	334	258	69	137	240	67	25	54
Number Included	334	258	69	137	240	67	25	54
Percent Included	58%	29%	52%	55%	63%	13%	42%	46%

Table VIII-3 displays the data attrition for the gas heating analysis. The table shows that across the gas utilities, 56 percent of the treatment group and 59 percent of the comparison group could be included in the analysis.

**Table VIII-3
Attrition Analysis
Gas Heating**

	All Utilities		PSE&G		NJNG		ETG		SJG	
	Treat	Comp.	Treat	Comp.	Treat	Comp.	Treat	Comp.	Treat	Comp.
Treated	5,691	8,388	2,883	5,317	1,384	1,280	894	1,099	530	692
Usage Data	5,232	7,800	2,721	5,054	1,146	1,037	892	1,099	473	610
330-390 Days	3,515	5,432	1,705	3,405	782	749	640	811	388	467
Outliers Removed	3,161	4,960	1,469	3,026	755	723	585	775	352	436
Number Included	3,161	4,960	1,469	3,026	755	723	585	775	352	436
Percent Included	56%	59%	51%	57%	55%	56%	65%	71%	66%	63%

Energy usage data were weather normalized to ensure that changes in energy usage were due to changes in usage patterns, rather than due to changes in weather. Several weather normalization techniques were employed to ensure that savings estimates were accurately modeled. The techniques fell into two main types – the house-by-house analysis and the pooled analysis.

- House-by-house analysis: PRISM is an example of the house-by-house analysis, where energy usage for each home is analyzed for periods before and after treatment. Gross savings is calculated for each home as the difference between pre and post treatment weather-adjusted usage. Net savings is calculated by adjusting gross savings by the

average change in weather-adjusted usage for comparison homes. In addition to PRISM, we estimated a degree day analysis that allowed for a greater percentage of cases to be included.

- Pooled analysis: Fixed effects regression modeling was also conducted, where savings were not estimated for each home, but instead the model directly estimated the program savings as a parameter of the regression model. Several formulations of the regressions were employed to assess the stability of the savings estimates.

Results were fairly consistent across the various models except when the data were analyzed at a very granular level (for example for the contractors with a small number of a certain type of job.) Results from the degree day individual analysis and the pooled analysis that includes a greater number of observations are displayed.

It is important to employ a comparison group in the analysis because changes in usage may relate to many factors exogenous to the NJCP program. Other factors that can impact usage include the economy and changes in energy billing rates.

To control for changes that are exogenous to the NJCP program, we compare the change for the treatment group to the change for the comparison group. The change for the treatment group is the gross change, the difference between what the customer experienced in the year before service delivery and the year after service delivery. The same time period is examined for the comparison group, but since these customers received services one year later, the two years examined for the comparison group are two years and one year prior to service delivery. The comparison group's change is an estimate of what the change for the treatment group would have been if they had not received services. By subtracting the comparison group's change from the treatment group's change, we obtain the net change, or the estimate of the impact of the program. This information is illustrated in Table VIII-4.

**Table VIII-4
Treatment and Comparison Groups**

	Pre	Post	Change	Measured
Treatment Group	Year Before Services	Year After Services	After - Before	Program Impact and Other Factors
Comparison Group	2 Years Before	1 Year Before	2 Years Before – 1 Year Before	Other Factors
Treatment - Comparison	2009-2011	2010-2012		Program Impact

B. Statewide Saving Estimates

This section provides an analysis of the savings across all utilities and contractors, by type of fuel. Electric baseload, electric heating, and gas heating jobs were always analyzed separately. Most jobs were treated with both electric baseload and gas heating services.

Table VIII-5A displays the electric baseload savings results. The table shows that these jobs saved 408 to 473 kWh on average. This represented 5.6 to 6.6 percent of pre-treatment electric usage.

Table VIII-5A
Electric Baseload Savings Analysis

Model	Treatment Group					Comparison Group					Net Savings	
	Obs.	Usage		Savings		Obs.	Usage		Savings		kWh	%
		Pre	Post	kWh	%		Pre	Post	kWh	%		
Individual	3,277	7,342	6,931	411**	5.6%	4,508	7,641	7,638	3	<0.1%	408**	5.6%
Pooled	5,097	7,193	6,718	475**	6.6%	6,919	7,384	7,381	2	<0.1%	473**	6.6%

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

The electric baseload measure that comprises the majority of these savings is refrigerator replacement. Table VIII-5B displays electric baseload savings results by whether or not the customer received a replacement refrigerator. The table shows that approximately 45 percent of the analysis group received a refrigerator replacement. While savings for those who received a refrigerator averaged 690 to 742 kWh, or 9.4 to 10.3 percent of pre-treatment usage, savings for those who did not receive a refrigerator averaged 180 to 247 kWh or 2.5 to 3.5 percent of pre-treatment usage. Average pre-treatment usage was very similar for those who did and did not receive the refrigerator replacement. Refrigerator replacement is discussed in more detail later in this section.

Table VIII-5B
Electric Baseload Savings Analysis
By Refrigerator Replacement

Model	Treatment Group					Comparison Group					Net Savings	
	Obs.	Usage		Savings		Obs.	Usage		Savings		kWh	%
		Pre	Post	kWh	%		Pre	Post	kWh	%		
Refrigerator												
Individual	1,455	7,367	6,649	718**	9.7%	1,773	7,834	7,806	28	0.4%	690**	9.4%
Pooled	2,324	7,241	6,482	759**	10.5%	2,722	7,502	7,485	17	0.2%	742**	10.3%
No Refrigerator												
Individual	1,821	7,317	7,152	165**	2.3%	2,733	7,515	7,529	-14	-0.2%	180**	2.5%
Pooled	2,748	7,155	6,914	241**	3.4%	3,979	7,261	7,267	-6	-0.1%	247**	3.5%

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

Table VIII-6A displays the electric heating savings results. The table shows that these jobs saved 824 to 1,071 kWh on average. This represented 6.1 to 8.2 percent of pre-treatment electric usage.

Table VIII-6A
Electric Heating Savings Analysis

Model	Treatment Group					Comparison Group					Net Savings	
	Obs.	Usage		Savings		Obs.	Usage		Savings			
		Pre	Post	kWh	%		Pre	Post	kWh	%	kWh	%
Individual	334	13,490	12,577	913**	6.8%	258	13,935	13,846	89	0.6%	824**	6.1%
Pooled	499	13,137	12,136	1,001**	7.6%	385	13,444	13,514	-70	-0.5%	1,071**	8.2%

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

We defined jobs as having a major measure if at least \$1,000 was spent on air sealing, insulation, duct sealing, and HVAC combined. Some jobs did not have installation of major measures because of health and safety problems or a lack of opportunity, and these jobs are expected to have much lower savings. Table VIII-6B shows that about 40 percent of electric heating jobs had a major measure. While those that had a major measure saved 1,561 to 1,867 kWh or 10.1 to 12.6 percent of pre-treatment usage, those that did not saved 370 to 414 kWh or 3.0 to 3.5 percent of pre-treatment usage. Jobs that received major measures had significantly higher pre-treatment usage than those that did not.

Table VIII-6B
Electric Heating Savings Analysis
By Whether Major Measure Was Installed

Model	Treatment Group					Comparison Group					Net Savings	
	Obs.	Usage		Savings		Obs.	Usage		Savings			
		Pre	Post	kWh	%		Pre	Post	kWh	%	kWh	%
Major Measure												
Individual	129	15,416	13,855	1,561**	10.1%	89	14,913	14,913	<1	<0.1%	1,561**	10.1%
Pooled	214	14,760	12,927	1,833**	12.4%	145	15,295	15,328	-33	-0.2%	1,867**	12.6%
No Major Measure												
Individual	205	12,278	11,773	505**	4.1%	169	13,419	13,284	136	1.0%	370#	3.0%
Pooled	285	11,949	11,590	359**	3.0%	234	12,423	12,477	-55	-0.4%	414*	3.5%

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

Table VIII-7A displays the gas heating savings results. The table shows that these jobs saved 43 to 50 ccf on average. This represented 4.1 to 4.9 percent of pre-treatment gas usage.

Table VIII-7A
Gas Heating Savings Analysis

Model	Treatment Group					Comparison Group					Net Savings	
	Obs.	Usage		Savings		Obs.	Usage		Savings		ccf	%
		Pre	Post	ccf	%		Pre	Post	ccf	%		
Individual	3,161	1,039	980	59**	5.7%	4,960	1,042	1,026	16**	1.6%	43**	4.1%
Pooled	4,828	1,017	947	70**	6.9%	7,225	1,016	996	20**	2.0%	50**	4.9%

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

Table VIII-7B shows that about 46 percent of gas heating jobs had a major measure installed, defined as at least \$1,000 on air sealing, insulation, duct sealing, and HVAC combined. While jobs that had a major measure saved 80 to 85 ccf or 7.3 to 7.6 percent of pre-treatment usage, those that did not had little or no savings. Jobs that had major measures installed had significantly higher pre-treatment usage than those that did not.

Table VIII-7B
Gas Heating Savings Analysis
By Whether Major Measure Was Installed

Model	Treatment Group					Comparison Group					Net Savings	
	Obs.	Usage		Savings		Obs.	Usage		Savings		ccf	%
		Pre	Post	ccf	%		Pre	Post	ccf	%		
Major Measure												
Individual	1,438	1,114	1,005	109**	9.8%	1,894	1,100	1,076	24**	2.2%	85**	7.6%
Pooled	2,285	1,097	985	112**	10.2%	2,848	1,079	1,048	31**	2.9%	80**	7.3%
No Major Measure												
Individual	1,722	976	959	17**	1.7%	3,063	1,005	994	11**	1.1%	6	0.6%
Pooled	2,539	947	917	30**	3.2%	4,309	972	960	12**	1.3%	18**	1.9%

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

C. Savings by Contractor

This section provides an analysis of savings by the prime implementation contractor. Table VIII-8A displays savings for electric baseload jobs by contractor. The table shows that Honeywell had higher savings than the other contractors. While Honeywell averaged about 500 kWh or seven percent of pre-treatment usage in savings, CMC, EIC, and Northeast Energy (NE) saved about 300 kwh or four percent of pre-treatment usage.⁴⁰

⁴⁰ Honeywell's savings using the individual model were statistically significantly higher than EIC's savings at the 99 percent level, than CMC's at the 95 percent level, and, than all three other contractors combined at the 99 percent level. Honeywell's

**Table VIII-8A
Electric Baseload Savings Analysis
By Contractor**

Contractor	Treatment Group					Comparison Group					Net Savings	
	Obs.	Usage		Savings		Obs.	Usage		Savings		kWh	%
		Pre	Post	kWh	%		Pre	Post	kWh	%		
Individual												
HW	2,106	7,219	6,722	497**	6.9%	4,508	7,641	7,638	3	<0.1%	494**	6.8%
CMC	408	7,444	7,203	241**	3.2%						238**	3.2%
EIC	523	7,762	7,522	240**	3.1%						237**	3.1%
NE	223	7,014	6,708	306**	4.4%						304**	4.3%
Pooled												
HW	3,198	7,158	6,616	542**	7.6%	6,919	7,338	7,336	2	<0.1%	540**	7.5%
CMC	680	7,581	7,227	354**	4.7%		7,378	7,376	2	<0.1%	352**	4.6%
EIC	769	7,170	6,940	230**	3.2%		7,441	7,439	2	<0.1%	228**	3.2%
NE	427	7,118	6,778	339**	4.8%		7,377	7,375	2	<0.1%	337**	4.7%

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

Table VIII-8B displays statistics on refrigerator and CFL replacement for baseload jobs by contractor. The table shows that Honeywell replaced refrigerators in about 50 percent of the electric baseload jobs, compared to about 35 percent by the other contractors.⁴¹ While it is possible that there were greater opportunities for replacement in the homes treated by Honeywell, the table shows that Honeywell was more likely to conduct metering, as they did so in 94 percent of the cases, compared to 57 percent metered by CMC and 77 percent metered by EIC.⁴² This implies that the other contractors may have found additional replacement opportunities if they had metered a higher percentage of refrigerators.⁴³

The table shows that for all contractors about 90 percent of metered refrigerators that were replaced had usage over 1,000 kWh. Metered usage averaged about 1,500 kWh for refrigerators replaced by Honeywell, CMC, and NE, whereas it averaged about 1,300 kWh for refrigerators replaced by EIC. While Honeywell and CMC had savings of about 700 kWh for jobs where the refrigerator was replaced, EIC and NE had savings of about 400 kWh for jobs where the refrigerator was replaced.⁴⁴

The table also showed that Honeywell and NE were more likely to replace CFLs and replaced a greater number of bulbs on average than the other contractors.

savings using the pooled model were statistically significantly higher than each other contract and all three combined at the 99 percent level.

⁴¹ These differences were statistically significant at the 99 percent level.

⁴² These differences were statistically significant at the 99 percent level.

⁴³ The NJCP Manual requires metering or using a database to determine consumption if metering cannot be done.

⁴⁴ The pooled differences between Honeywell and EIC were statistically significant at the 99 percent level and the pooled differences between CMC and EIC were statistically significant at the 90 percent level.

Table VIII-8B
Electric Baseload Savings Analysis
By Contractor and Refrigerator Replacement

Contractor	Obs.	% Metered	% Replaced	Refrigerator Replaced						CFLs	
				Yes	No	Yes	No	Yes	No	Mean #	% With 1 or More
				% Usage >1,000 kWh		Metered Usage (kWh)		Net Savings (kWh)			
Individual											
HW	2,106	94%	51% ¹	89%	32%	1,482	1,085	730**	137*	12.9	90%
CMC	408	57%	27%	92%	19%	1,564	796	704**	218*	5.2	58%
EIC	523	77%	35%	84%	9%	1,326	645	439**	27	8.5	71%
NE	223	70%	36%	92%	13%	1,572	706	388#	135	12.7	91%
Pooled											
HW	3,198	93%	54% ²	90%	33%	1,493	1,111	792**	246**	12.5	89%
CMC	680	59%	29% ³	88%	18%	1,529	780	648**	237**	5.0	55%
EIC	769	77%	34%	83%	9%	1,306	631	390**	146*	8.3	72%
NE	427	71%	39% ⁴	92%	10%	1,566	688	774**	92	13.0	93%

**Denotes significance at the 99 percent level. *Denotes significance at the 95 percent level. #Denotes significance at the 90 percent level.
¹One account did not have measure data. ²22 accounts did not have measure data. ³Two accounts did not have measure data. ⁴One account did not have measure data.

Table VIII-9A displays savings for electric heating jobs by contractor. Northeast Energy and Optimal Energy are not shown, as they only had 21 and 2 observations in the analysis. While Honeywell averaged about 900 kWh in savings, CMC and EIC saved about 750 kWh. However, differences were not statistically significant due to the small sample sizes.

Table VIII-9A
Electric Heating Savings Analysis
By Contractor

Contractor	Treatment Group					Comparison Group					Net Savings	
	Obs.	Usage		Savings		Obs.	Usage		Savings		kWh	%
		Pre	Post	kWh	%		Pre	Post	kWh	%		
Individual												
HW	200	13,518	12,550	968**	7.2%	258	13,935	13,846	89	0.6%	879**	6.5%
CMC	54	13,428	12,584	844**	6.3%						755**	5.6%
EIC	68	13,030	12,219	810**	6.2%						721**	5.5%
Pooled												
HW	200	13,454	12,465	989**	7.4%	385	13,234	13,305	-71	-0.5%	1,061**	7.9%
CMC	54	12,470	11,963	507#	4.1%						575#	4.6%

Contractor	Treatment Group					Comparison Group					Net Savings	
	Obs.	Usage		Savings		Obs.	Usage		Savings			
		Pre	Post	kWh	%		Pre	Post	kWh	%	kWh	%
EIC	68	12,245	11,391	854**	7.0%		13,552	13,622	-70	-0.5%	924**	7.5%

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

Table VIII-9B displays statistics on major measure installation for electric heating jobs by contractor. The table shows that all of the contractors installed major measures in about 40 percent of the jobs.

Table VIII-9B
Electric Heating Savings Analysis
By Contractor and Major Measure

Contractor	Treatment Group					
	Obs.	% Major Measure	Net Savings			
			Major Measure		No Major Measure	
			kWh	%	kWh	%
Individual						
HW	200	38%	1,658**	11.2%	418#	3.3%
CMC	54	46%	1,671**	10.8%	-6	-0.1%
EIC	68	37%	1,511**	8.8%	267	2.5%
Pooled						
HW	285	44%	1,636**	11.2%	463*	3.6%
CMC	74	53%	1,501**	10.8%	218	1.9%
EIC	68	37%	1,610**	10.7%	411	3.7%

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

#Denotes significance at the 90 percent level.

Table VIII-10A displays savings for gas heating jobs by contractor. Optimal Energy is not shown, as they only had 19 observations in the analysis. The table shows that NE and CMC had higher gas savings than the other contractors.⁴⁵ While NE averaged about 100 ccf or eight percent of pre-treatment usage in savings and CMC averaged about 70 ccf or 7.5 percent of pre-treatment usage, Honeywell and EIC saved 30 to 50 ccf or three to four percent of pre-treatment usage.

⁴⁵ Differences were statistically significant at the 95 percent level.

Table VIII-10A
Gas Heating Savings Analysis
By Contractor

Contractor	Treatment Group					Comparison Group					Net Savings	
	Obs.	Usage		Savings		Obs.	Usage		Savings		ccf	%
		Pre	Post	ccf	%		Pre	Post	ccf	%		
Individual												
HW	2,024	1,009	964	45**	4.5%	4,960	1,042	1,026	16**	1.6%	29**	2.8%
CMC	436	979	892	88**	9.0%						71**	7.3%
EIC	479	1,095	1,033	61**	5.6%						45**	4.1%
NE	207	1,322	1,204	117**	8.9%						101**	7.6%
Pooled												
HW	3,029	993	936	57**	5.7%	7,225	1,010	990	20**	2.0%	37**	3.7%
CMC	677	959	863	95**	9.9%		1,011	991	19**	1.9%	76**	7.9%
EIC	717	1,064	997	67**	6.3%		1,012	993	20**	1.9%	48**	4.5%
NE	386	1,191	1,069	122**	10.3%		1,015	995	20**	2.0%	102**	8.6%

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

Table VIII-10B displays statistics on major measure installation for gas heating jobs by contractor. The table shows that while Honeywell and CMC installed major measures in 40 to 50 percent of the homes, EIC and NE installed major measures in closer to 60 percent.⁴⁶ CMC and NE had greater savings than HW and EIC both in homes with major measures, and without.⁴⁷

Table VIII-10B
Gas Heating Savings Analysis
By Contractor and Major Measure

Contractor	Treatment Group					
	Obs.	% Major Measure	Net Savings			
			Major Measure		No Major Measure	
			ccf	%	ccf	%
Individual						
HW	2,023 ¹	41%	69**	6.6%	<1	<0.1%
CMC	436	45%	116**	11.1%	34**	3.7%
EIC	479	59%	77**	6.3%	-8	-0.8%
NE	207	58%	145**	10.6%	34	2.7%

⁴⁶ Differences were statistically significant at the 95 percent level.

⁴⁷ Differences in homes with major measures were statistically significant at the 95 percent level. Most differences in homes without major measures were statistically significant at the 95 percent level.

Contractor	Treatment Group					
	Obs.	% Major Measure	Net Savings			
			Major Measure		No Major Measure	
			ccf	%	ccf	%
Pooled						
HW	3,027 ²	43%	66**	6.2%	12*	1.3%
CMC	676 ³	49%	112**	10.9%	39**	4.3%
EIC	717	59%	72**	6.2%	-4	-0.4%
NE	385 ³	57%	121**	9.5%	79**	7.2%

¹One account did not have measure data. ²Two accounts did not have measure data. ³One account did not have measure data.

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

#Denotes significance at the 90 percent level.

D. Measure Savings

This section provides an analysis of the savings that were attributable to the installed measures by type. Table VIII-11 displays savings that were attributable to refrigerators and to CFLs installed on baseload jobs. The table provides the following information.

- Refrigerator savings – Refrigerators saved 437 to 517 kWh on average.
- CFL savings – CFLs saved an average of 8 to 10 kWh per CFL installed. With an average of 11 CFLs across all jobs, customers saved an average of 88 to 110 kWh from CFLs installed in their homes.

**Table VIII-11
Electric Baseload Jobs
Measure Savings Analysis**

Protocol Savings Category	Individual	Pooled
Obs	3,276	5,072
	kWh Savings	
Refrigerator	517 (±96)	437 (±86)
CFL	10 (±5)	8 (±5)

Numbers in the parentheses indicate 90% confidence interval.

Table VIII-12A examines electric heating savings by the number of major measures installed, using two different types of counts. The table shows that customers saved more energy as more major measures were installed. Customers who had four or more major measures installed saved over 2,000 kWh and 15 to nearly 20 percent of pre-treatment usage.

Table VIII-12A
Electric Heating Savings
By Number of Major Measures Installed

Number of Major Measures	Air Sealing, Insulation, Duct Sealing, Refrigerator						Air Sealing, Attic Insulation, Other Insulation, HVAC Replacement, Duct Sealing, Refrigerator Replacement					
	Individual Analysis			Pooled Analysis			Individual Analysis			Pooled Analysis		
	Obs.	Net Savings		Obs.	Net Savings		Obs.	Net Savings		Obs.	Net Savings	
		kWh	%		kWh	%		kWh	%		kWh	%
None	73	69	0.6%	103	45	0.4%	72	3	<0.1%	102	-29	-0.3%
1 Measure	89	376	2.9%	122	546 [#]	4.4%	90	427	3.3%	121	564 [*]	4.5%
2 Measures	96	1,232 ^{**}	9.0%	149	1,388 ^{**}	10.4%	87	1,172 ^{**}	8.8%	137	1,223 ^{**}	9.6%
3 Measures	61	1,542 ^{**}	10.3%	95	2,059 ^{**}	14.0%	63	1,429 ^{**}	9.4%	97	1,982 ^{**}	13.2%
4-5 Measures	15	2,139 ^{**}	13.4%	30	2,714 ^{**}	17.8%	22	2,293 ^{**}	14.1%	42	2,934 ^{**}	19.0%
Total	334	824 ^{**}	6.1%	499	1,071 ^{**}	8.2%	334	824 ^{**}	6.1%	499	1,071 ^{**}	8.2%

^{**}Denotes significance at the 99 percent level. ^{*}Denotes significance at the 95 percent level. [#]Denotes significance at the 90 percent level.

Table VIII-12B displays the electric heating measure saving analysis. Insulation is not separated into different types (attic, floor, sidewall, and wall) because, while there are 108 cases in the individual analysis and 175 cases in the pooled analysis with attic insulation, there are only one to 27 cases with each of these other types of insulation.

The table shows that most of the measure estimates were not statistically significant, due to the small sample size that is available for electric heating cases. Results between the two models differed dramatically for some of the measures, also due to the small sample sizes.

Table VIII-12B
Electric Heating Jobs
Measure Saving Analysis

Protocol Savings Category	Net Savings (kWh)	
	Individual	Pooled
Obs.	334	499
Per \$1,000 on Measure		
Air Sealing	406 (±325)	365 (±463)
Insulation	178 (±233)	798 (±294)
HVAC	361 (±208)	121 (±295)
Duct Sealing	1,406 (±2,731)	348 (±1,941)
Hot Water	17 (±456)	-614 (±590)
Thermostat Flag	-35 (± 382)	-499 (±580)
Refrigerator	-65 (±365)	334 (±492)

Protocol Savings Category	Net Savings (kWh)	
	Individual	Pooled
CFL	47 (± 25)	26 (± 34)

Numbers in the parentheses indicate 90% confidence interval.

Table VIII-13A examines gas heating savings by the number of major measures installed using two different counts. The table shows that customers saved more energy as more major measures were installed. Customers who had five or more measures installed saved an average of 124 ccf, or 10.4 percent of pre-treatment usage using the first count and 218 ccf or 15.9 percent of pre-treatment usage with the second type of count.

Table VIII-13A
Gas Heating Savings
By Number of Major Measures Installed

Number of Major Measures	Air Sealing, Insulation, HVAC, Duct Sealing, Hot Water						Air Sealing, Attic Insulation, Floor Insulation, Sidewall Insulation, Wall/Perimeter Insulation, HVAC Replacement, Duct Sealing					
	Individual Analysis			Pooled Analysis			Individual Analysis			Pooled Analysis		
	Obs.	Net Savings		Obs.	Net Savings		Obs.	Net Savings		Obs.	Net Savings	
		ccf	%		ccf	%		ccf	%		ccf	%
None	346	3	0.3%	462	11	1.2%	938	8	0.8%	1,365	11	1.1%
1 Measure	509	3	0.3%	750	9	0.9%	678	15	1.6%	1,066	35**	3.9%
2 Measures	705	24**	2.3%	1,051	31**	3.1%	838	25**	2.5%	1,284	34**	3.5%
3 Measures	803	53**	5.3%	1,263	65**	6.6%	506	111**	9.9%	792	97**	8.8%
4 Measures	607	69**	6.3%	972	74**	6.8%	168	170**	13.5%	260	150**	12.4%
5-6 Measures	190	149**	12.0%	326	124**	10.4%	32	237**	17.3%	57	218**	15.9%
Total	3,161	43**	4.1%	4,828	50**	4.9%	3,161	43**	4.1%	4,828	50**	4.9%

Table VIII-13B displays the gas heating measure saving analysis. The table shows the following results for the first model that does not separate insulation by type and does not separate HVAC work by whether it was a replacement or repair.

- Air Sealing – savings from air sealing were 11 ccf per \$1,000 spent.
- Insulation – savings from insulation were 35 ccf per \$1,000 spent.
- HVAC – savings from HVAC work were 7 ccf per \$1,000 spent.
- Programmable Thermostat – savings were 46 ccf for an installation.

When the analysis was done separately by type of insulation, the results showed the greatest insulation savings resulted from attic floor insulation, followed by attic insulation, and then sidewall insulation. As expected, the greatest HVAC savings resulted from HVAC replacement.

**Table VIII-13B
Gas Heating Jobs
Measure Saving Analysis**

Protocol Savings Category	Model 1 Net Savings (ccf)		Model 2 Net Savings (ccf)	
	Individual	Pooled	Individual	Pooled
Obs	3,160	4,824	3,160	4,824
Per \$1,000 on Measure				
Air Sealing	15 (± 7)	11 (± 8)	14 (± 7)	12 (± 8)
Insulation	39 (± 5)	35 (± 6)		
Attic Insulation			47 (± 8)	37 (± 9)
Floor Insulation			38 (± 21)	62 (± 24)
Perimeter/Wall Insulation			67 (± 78)	-51 (± 116)
Sidewall Insulation			28 (± 10)	27 (± 11)
HVAC	18 (± 4)	7 (± 4)		
HVAC Replacement			19 (± 5)	8 (± 5)
HVAC Repair			4 (± 17)	-2 (± 19)
Duct Sealing	13 (± 28)	11 (± 27)	9 (± 29)	4 (± 28)
Hot Water	<1 (± 11)	9 (± 11)	1 (± 11)	8 (± 11)
Thermostat Flag				
Programmable	34 (± 12)	46 (± 14)	36 (± 12)	48 (± 14)
Other	-13 (± 25)	8 (± 26)	-13 (± 25)	8 (± 26)

Numbers in the parentheses indicate 90% confidence interval.

E. Cost-Effectiveness

This section assesses the cost-effectiveness of the program by job type and by measure installed. Table VIII-14 displays the cost per unit of energy saved by job type. The table shows that the electric heating jobs were close to cost-effective as shown by the \$0.14 cost per kWh saved.

**Table VIII-14
Cost Per Unit Saved
By Job Type**

Job Type	Jobs	Savings	Measure Cost	Total Job Cost	Total Cost Without Health and Safety Spending	Average Measure Life (Years)	Cost Per Unit Saved Over Lifetime
Electric Baseload	5,072 ¹	473 kWh	\$1,024	\$1,296	\$1,254	15.1	\$0.25/kWh
Electric Heat	499	1,071 kWh	\$2,009	\$2,281	\$2,047	22.6	\$0.14/kWh
Gas Heat	4,824 ²	50 ccf	\$1,796	\$2,164	\$1,746	24.2	\$2.52/ccf

Note: 15-year measure life, and five percent discount rate.

¹25 accounts did not have measure information. ²Four accounts did not have measure information.

Table VIII-15 displays the cost-effectiveness for measures that were found to have statistically significant estimates of savings in the pooled regression analysis. The table shows that insulation in the electric heat jobs and programmable thermostats in the gas heat jobs were cost-effective measures.

**Table VIII-15
Measure Cost-Effectiveness Effectiveness**

	Savings	Cost/Home	\$/Unit Saved	Measure Life	\$/Unit Saved Over Lifetime
Electric Baseload					
Refrigerator	437 kWh	\$1,186	\$2.72/kWh	12	\$0.31/kWh
CFLs	103 kWh	\$204	\$1.96/kWh	5	\$0.45/kWh
Electric Heat					
Insulation	1,217 kWh	\$1,525	\$1.25/kWh	40	\$0.07/kWh
Gas Heat					
Air Sealing	12 ccf	\$1,031	\$89.19/ccf	20	\$7.16//ccf
Insulation	63 ccf	\$1,800	\$28.65/ccf	40	\$1.67/ccf
HVAC	6 ccf	\$873	\$152.13/ccf	20	\$12.20/ccf
Programmable Thermostat	46 ccf	\$153	\$3.34/ccf	15	\$0.32/ccf

Note: five percent discount rate.

F. Realization Rates

This section provides a comparison of the projected energy savings using the NJCP Energy Saving Protocols to the savings that were estimated in the usage impact analysis.

Table VII-16 displays the savings based on the protocols, the savings based on the usage impact analysis, and the ratio of the two. Two different methods of comparing the savings are provided.

1. **Average Customer Realization = Mean {Usage Impact Savings/Projected Savings}**
2. **Average Program Realization = Sum of Usage Impact Savings/Sum of Projected Savings**

Table VII-16 shows that projected savings are much higher than the usage impact savings. NJCP applies deemed savings protocols as required by the BPU.

- Electric Baseload – Projected average savings were 1,311 and average usage impact savings were 455 kWh.
- Electric Heating – Projected average savings were 1,547 kWh and average usage impact savings were 973 kWh.
- Gas Heating – Projected average savings were 118 ccf and average usage impact savings were 71 ccf.

**Table VIII-16
NJCP Realization Rates**

	Obs.	Mean Total Projected Savings (kWh)	Mean Usage Impact Savings (kWh)	Mean Customer Realization	Mean Program Realization
Electric Baseload	2,709 ¹	1,311	455	30%	35%
Electric Heating	289 ²	1,547	973	66%	63%
	Obs.	Mean Total Projected Savings (ccf)	Mean Usage Impact Savings (ccf)	Mean Customer Realization	Mean Program Realization
Gas Heating	2,383 ³	118	71	48%	61%

¹268 accounts had no protocol savings data. ²13 accounts had no protocol savings data. ³514 accounts had no protocol savings data. Note: Top and bottom 5% in terms of average customer realization in each group are excluded.

Table VIII-17 displays electric baseload realization rates by contractor. The table shows that Honeywell and CMC had higher electric baseload realization rates than EIC and NE. However, the highest electric baseload realization rates were still only 34 to 39 percent, using the two different measures.

**Table VIII-17
NJCP Realization Rates for Electric Baseload
By Contractor**

	Obs.	Mean Total Projected Savings (kWh)	Mean Usage Impact Savings (kWh)	Mean Customer Realization	Mean Program Realization
HW	1,837	1,410	525	33%	37%
CMC	259	1,015	394	34%	39%
EIC	407	1,062	271	19%	26%
NE	194	1,290	241	20%	19%
Total	2,709	1,311	455	30%	35%

Table VIII-18 displays electric heating realization rates by contractor. The table shows that Honeywell and CMC had higher electric heating realization rates than EIC. (NE is not shown because there were only eight observations.) CMC had an average customer realization rate of 81 percent and an average program realization rate of 65 percent.

**Table VIII-18
NJCP Realization Rates for Electric Heating
By Contractor**

	Obs.	Mean Total Projected Savings (kWh)	Mean Usage Impact Savings (kWh)	Mean Customer Realization	Mean Program Realization
HW	180	1,518	1,030	67%	68%
CMC	45	1,687	1,093	81%	65%
EIC	55	1,446	798	57%	55%
Total	289	1,547	973	66%	63%

Table VIII-19 displays gas heating realization rates by contractor. The table shows that CMC had the highest realization rates, followed by NE. CMC had an average customer realization rate of 130 percent and an average program realization rate of 92 percent. EIC had the highest projected savings and the lowest realization rates, averaging only 17 percent for the customer realization and 43 percent for the program realization.

Table VIII-19
NJCP Realization Rates for Gas Heating
By Contractor

	Obs.	Mean Total Projected Savings (ccf)	Mean Usage Impact Savings (ccf)	Mean Customer Realization	Mean Program Realization
HW	1,518	99	54	33%	55%
CMC	301	125	115	130%	92%
EIC	373	168	72	17%	43%
NE	177	148	128	97%	87%
Total	2,383	118	71	48%	61%

G. Summary

This section provided an analysis of the energy saving impacts of the NJCP program using electric and gas usage data provided by the six participating utilities. Overall savings estimates were as follows.

- Electric Baseload – Savings averaged 473 kWh, or 6.6 percent of pre-treatment usage.
- Electric Heating – Savings averaged 1,071 kWh, or 8.2 percent of pre-treatment usage.
- Gas Heating – Savings averaged 50 ccf, or 4.9 percent of pre-treatment usage.

One reason that overall savings were lower than expected was the low penetration rate for major measures. This is at least partially related to the joint electric and gas service delivery model. The NJCP program serves customers with both electric and gas treatments if they are referred for one of the fuels and the customer has regulated utility service for the other fuel. For example, if a gas heating customer was targeted for service delivery due to high gas usage, the customer would also receive electric baseload NJ CP services if the customer was served by a regulated electric utility, regardless of the electric usage level of the customer. This process provides advantages to the program because the contractors are already in the home and the fixed costs of getting to the home can be allocated between the two utilities. The process also provides advantages to the customer because the customer receives more comprehensive services and only needs to work with one contractor and one set of appointments. However, it does provide constraints on the homes that each individual utility can choose to serve and may result in lower pre-treatment usage homes being served than otherwise would have been served in an individual utility program.

An analysis of the data shows that 88 percent of the treatment group received both electric baseload and gas heating services. The analysis also showed that high gas users and electric baseload users were usually not the same and most customers do not have high usage with both fuels.

Savings for jobs with major measures were as follows.

- Electric Baseload – Savings for jobs with refrigerator replacement (45 percent of baseload jobs) averaged 742 kWh, or 10.3 percent of pre-treatment usage.
- Electric Heating – Savings for jobs with at least \$1,000 in spending on air sealing, insulation, duct sealing and HVAC combined (40 percent of electric heating jobs) were 1,867 kWh or 12.6 percent of pre-treatment usage. Jobs with air sealing, insulation, duct sealing, and refrigerator replacement saved an average of 2,714 kWh or 17.8 percent of pre-treatment usage.
- Gas Heating – Savings for jobs with at least \$1,000 in spending on air sealing, insulation, duct sealing and HVAC combined (45 percent of gas heating jobs) were 80 ccf, or 7.3 percent of pre-treatment usage. Jobs with air sealing, insulation, HVAC work, duct sealing, and hot water work saved 124 ccf, or 10.4 percent of pre-treatment usage.

Savings were found to vary by contractor.

- Electric Baseload – Honeywell had higher savings than the other contractors, averaging 540 kWh or 7.5 percent of pre-treatment usage, compared to about 300 kWh on average for the other contractors. Honeywell achieved higher savings by metering and replacing a higher percentage of refrigerators, by installing a greater number of CFLs, and by achieving higher savings in jobs with refrigerator replacement than some other contractors.
- Electric Heating – Honeywell averaged about 900 kWh in savings, compared to about 750 kWh for CMC and EIC. However, differences were not statistically significant due to the small sample sizes.
- Gas Heating – NE saved about 100 ccf or eight percent of pre-treatment usage and CMC saved about 70 ccf or 7.5 percent of pre-treatment usage compared to 37 ccf for Honeywell and 48 ccf for EIC. While Honeywell and CMC installed major measures in about 40 to 50 percent of these jobs, EIC and NE installed major measures in close to 60 percent of these jobs. CMC and NE had higher savings than EIC and HW in homes with major measures.

The overall program was not found to be cost-effective due to the lower than expected savings. However, electric heating jobs with major measures overall, insulation work on electric heating jobs, and programmable thermostats on gas heating jobs were close to cost-effective or cost-effective.

The realization rate analysis showed that savings estimated through the usage impact analysis were generally lower than those projected using the protocols. NJCP applies deemed savings protocols as required by the BPU.

- Average electric baseload realization rates were 35 percent.
- Average electric heating realization rates were 65 percent.

- Average gas heating realization rates were 50 to 60 percent. CMC had the highest gas heating realization rates, with an average customer realization of 130 percent and an average program realization of 92 percent.

IX. Affordability Impacts

The Affordability Impact Evaluation is an important component of the comprehensive NJCP program evaluation, as it provides estimates of the impact of energy savings on energy bills, affordability, and bill payment.

This section provides a detailed discussion of the research methodology, and an analysis of the impacts of the program on the following.

- Energy Bills
- Customer Payments
- Bill Coverage Rates
- Balance
- Energy Burden
- NJ USF Subsidy
- NJ USF Participation

A. *Methodology*

Customers were defined to be included in Treatment and Comparison Groups as follows.

- Treatment Group: Customers who received NJCP audits between September 2010 and August 2011
- Comparison Group: Customers who received NJCP audits between September 2011 and August 2012

The analyses presented in this section include four groups.

- Electric Baseload – electric transactions only (PSE&G electric customers with billing for both electric and gas are not included as their electric payments cannot be separated from their gas payments.)
- Electric Heating – electric transactions only
- Gas Heating – gas transactions only
- Electric and Gas – for PSE&G dual fuel customers

Billing and payment data were requested and received from the electric and gas utilities for August 2009 through October 2012. Table IX-1 displays the data attrition for the electric baseload analysis. The table shows that across the electric utilities, 67 percent of the treatment group and 65 percent of the comparison group could be included in the analysis. Customers were excluded from the analysis because transactions data were not obtained, customers did not have enough pre- or post-treatment data, or customers were billing or payment outliers.

Table IX-1
Attrition Analysis
Electric Baseload

	All Utilities		PSE&G		JCP&L		ACE	
	Treat	Comp.	Treat	Comp.	Treat	Comp.	Treat	Comp.
Treated	3,179	3,574	866	1,252	1,843	1,624	470	698
Payment Data	2,964	3,306	724	1,124	1,834	1,602	406	580
330-390 Days	2,250	2,425	483	718	1,460	1,271	307	436
Outliers Removed	2,143	2,307	459	691	1,386	1,189	298	427
Number Included	2,143	2,307	459	691	1,386	1,189	298	427
Percent Included	67%	65%	53%	55%	75%	73%	63%	61%

Table IX-2 displays the data attrition for the electric heating analysis. The table shows that across the electric utilities, 65 percent of the treatment group and 67 percent of the comparison group could be included in the analysis.

Table IX-2
Attrition Analysis
Electric Heating

	All Utilities		PSE&G		JCP&L		ACE	
	Treat	Comp.	Treat	Comp.	Treat	Comp.	Treat	Comp.
Treated	536	835	95	184	381	533	60	118
Payment Data	512	800	84	172	378	525	50	103
330-390 Days	378	612	58	131	285	410	35	71
Outliers Removed	348	557	57	125	260	365	31	67
Number Included	348	557	57	125	260	365	31	67
Percent Included	65%	67%	60%	68%	68%	68%	52%	57%

Table IX-3 displays the data attrition for the gas heating analysis. The table shows that across the gas utilities, 57 percent of the treatment group and 45 percent of the comparison group could be included in the analysis. Elizabethtown Gas was not able to provide data for the comparison group. Therefore, when we examine these customers separately, we use all gas customers as a comparison group for Elizabethtown Gas.

**Table IX-3
Attrition Analysis
Gas Heating**

	All Utilities		PSE&G		NJNG		ETG		SJG	
	Treat	Comp.	Treat	Comp.	Treat	Comp.	Treat	Comp.	Treat	Comp.
Treated	3,198	3,478	390	407	1,384	1,280	894	1,099	530	692
Payment Data	2,864	3,069	301	277	1,229	1,122	891	1,099	473	610
330-390 Days	1,874	1,611	236	208	1,199	1,083	259	14	380	460
Outliers Removed	1,813	1,556	232	198	983	906	226	5	372	447
Number Included	1,813	1,556	232	198	983	906	226	5	372	447
Percent Included	57%	45%	59%	49%	71%	71%	25%	<1%	70%	65%

Table IX-4 displays the data attrition for the joint PSE&G electric and gas analysis. The table shows that 56 percent of the treatment group and 62 percent of the comparison group could be included in the analysis.

**Table IX-4
Attrition Analysis
PSE&G Electric and Gas Combination Customers**

	PSE&G	
	Treatment	Comparison
Treated	2,493	4,910
Payment Data	2,338	4,804
330-390 Days	1,487	3,275
Outliers Removed	1,386	3,023
Number Included	1,386	3,023
Percent Included	56%	62%

B. Energy Bills, Payments, Coverage Rates, and Balances

Table IX-5A displays electric bills and payments for electric baseload jobs excluding PSE&G combination customers. The table shows a net reduction in charges of \$58. While cash payments increased, assistance payments declined, resulting in a net decline in total credits. There was no significant change in the total coverage rate or the balance.

Table IX-5A
Electric Baseload Jobs
Electric Bills and Payments

	Treatment Group			Comparison Group			Net Change
	Pre	Post	Change	Pre	Post	Change	
Observations	2,143			2,307			
Bills	\$1,416	\$1,189	-\$227**	\$1,519	\$1,357	-\$162**	-\$65**
Other Charges	\$40	\$71	\$31**	\$49	\$73	\$25**	\$7
Total Charges	\$1,456	\$1,260	-\$196**	\$1,568	\$1,430	-\$137**	-\$58**
# Payments	9.0	8.0	-1.0**	9.0	8.0	-1.0**	>-.1
Cash Payments	\$1,018	\$811	-\$207**	\$1,126	\$869	-\$256**	\$50**
Assistance Payments	\$398	\$444	\$46**	\$397	\$558	\$161**	-\$115**
Other Credits	\$17	\$36	\$18**	\$19	\$37	\$19**	>-\$1
Total Credits	\$1,443	\$1,300	-\$144**	\$1,552	\$1,477	-\$75**	-\$69**
Cash Coverage Rate	71.8%	64.5%	-7.3%**	72.8%	61.9%	-10.9%**	3.6%**
Total Coverage Rate	99.8%	103.8%	4.0%**	99.4%	104.5%	5.1%**	-1.1%
Balance Change	\$31	-\$56	\$87**	\$40	-\$64	\$104**	-\$17

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

Table IX-5B displays the coverage rate distribution for electric baseload jobs. Both treatment and comparison group customers had a small increase in the percent paying their full bill from pre-treatment to post-treatment period.

Table IX-5B
Electric Baseload Jobs
Total Coverage Rate

	Treatment Group		Comparison Group	
	Pre	Post	Pre	Post
Observations	2,143		2,307	
<80%	7%	5%	8%	5%
80-89%	9%	7%	9%	8%
90-99%	24%	23%	25%	24%
≥100%	60%	65%	58%	62%
Total	100%	100%	100%	100%

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

Table IX-6A displays electric bills and payments for electric heating jobs excluding PSE&G combination customers. The table shows a net reduction in charges of \$87. These customers also increased their cash payments but had reduced assistance payments, resulting in a net decline in total credits. There was no significant change in the total coverage rate or the balance.

Table IX-6A
Electric Heating Jobs
Electric Bills and Payments

	Treatment Group			Comparison Group			Net Change
	Pre	Post	Change	Pre	Post	Change	
Observations	348			557			
Bills	\$2,284	\$1,927	-\$357**	\$2,451	\$2,194	-\$257**	-\$100**
Other Charges	\$66	\$94	\$28*	\$66	\$81	\$15#	\$13
Total Charges	\$2,349	\$2,021	-\$328**	\$2,517	\$2,276	-\$241**	-\$87**
# Payments	8.1	6.5	-1.6**	8.7	6.2	-2.5**	0.9**
Cash Payments	\$1,383	\$1,037	-\$346**	\$1,586	\$1,032	-\$554**	\$208**
Assistance Payments	\$895	\$889	-\$6	\$849	\$1,092	\$243**	-\$249**
Other Credits	\$46	\$205	\$159**	\$40	\$212	\$172**	-\$13
Total Credits	\$2,338	\$2,141	-\$198**	\$2,485	\$2,346	-\$139**	-\$59
Cash Coverage Rate	57.5%	49.0%	-8.5%**	62.9%	43.2%	-19.7%**	11.2%**
Total Coverage Rate	99.6%	106.1%	6.4%**	99.5%	104.1%	4.5%**	1.9%
Balance Change	\$27	-\$156	\$183**	\$54	-\$120	\$174**	\$8

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

Table IX-6B displays the coverage rate distribution for electric heating jobs. While 58 percent of treatment group customers covered their full bill in the pre period, 70 percent covered their full bill in the post period, a 12 percentage point increase. Comparison group customers had a smaller increase and only 60 percent covered their full bill in the post period. This indicates a positive impact of the program on bill coverage rates.

Table IX-6B
Electric Heating Jobs
Total Coverage Rate

	Treatment Group		Comparison Group	
	Pre	Post	Pre	Post
Observations	348		557	
<80%	8%	6%	8%	5%
80-89%	9%	8%	12%	10%

	Treatment Group		Comparison Group	
	Pre	Post	Pre	Post
90-99%	25%	16%	25%	24%
≥100%	58%	70%	56%	60%
Total	100%	100%	100%	100%

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

Table IX-7A displays bills and payments for gas heating jobs excluding PSE&G combination customers. The table shows that there was no significant change in the amount charged. These customers also increased their cash payments but had reduced assistance payments. The total coverage rate declined by 2.8 percentage points and the balance increased by \$43.

Table IX-7A
Gas Heating Jobs
Gas Bills and Payments

	Treatment Group			Comparison Group			Net Change
	Pre	Post	Change	Pre	Post	Change	
Observations	1,813			1,556			
Bills	\$1,276	\$1,033	-\$243**	\$1,342	\$1,090	-\$252**	\$10
Other Charges	\$46	\$46	>-\$1	\$20	\$17	-\$4*	\$3
Total Charges	\$1,322	\$1,078	-\$243**	\$1,363	\$1,107	-\$256**	\$13
# Payments	6.7	5.6	-1.1**	6.9	5.3	-1.6**	0.5**
Cash Payments	\$743	\$551	-\$193**	\$816	\$530	-\$286**	\$93**
Assistance Payments	\$516	\$512	-\$4	\$500	\$599	\$99**	-\$103**
Other Credits	\$85	\$71	-\$13**	\$52	\$51	>-\$1	-\$13*
Total Credits	\$1,349	\$1,136	-\$214**	\$1,372	\$1,185	-\$187**	-\$26
Cash Coverage Rate	55.7%	49.0%	-6.7%**	58.8%	44.9%	-14.0%**	7.2%**
Total Coverage Rate	102.6%	106.2%	3.6%**	101.3%	107.7%	6.4%**	-2.8%*
Balance Change	-\$17	-\$76	-\$59**	\$7	-\$96	-\$102**	\$43*

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

Table IX-7B displays the coverage rate distribution for gas heating jobs. Both treatment and comparison group customers had a small increase in the percent paying their full bill from pre-treatment to post-treatment period.

**Table IX-7B
Gas Heating Jobs
Total Coverage Rate**

	Treatment Group		Comparison Group	
	Pre	Post	Pre	Post
Observations	1,813		1,556	
<80%	10%	12%	11%	12%
80-89%	11%	10%	11%	9%
90-99%	20%	16%	21%	14%
≥100%	59%	62%	56%	65%
Total	100%	100%	100%	100%

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

Table IX-8A displays bills and payments for PSE&G combination customers. The table shows that total charges declined by \$107 and total credits declined by \$195 due to a decrease in assistance payments. The total coverage rate declined by 3.3 percentage points and the balance increased by \$79.

**Table IX-8A
Combination Customers (PSE&G)
Gas and Electric Bills and Payments**

	Treatment Group			Comparison Group			Net Change
	Pre	Post	Change	Pre	Post	Change	
Observations	1,386			3,023			
Bills	\$2,693	\$2,255	-\$439**	\$2,739	\$2,403	-\$336**	-\$103**
Other Charges	\$95	\$99	\$4	\$107	\$116	\$9*	-\$5
Total Charges	\$2,788	\$2,354	-\$434**	\$2,847	\$2,519	-\$327**	-\$107**
# Payments	8.3	6.9	-1.4**	8.3	6.7	-1.6**	0.2#
Cash Payments	\$1,742	\$1,289	-\$453**	\$1,726	\$1,228	-\$498**	\$45
Assistance Payments	\$1,099	\$1,069	-\$31#	\$1,140	\$1,351	\$211**	-\$241**
Other Credits	\$35	\$35	<\$1	\$37	\$36	>-\$1	\$1
Total Credits	\$2,876	\$2,392	-\$484**	\$2,903	\$2,615	-\$288**	-\$195**
Cash Coverage Rate	60.7%	52.1%	-8.6%**	59.8%	46.7%	-13.1%**	4.5%**
Total Coverage Rate	103.5%	102.1%	-1.4%#	102.4%	104.2%	1.9%**	-3.3%**
Balance Change	-\$57	-\$53	\$4	-\$17	-\$92	-\$75**	\$79**

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

Table IX-8B displays the coverage rate distribution for combination customers. Treatment group customers had a small decline in the percent paying their full bill and comparison group customers had a small increase in the percent paying their full bill from pre-treatment to post-treatment period.

Table IX-8B
Combination Customers
Total Coverage Rate

	Treatment Group		Comparison Group	
	Pre	Post	Pre	Post
Observations	1,386		3,023	
<80%	7%	7%	7%	5%
80-89%	9%	13%	10%	10%
90-99%	27%	28%	28%	29%
≥100%	57%	52%	54%	56%
Total	100%	100%	100%	100%

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

C. NJ USF Participation and Subsidy

This section examines changes in NJ Universal Service Fund Program participation and credits. The reduction in costs resulting from the reduction in energy usage will accrue to the customer and the ratepayer in various proportions depending on several factors. A few examples are described below and illustrated in Table IX-9.

- If the customer does not receive the maximum subsidy amount of \$1,800 prior to treatment, the reduction in energy costs will result in a reduction in the customer's USF credit, because the customer does not need as large of a credit to reach a six percent energy burden, as targeted by the USF program. All of the benefits accrue to the ratepayers.
- If the customer is close to having a 6 percent energy burden without the USF and only has a small USF subsidy prior to program treatments, a usage reduction may be enough to reduce the customer's pre-USF energy burden to less than six percent. In this case, the savings can eliminate the USF subsidy and reduce the amount that the customer is required to pay. The benefits are therefore split between the customer and the ratepayer.
- If the customer has the maximum \$1,800 USF subsidy and still has an energy burden that is greater than six percent, the benefit accrual depends on the customer's required assistance after the usage reduction. If the customer still needs \$1,800 to reach a six percent burden or still cannot reach the six percent burden even with the full subsidy, the

reduction in cost will reduce the amount over a six percent burden that the customer pays. In this case, the benefits accrue to the participant.

- If the customer has the maximum \$1,800 USF subsidy prior to services but no longer needs \$1,800 to reach a six percent burden after services, the reduction in cost can both reduce the subsidy and reduce the customer payment. The benefits accrue to both the participant and the ratepayers.

The short-term impact of the program may accrue to the customer more than in the longer term if the estimate of the customer's usage that is utilized for the USF benefit determination does not take into account the full reduction in usage that results from the program. This will depend on the timing of the USF benefit calculation compared to the timing of program participation.

**Table IX-9
Illustration of Potential Impacts for Customers and Ratepayers**

	Customer 1	Customer 2	Customer 3	Customer 4
<u>Pre-Treatment</u>				
Income	\$10,000	\$10,000	\$10,000	\$10,000
Bill	\$1,000	\$650	\$3,000	\$2,400
Burden	10.0%	6.5%	30.0%	24.0%
USF Subsidy	\$400	\$50	\$1,800	\$1,800
Customer Payment	\$600	\$600	\$1,200	\$600
<u>Post-Treatment</u>				
Bill	\$850.00	\$552.50	\$2,550.00	\$2,040.00
Burden	8.5%	5.5%	25.5%	20.4%
Subsidy	\$250	\$0	\$1,800.00	\$1,440.00
Customer Payment	\$600	\$552.50	\$750.00	\$600.00
Customer Savings	\$0	\$47.50	\$450.00	\$0.00
Subsidy Reduction	\$150	\$50	\$0.00	\$360.00
Pre Burden (Before USF)	>6%	>6%	>6%	>6%
Pre Burden (After USF)	6%	6%	>6%	6%
Pre USF Amount	< \$1,800	<\$1,800	\$1,800	\$1,800
Post Burden (Before USF)	>6%	<6%	>6%	>6%
Post Burden (After USF)	6%	No USF	>6%	6%
Benefit To:	Ratepayers	Participant and Ratepayers	Participant	Ratepayers

Table IX-10 displays the number and percent of treatment and comparison group accounts that received USF credits in the pre and post period. The table shows that while 6 percent of the treatment group received credits only in the post period, 15 percent of the comparison group received credits only in the post period.

Table IX-10
USF Credits Received

USF Credits Received	Treatment		Comparison	
	Count	Percent	Count	Percent
Pre and Post	2,490	60%	3,978	64%
Pre Only	283	7%	191	3%
Post Only	247	6%	899	15%
Neither	1,124	27%	1,118	18%
Total	4,144	100%	6,186	100%

Table IX-11 displays mean total pre and post USF credits by type of USF credit received in the pre period for the treatment and comparison groups. This allows for a separate analysis of customers who did not receive credits in the pre period. The distinction is important, because the comparison group customers were more likely to be new USF participants in the post period (as shown in the table above.) This is due to the fact that USF participants are targeted for NJCP recruitment. In that sense, the comparison group would not provide a good control, as they would be expected by definition to be new USF participants and to increase their USF payments from \$0 in credits in the pre period (two years before NJCP participation) to a positive credit in the post period (one year before NJCP participation.) However, this issue is resolved by only looking at customers who did receive USF in the pre period, and also by only looking at customers who received USF credits in both periods.

When looking only at those customers that did receive a USF credit in the pre period, there is a reduction in USF credits for the treatment group compared to the change for the comparison group, with the exception of gas only jobs. Electric heat customers have the greatest net reduction, a decline of \$162, due to their greater reduction in usage.

The bottom part of the table shows that about six percent of the treatment group and 15 percent of the comparison group did not receive credits in the pre period, but did receive them in the post period. As expected, the comparison group is more likely to be comprised of new USF participants in the post period (the year prior to NJCP participation). While new treatment group participants had average benefits of \$802, new comparison group participants had average benefits of \$1,057.

This positive impact of the NJCP program results in reduced ratepayers subsidies for the USF program.

Table IX-11
Mean USF Credits for Gas and Electric Utilities Combined1
By Type of USF Received in Pre Period

	Treatment Group				Comparison Group				Net Change
	Obs.	Pre	Post	Change	Obs.	Pre	Post	Change	
Full Analysis Group	4,144	\$796	\$781	-\$15	6,186	\$982	\$1,132	\$150**	-\$165**
With Pre Period Credit									
Electric Baseload Only	471	\$600	\$584	-\$16	665	\$620	\$701	\$81**	-\$97**
Electric Heat Only	214	\$833	\$787	-\$46	369	\$757	\$873	\$116**	-\$162**
Gas Only	328	\$377	\$345	-\$32	266	\$412	\$387	-\$25	-\$7
Both Electric and Gas	1,760	\$1,543	\$1,410	-\$133**	2,869	\$1,839	\$1,800	-\$39*	-\$94**

No USF in Pre Period	Treatment Group				Comparison Group				Net Change
	Obs.	Pre	Post	Change	Obs.	Pre	Post	Change	
All with No USF in Pre Period ²	1,371	\$0	\$145	\$145**	2,017	\$0	\$471	\$471**	-\$326**
\$0 USF in Pre, Positive USF in Post	247	\$0	\$802	\$802**	899	\$0	\$1,057	\$1,057**	-\$254**
No USF in Pre Period USF Received in Post Period									
Electric Baseload Only	60	\$0	\$395	\$395**	183	\$0	\$540	\$540**	-\$145*
Electric Heat Only	27	\$0	\$591	\$591**	78	\$0	\$753	\$753**	-\$161
Gas Only	36	\$0	\$181	\$181**	55	\$0	\$325	\$325**	-\$144*
Both Electric and Gas	124	\$0	\$1,226	\$1,226**	583	\$0	\$1,328	\$1,328**	-\$102

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

¹ Only the jobs which survived both electric and gas attritions are included.

² 1,124 treatment group accounts and 1,118 comparison group accounts did not receive USF credits in analysis periods.

Table IX-12 displays the percent of customers with USF credits in both pre and post periods who had changes in their USF credits from the last pre-treatment credit to the last post-treatment credit. While 32 percent of treatment group customers had their monthly credit increase, 37 percent of comparison group customers had their credit increase, and while 56 percent of the treatment group had their USF credits decline, 51 percent of the comparison group had their monthly credit decline. This indicates a small but positive impact on the program in reducing USF benefits.

Table IX-12
Change in Last Month USF Credit Amount from Pre to Post Period
Customers with USF Credits in Pre and Post Period

	Treatment		Comparison	
	% of Customers	Average \$ Change	% of Customers	Average \$ Change
Observations	2,490		3,978	
Increase	32%	\$39	37%	\$42
Decrease	56%	-\$48	51%	-\$47
No Change	11%	\$0	13%	\$0
Total	100%	-\$14	100%	-\$8

D. Summary

The Affordability Analysis examined the impact of the program on energy bill affordability and bill payment coverage.

- *Electric and Gas Charges:* The analysis showed a net reduction in charges for electric baseload, electric heating, and combination gas and electric bill customers. While electric baseload customers had a \$58 net decline in electric charges, electric heating customers had an \$87 net decline in electric charges, and combination customers had a \$107 net decline in electric and gas charges.
- *Coverage Rates:* Most of the average total coverage rates did not improve for participants, due to the decline in assistance payments. However, electric heating customers were more likely to cover their full bill after receiving services as compared to the comparison group. While the treatment group increased the percent covering the full bill from 58 percent in the pre period to 70 percent in the post period, the comparison group increased their percent covering the full bill from 56 percent in the pre period to only 60 percent in the post period.
- *USF Participation and Credits:* Treatment group customers who had a USF credit in the pre and post periods were more likely to reduce the credit amount and were less likely to increase the credit amount than comparison group customers who had a credit in both periods. While 32 percent of the treatment group had their monthly credit increase compared to 37 percent of the comparison group, 56 percent had their monthly credit decrease, compared to 51 percent of the comparison group.

Overall, the analysis showed small but positive impacts on affordability and a positive impact for ratepayers, as the USF credit declined.

X. Energy Saving Protocols

The NJCP 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.

- Report to the Board on program performance.
- Inputs for planning and cost-effectiveness calculations.
- Calculation of lost margin revenue recovery (as approved by the BPU).
- Determination of eligibility for administrative performance incentives.⁴⁸
- Assessment of the environmental benefits of program implementation.

This section provides recommendations for updating the protocols. The following research and analyses are summarized.

1. Review of the calculations made with the current protocols using data in the NJCP database. The purpose of this review is to ensure that Protocol Savings Estimates are calculated in accordance with the procedures that are currently in place.
2. Recommend changes for existing protocols that can be refined to take additional information into account or to more accurately estimate savings.
3. Recommend additional protocols for measures that do not have protocols or are being considered for addition to the program.
4. Provide engineering estimates for new and recommended changes to protocols.

A. *Review of Energy Saving Protocol Calculations*

Checks of the Energy Saving Protocol calculations found that almost all of the savings data in the NJCP Tracking database matched the specifications provided in the documentation. The following protocols were calculated according to the documentation.

- Baseload
 - CFLs
 - Fixtures
 - Lamps
- Hot Water
 - Average Package of DHW Measures – electric and gas
- Refrigerators and Freezers
- Space Conditioning
 - Air Sealing – electric and gas

⁴⁸To the extent that such incentives are approved by the BPU.

- Furnace/Boiler Replacement - gas
- Duct Sealing and Repair with Central Conditioning - electric
- Duct Sealing and Repair without Central Conditioning – electric and gas
- Insulation Upgrades – electric and gas
- Thermostat Replacement – electric and gas
- Heating and Cooling Equipment Maintenance Repair - electric

The one exception where the calculation did not match the documentation was the furnace and boiler replacements.

B. Recommended Changes for Existing Protocols

We recommend the following changes to existing protocols.

- *Refrigerator Removal* – Refrigerator removal savings are not included in the NJCP Energy Saving Protocols. The refrigerator removal savings should be estimated as the annual metered usage of the refrigerator that was removed. The NJCP program should encourage extra refrigerator removal or two-for-one swaps and take credit for the savings from these removals.⁴⁹
- *Hot Water Measures* – Currently a fixed kWh or ccf savings amount is applied for a “standard package” of hot water measures. We recommend instead that separate savings are applied for each of the following measures.
 - Hot Water Heater Replacement
 - Hot Water Tank Wrap
 - Hot Water Pipe Insulation
 - Aerators
 - Showerheads
- *Shell Measures* – The protocols currently apply the following thresholds for spending on air sealing, duct sealing, insulation, and HVAC before the percentage savings is applied.
 - Air Sealing - \$100
 - Duct Sealing - \$100
 - Insulation - \$100
 - HVAC (electric) - \$100
 - HVAC (gas) - \$2,000

Below we provide an analysis and recommendations regarding these thresholds.

⁴⁹Observers noted missed opportunities for two-for-one swaps in the field.

Air Sealing

Tables X-1A and X-1B display the relationship between spending on air sealing, mean protocol saving estimates, and total job savings from the usage impact analysis. Table X-1A shows that for gas jobs, the protocol savings estimates from air sealing are greater than the home's total usage impact savings for jobs with spending on air sealing of less than \$200, and the protocol savings are almost equal to total gas savings from the usage impact analysis for jobs with spending between \$200 and \$300. Therefore, we recommend a spending threshold of at least \$300 on air sealing for gas heating jobs before the five percent savings is applied to gas space consumption.

Table X-1B displays similar results for air sealing on electric heating jobs. A less detailed analysis is presented here because there are a smaller number of these jobs. However, these results also suggest that a \$300 or \$400 threshold should be applied.

Table X-1A
Air Sealing Spending and Savings – Gas Heating Jobs

Air Sealing Spending	# Obs.	Mean Protocol Gas Savings (ccf)	Mean Total Gas Savings from Usage Impact Analysis (ccf)
≤\$100	3	20	9
\$101-\$200	263	28	18
\$201-\$300	305	31	34
\$301-\$400	287	33	61
\$401-\$500	262	37	34
\$501-\$600	224	38	71
\$600+	1,576	48	86
Total	2,920	41	68

Table X-1B
Air Sealing Spending and Savings – Electric Heating Jobs

Air Sealing Spending	# Obs.	Mean Protocol Electric Savings (kWh)	Mean Total Electric Savings from Usage Impact Analysis (kWh)
≤ \$200	42	321	203
\$201-\$400	57	406	1,479
\$401-\$600	44	336	1,399
\$601-\$800	31	373	821
\$801+	130	443	2,115
Total	304	396	1,538

Duct Sealing

Table X-2 displays the relationship between spending on duct sealing, mean protocol saving estimates, and total job savings from the usage impact analysis for gas heating jobs. The table also shows the percent of these jobs that had air sealing and insulation work and the average dollars spent on these other measures. This analysis is not provided for electric heating jobs, as there were many fewer electric heating jobs in total, and only 56 electric heating jobs with data on this measure.

The table shows that mean protocol gas savings for duct sealing range from 15 ccf for jobs that had \$101 to \$150 in spending on duct sealing to 19 ccf for jobs that had over \$400 spent on duct sealing. It appears that \$100 is a good threshold to use for spending before the percentage savings is applied. However, given that most of these jobs had air sealing and about half had significant insulation work as well, the two percent of gas space consumption savings for duct sealing may be too high of an estimate.

Table X-2
Duct Sealing Spending and Savings – Gas Heating Jobs

Duct Sealing Spending	# Obs.	Mean Protocol Gas Savings (ccf)	Mean Total Gas Savings from Usage Impact Analysis (ccf)	Percent with Air Sealing	Mean Air Sealing Spending	Percent with Insulation	Mean Insulation Spending
≤\$100	0	-	-				
\$101-\$150	213	15	48	90%	\$907	51%	\$1,355
\$151-\$200	163	15	91	88%	\$1,139	55%	\$1,437
\$201-\$250	104	16	58	96%	\$1,011	54%	\$1,774
\$251-\$300	66	14	46	92%	\$1,092	58%	\$1,399
\$301-\$350	42	16	101	100%	\$1,150	55%	\$1,379
\$351-\$400	38	17	66	97%	\$971	63%	\$1,913
\$401+	132	19	125	91%	\$1,318	61%	\$2,185
Total	758	16	75	92%	\$1,075	55%	\$1,626

Insulation

Table X-3 displays the relationship between spending on insulation, mean protocol saving estimates, and total job savings from the usage impact analysis for gas heating jobs. This analysis is not provided for electric heating jobs, as there were many fewer electric heating jobs in total, and only 187 electric heating jobs with data on this measure.

Table X-3 shows that for gas jobs, the protocol savings estimates from insulation are greater than the home's total usage impact savings for all jobs with spending on insulation of less than \$900 with the current protocol of 13 percent of gas space heating consumption.

We propose that a lower percentage savings be applied for this measure. For illustration purposes, we divide the protocol savings by 3, for an approximate percentage of 4.33 percent of gas heating consumption saved. If a lower percentage around this level is applied, we recommend applying this percentage savings to jobs with at least \$300 in spending on insulation.

**Table X-3
Insulation and Savings – Gas Heating Jobs**

Insulation Spending	# Obs.	Mean Protocol Gas Savings (ccf)		Mean Total Gas Savings from Usage Impact Analysis (ccf)
		Current (13%)	Proposed (4.33%)	
≤\$100	0	-		-
\$101-\$200	56	85	28	9
\$201-\$300	78	94	31	59
\$301-\$400	60	88	29	59
\$401-\$500	53	87	29	83
\$501-\$600	59	103	34	56
\$601-\$700	79	97	32	35
\$701-\$800	63	109	36	74
\$801-\$900	66	109	36	58
\$901-\$1,000	70	107	36	127
\$1,001+	947	134	45	134
Total	1,531	120	40	109

HVAC

The current spending thresholds for HVAC measures are as follows and are much higher for gas than for electric to separate installations of new systems from repairs.

- HVAC (electric) - \$100
- HVAC (gas) - \$2,000

We recommend that the separate replacement protocol is used for replacement rather than the repair, as shown in the following section of this report. The NJCP Protocols did not provide savings protocols for gas heating repairs. Following this change, the lower spending threshold for gas HVAC repairs can be implemented. The energy saving factor shown below is five percent, but may need to be adjusted depending on the type and amount of repair work that is performed.

- *Gas Usage Disaggregation* – Under the current protocols, baseload gas usage is assumed to be 300 ccf in most cases. The system should be programmed to disaggregate both gas and electric usage. This information can increase the accuracy of the Protocol Savings estimates. More importantly, the information should be provided to the contractors to

help them diagnose energy usage issues in the home. Once the disaggregation is done by the system, the system can also calculate seasonal spending guidelines for the contractors.

C. *Additional Recommended Protocols*

This section provides recommendations for additional protocols for the measures that do not have protocols or are being considered for addition to the program.

1. **Combined Gas Boiler and Water Heater**

These units have become common to replace both a gas boiler and water heater where there were previously two separate units. However, there are no existing protocol savings formulas for this measure as they were not considered when the protocols were developed. There is not currently a separate measure code for combination units in the NJCP System, so this code should be added if this protocol is adopted. We recommend the formula from Connecticut's 2012 program savings document.⁵⁰

2. **HVAC Repair – Gas Savings**

While the protocols included electric savings for HVAC repairs, they did not include gas savings. The formula recommended is for gas savings from New York's 2010 Technical Resource Manual.⁵¹

3. **Hot Water Heater Replacements**

The gas savings for hot water heater replacements is calculated in the NJ Clean Energy Protocols. Additionally, we recommend the formula for hot water heater replacements from New York's 2013 Technical Resource Manual.^{52,53}

4. **Drain Water Heat Recovery System (GFX) Installation**

The New Jersey Clean Energy Program has assumed a constant savings per installed drain water heat recovery unit in a household with an electric water heater and a percentage savings for drain water heat recovery installation in a home with a gas hot water heater.

- Electric Savings = 1,457 kWh
- Gas Savings = Baseline gas water heater usage * .30

Additionally, we recommend the formula for GFX from the Minnesota Technical Reference Manual from 2014.⁵⁴

⁵⁰Connecticut Light and Power and United Illuminating. "Connecticut Program Savings Document, 8th Edition for 2013 Program Year." October 30, 2012. Pages 143-148, 241-242.

⁵¹New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs. October 15, 2010. Page 68.

⁵²New York Evaluation Advisory Contractor Team and TecMarket Works. "New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs; Residential, Multi-Family, and Commercial/Industrial Measures." October 15, 2010. Page 79.

⁵³New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs (Technical Resource Manual – TRM) Record of Revision." November 26, 2013. Page 12.

5. Heat Pump Water Heaters

The New Jersey Clean Energy Program has assumed a constant savings per installed heat pump water heater.

- Electric Savings = 2,662 kWh

Additionally, we recommend the formula from New York's 2013 Technical Resource Manual.^{55,56}

6. Indirect Hot Water Heater

We recommend the savings formula from Wisconsin's 2013 Focus on Energy Deemed Savings.⁵⁷

7. Solar Hot Water Heater

The New Jersey Clean Energy Program has assumed a constant savings per installed solar hot water heater augmenting electric resistance DHW.

- Electric Savings = 3,100 kWh

We also recommend the calculation from Pennsylvania Public Utilities Commission's 2014 Technical Reference Manual.⁵⁸

8. Water Heater Pipe Insulation

We recommend the formula from Connecticut's 2012 program savings document.⁵⁹

9. Water Heater Tank Wrap

We recommend the formula for electric water heaters from Delaware's 2012 program savings document.⁶⁰ We recommend application of the formula for electric water heaters from Connecticut's 2012 program savings document to gas savings and converting based on the difference in insulation levels for gas water heater wraps.⁶¹

⁵⁴Minnesota Department of Commerce. "State of Minnesota Technical Reference Manual for Energy Conservation Improvement Programs Version 1.0." Effective January 1-December 31, 2014. Pages 212-213.

⁵⁵New York Evaluation Advisory Contractor Team and TecMarket Works. "New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs; Residential, Multi-Family, and Commercial/Industrial Measures." October 15, 2010. Pages 89-91.

⁵⁶"New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs (Technical Resource Manual – TRM) Record of Revision." November 26, 2013. Pages 17-18.

⁵⁷The Cadmus Group, Inc. "Final Report Focus on Energy Evaluated Deemed Savings Changes." *Prepared for the Public Service Commission of Wisconsin*. November 26, 2013. Pages 15-16.

⁵⁸Pennsylvania Public Utility Commission. "Technical Reference Manual, State of Pennsylvania." June 2014. Pages 72-75.

⁵⁹Connecticut Light and Power and United Illuminating. "Connecticut Program Savings Document, 8th Edition for 2013 Program Year." October 30, 2012. Pages 246-249.

⁶⁰Opinion Dynamics Corporation. "Delaware Technical Resource Manual, An Update to the Mid Atlantic TRM." April 30, 2012. Page 79-80.

⁶¹Oak Ridge National Laboratory. "Meeting the Challenge: The Prospect of Achieving 30 Percent Energy Savings Through the Weatherization Assistance Program," May 2002. Page 25.

10. Showerheads

We recommend the formula for electric water heaters from the Ohio 2010 Technical Reference Manual.⁶²

11. Aerators

We recommend the formula from New York's 2010 Technical Resource Manual.⁶³

12. Window Air Conditioners

The New Jersey Clean Energy Program has assumed a constant savings per replaced window air conditioner.

- Electric Savings = 56.4 kWh

We also recommend the formula from Connecticut's 2012 program savings document.⁶⁴

13. LED Lighting Replacement

The savings from LED replacements would follow the same formula as the CFL replacement, with a different assumption for LED wattage. These lights are assumed to use eight watts to replace 60 watts.

14. LED Night Light

The savings from LED replacements would follow the same formula as the CFL replacement, with a different assumption for LED wattage and hours of use. These lights are assumed to be used 24 hours per day and to use a fraction of a watt.

15. Smart Strips

The New Jersey Clean Energy Program has assumed a constant savings per installed smart strip.

- Electric Savings = 102.8 kWh

Additionally, we recommend the formula from Pennsylvania's 2014 Technical Reference Manual.⁶⁵

16. Solar Panels

The NJ Clean Energy Program formerly used a deemed value method for estimating savings from solar panels. This deemed value was approximately 1,200 kWh/year per kW of installed capacity.

⁶²Vermont Energy Investment Corporation. "State of Ohio Energy Efficiency Technical Reference Manual, Including Predetermined Savings Values and Protocols for Determining Energy and Demand Savings." August 6, 2010. Pages 93-96.

⁶³New York Evaluation Advisory Contractor Team and TecMarket Works. "New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs; Residential, Multi-Family, and Commercial/Industrial Measures." October 15, 2010. Pages 94-96.

⁶⁴Connecticut Light and Power and United Illuminating. "Connecticut Program Savings Document, 8th Edition for 2013 Program Year." October 30, 2012. Pages 143-148, 241-242.

⁶⁵Pennsylvania Public Utility Commission. "Technical Reference Manual, State of Pennsylvania." June 2014. Pages 65-71.

While solar photovoltaic (PV) manufacturers provide ratings for direct current (DC) power production, installers and program evaluators rely on modeling software and online calculators to provide production estimates for solar PV technology. A list of models used to estimate energy production is available in the report “Models Used to Assess the Performance of Photovoltaic Systems,” by Geoffrey Klise and Joshua Stein.⁶⁶ These models include National Renewable Energy Laboratory’s (NREL) PVWatts calculator⁶⁷ and RETScreen International’s software suite⁶⁸.

Additionally, we recommend the protocol from the National American Board of Certified Energy Practitioners.⁶⁹

17. Cool Roofs

An EPA article regarding cool roof technology recommends online calculators to estimate savings from this technology. The two calculators mentioned in this article are an Energy Star® Calculator and a calculator developed by the Oak Ridge National Laboratory (ORNL). Inputs for the ORNL calculator include building location, roof insulation, solar reflectance, and thermal emittance.⁷⁰

This technology was mentioned in technical reference manuals for New York, Ohio and Connecticut, but detailed equations for savings estimates were not included. An equation found in New York’s technical reference manual is also recommended.⁷¹

D. Engineering Estimates for New Protocols

This section provides engineering estimates for new protocols when participants have implemented these measures and input data are available. Tables X-4 and X-5 display these results.

Table X-4
Engineering Estimates for Electric Savings

Measure	Observations	NJ Protocol Savings	Other Protocol Savings
Hot Water Heater Replacement*	59	--	1,001 kWh
GFX**	0	1,457 kWh	817 kWh

⁶⁶Klise, Geoffrey T. and Joshua S. Stein. “Models Used to Assess the Performance of Photovoltaic Systems.” December 2009.

⁶⁷National Renewable Energy Laboratory. “PVWatts.” 18 November 2013. Web. 14 February 2014. <http://www.nrel.gov/redec/pvwatts/>.

⁶⁸RETScreen International. “RETScreen International Home.” 23 May 2014. <http://www.etscreen.net/ang/home.php>.

⁶⁹National American Board of Certified Energy Practitioners. “Photovoltaic (PV) Installer Resource Guide.” March 2012. <http://www.nabcep.org/wp-content/uploads/2012/08/NABCEP-PV-Installer-Resource-Guide-August-2012-v.5.3.pdf>

⁷⁰U.S. Environmental Protection Agency. “Reducing Urban Heat Islands: Compendium of Strategies, Cool Roofs.” October 2008. Pages 22-24.

⁷¹New York Evaluation Advisory Contractor Team and TecMarket Works. “New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs; Residential, Multi-Family, and Commercial/Industrial Measures.” October 15, 2010. Pages 127-128.

Measure	Observations	NJ Protocol Savings	Other Protocol Savings
Heat Pump Water Heater***	0	2,662 kWh	2,943 kWh
Solar Water Heater****	0	3,100 kWh	1,748 kWh
Water Heater Pipe Insulation [#]	84	--	73 kWh
Water Heater Tank Wrap	53	--	79 kWh
Showerheads	125	--	167 kWh
Aerators ^{###}	7	--	168 kWh
Window Air Conditioners ^{###}	28	56 kWh	68 kWh
LED Lighting	0	--	47 kWh
LED Night Lights	0	--	59 kWh

*Hot Water Heater Replacement Efficiency fixed at 95%, hot water temperature fixed at 130° F, cold water temperature fixed at 62.5° F. (NYC water main temperature from Table IV-7). GPD fixed at 78 (per table IV-11)

**GFX: GPD calculated as 0.7*(Single Family Value) + 0.3*(Multi Family Value) = 46.6 (per table IV-9)

70% of treatment group was Single Family. Energy Factor of Water Heater fixed at 0.904

***Heat Pump Water Heater: Baseline Water Heater Energy Factor fixed at 0.904.

****Solar Water Heater: hot water temperature fixed at 130° F.

[#]Water Heater Pipe Insulation: averaged electric savings per foot of pipe insulation between values for pipe diameter of 0.5 and 0.75 inches. Feet of insulation installed capped at 6 feet.

^{##}Aerator: temp to heater fixed at 62.5° F (NYC water main temperature from Table IV-7)

^{###}Window AC: EER of old unit fixed at 8 & EER of new unit fixed at 10. Capacity fixed at 10,000 Btu

Table X-5
Engineering Estimates for Gas Savings

Measure	Observations	NJ Protocol Savings	Other Protocol Savings
Combined Gas Boiler and Water Heater*	0	--	25.94 therms
HVAC Repairs	2	--	0.56 therms
Hot Water Heater Replacement**	315	8.55 therms	12.63 therms
GFX***	0	--	31.51 therms
Indirect Water Heater	0	--	32 therms
Water Heater Pipe Insulation [#]	1,032	--	3.88 therms
Water Heater Tank Wrap ^{##}	492	--	7.35 therms
Showerheads	1,036	--	7.39 therms
Aerators ^{###}	19	--	7.42 therms

*Combined Gas Boiler & Water Heater: SF fixed at median for treatment group square footage (1,200). HF fixed at 38,700, based on median home age of 55. Existing efficiency fixed at 80%.

**Hot Water Heater Replacement Efficiency fixed at 65%. Maximum of 65% efficiency imposed for old unit. Hot water temperature fixed at 130° F. Cold water temperature fixed at 62.5° F. (NYC water main temperature from Table IV-7). GPD fixed at 78 (per table IV-11).

***GFX: GPD calculated as 0.7*(Single Family Value) + 0.3*(Multi-Family Value) = 46.6 (per table IV-9). 70% of treatment group was Single Family. Energy Factor of Water Heater fixed at 0.8.

****Water Heater Pipe Insulation: averaged gas savings per foot of pipe insulation between values for pipe diameter of 0.5 and 0.75 inches

[#]Water Heater Pipe Insulation: Feet of insulation installed capped at 6.

##Hot Water Heater Tank Wrap: hot water temperature fixed at 130° F. Cold water temperature fixed at 62.5° F. (NYC water main temperature from Table IV-7)

###Aerator: temp to heater fixed at 62.5° F (NYC water main temperature from Table IV-7).

XI. Findings and Recommendations

This section provides recommendations for the data tracking system, program procedures, training, customer targeting, quality control, and the program improvement process.

A. *Data Tracking System*

The NJCP Tracking System provides important data to manage and implement the program, to evaluate the program, and to determine how the program can be improved. Data that are available to program managers and contractors are much more comprehensive than have been seen in many other programs. Recommendations for improving the system to provide for more efficient program management and operations and to allow for a more comprehensive evaluation are summarized below. However, it is important to weigh the costs of such changes against the potential benefits from providing the additional data.

- Management – Two utilities noted that they utilize the messaging function in the NJCP system. All utilities should use this function as it is important that critical information becomes a permanent part of the customer’s job record.
- Reporting – Many reports specifically designed and programmed for the NJCP program allow the utilities to obtain a list of customers who meet certain criteria. However, only the savings report and the inspection report provide summary information on selected jobs. Additional reports that provide summary statistics could provide useful information to help manage the program. For example, the following types of reports, by contractor and utility over specified time periods, may be useful for utilities and/or contractors.
 - Number of jobs audited, installed, and completed.
 - Percent of jobs deferred or partially completed due to service delivery barriers.
 - Average job cost.
 - Percent of jobs that have certain key measures installed.
 - Average measure cost for key measures installed.

The utilities and contractors should develop a list of reports that would be helpful for program management.

- Operations – The NJCP Tracking System should allow contractors to download data on the jobs that they served. This could allow the contractors to then upload those data into their own systems to avoid double data entry and reduce data errors. It could also allow the contractors to generate their own reports for program management.

Utility and contractor managers both had data needs that point toward a tablet system that synchronizes with the NJCP tracking system. Utility managers noted the desire for more up-to-date information on job status, as that information is currently not available until contractors manually provide updates in the tracking system. Contractors noted the

increased efficiency that would result if they did not need to manually update the data from the audit forms. Such a system could also result in increased data accuracy, as each time the data is entered there is additional possibility for error. While such a capability is beyond the currently planned system enhancements, it should be seriously considered for future upgrades.

- **Data Accuracy** – The type and amount of quality control conducted on data entered into the system varied by contractor. While two contractors had formal data validation checks and balances, the three other contractors did not. In our use of the NJCP Tracking System to request usage, billing, and payment data from the utilities, we found many inaccuracies in the account numbers contained within the tracking system. In several cases, the account numbers did not follow the format that was used by the utility, indicating that quality control review could resolve these issues. We recommend that the utility managers require that the contractors develop and submit a data quality control plan and that the tracking system include, as planned, additional data quality checks.
- **Evaluation Data** – Previous research has documented the potential and actual health and safety benefits that result from energy efficiency services. Some of these impacts can be best documented using data that are collected on the audit paperwork, but that are not currently included in the tracking system data fields. Adding a few fields to the database would allow for analysis of the prevalence of these types of issues and how frequently they are resolved by the program. The NJCP program could then document the health and safety impacts of the program.

We recommend that the following additional fields are added to the tracking system.

- Ambient CO pre and post
- Flue CO pre and post
- Gas Leak detected

Additional data items that would be useful in the evaluation are described below.

- **Inspection Type** – The database allows for assessment of the percent of inspections that were done and the pass rate and problems found. However, the system does not indicate the type of inspection that was done. It would be useful for the evaluation to have a better understanding of the comprehensiveness of inspections that were undertaken.⁷²
- **Measure Coding** – It would be useful to have the system code measures as to whether or not they are included in the seasonal spending allowance. This would allow for a clean comparison of the amount spent on seasonal measures and the seasonal allowance that was calculated.

⁷² This is on the list of future enhancements.

B. Program Procedures

The NJCP Program provides procedures, specifications, and guidelines in two documents.

- The New Jersey Comfort Partners Procedures Manual (Manual)
- The New Jersey Comfort Partners Building Performance Field Guide (Field Guide)

This section provides key recommendations for changes to the NJCP program procedures based upon review of the Manual and Field Guide, as well as findings from the on-site observation of service delivery, the inspections of completed jobs, and the usage impact analysis. Some of these recommendations relate to changes in current procedures but many relate to increased emphasis or clarity on the most important areas for service delivery.

The team of technical reviewers discussed and came to agreement on the most important issues and the order of priority for the issues explained below.

1. Testing – Use testing results to guide work and affirm continuous thermal boundary.

The observation and inspection work found that while extensive testing was conducted, that testing was not used in most cases to inform the process and perform air sealing work in a way to achieve the best results for each individual home.

We recommend the following changes in procedures to align the work with audit and testing results.

- Continuous thermal boundary – In many of the observed houses, contractors failed to identify and create a continuous thermal boundary, resulting in unchanged (or even increased) air leakage. The continuous thermal boundary is especially critical to ensure effective work in crawlspaces and knee wall attics. Contractors should be required to identify the thermal boundary, use testing for verification, and document this assessment in the audit write-up.⁷³
- Air sealing targets – The auditor should be required to develop air sealing targets that are based on the condition of the home and not the Building Tightness Limit (BTL). The blower door should be used by installers as a guide and reduction measurement tool during the air sealing process, and not to just generate numbers. All too often, minimal reductions are achieved, but the installers do not use the information to improve the

⁷³It may be useful to create form sections that force the auditors to identify the existing and proposed thermal boundaries for knee wall attics and crawlspaces. For example, they could be required to state whether the existing thermal boundary for knee wall attics is (1) the rafters, or (2) the knee wall and attic floors. Then they would be required to state where the proposed thermal boundary should be. A similar approach for crawl spaces would require them to state whether that space will be (1) vented and isolated from the house, or (2) unvented and connected to the house.

quality of their work. Proper zone testing could help determine the potential and assess the effectiveness of the air sealing work.⁷⁴

- Prioritize air sealing work in the most important areas of the home – Establish a clear priority for air sealing activities, and require the following steps to ensure this priority is followed.
 - Run blower door.
 - While running the initial blower door test, the contractor should complete zonal testing on the attic(s), garage, and basement/crawlspace to determine the as-found conditions. In addition, the ducts should be tested.
 - Seal at top of envelope.
 - Run blower door to assess air leakage reduction, and continue air sealing if targeted reduction is not achieved or if zone pressure to attic indicates it is still significantly connected to the house. This is important to ensure that minimal moisture migrates to the attic. Zone pressure targets can be established for highly vented, moderately vented, and unvented attics.
 - Retest with blower door.
 - Seal ducts with highest pressure pan readings and returns in CAZ.
 - Repeat duct tests to assure pressure pan readings less than 2 Pa.
 - Seal and retest as needed.
 - Seal connections to attached garages based on zone testing.
 - Repeat zone testing to ensure that garage is isolated from house.
 - Seal basement if CAZ testing indicates that this areas is not near the depressurization limit.
 - Run blower door to assess air leakage reduction.
 - Run blower door to identify other areas of major leakage.
 - Seal these major leakage areas.
 - Retest to ensure effective sealing.
 - In some cases, it may be impossible or impractical to seal all of the leaks, and in these cases it should be documented. This may be due to spending limits or the Building Tightness Limit (BTL).

Consider linking payment to contractors for attic air leakage reduction. Using a performance-based financial incentive could help incent contractors to find the most cost-effective method for achieving results rather than installing measures that do not achieve the targeted results. However, such a payment structure would need to be tied to the

⁷⁴Experts disagree on the most effective procedures. Some state that zone diagnostics should not be a single pressure measurement between the house and zone but should be a zone pressure measurement with reference to the outside, adding a hole in the plane with the greatest pressure differential, followed by another zone pressure measurement with reference to outside. Others believe that doing this test correctly and properly interpreting the results is too challenging to require of the contractors and can result in comfort/debris issues in the houses. Therefore, other experts recommend that it would be better to continue the single pressure tests and give the auditors better training and guidelines on how to use the results.

approach above, with measurements recorded at various steps, to ensure that the leakage reduction resulted from changes in the most important zones.⁷⁵

- Use zonal testing to determine when insulation can be installed and attics left unventilated – Keeping moist air from flowing into attics from the house is the most important factor in minimizing condensation issues. Zonal testing can confirm a complete pressure boundary. Only after that is confirmed should insulation be installed. Some attics are very difficult to ventilate. Proper zonal test results can indicate that it is acceptable to leave a knee wall attic without ventilation.⁷⁶
- Target comfort issues noted by customer - The Audit Form should have an additional entry to capture how the work scope affects comfort issues. These may be not be immediately solvable, but documenting an auditor's good faith effort to address the customer's comfort and linking it to the scope of work performed in the home is reasonable. Additionally, when the auditor really hears the customer and targets the noted comfort issues, the work can lead to better savings results.⁷⁷

2. Duct Sealing - Use pressure testing to guide duct sealing, and focus work on areas with the greatest potential for savings.⁷⁸

The pressure pan testing should be used to ensure that leak sealing focuses on ducts that are outside the thermal barrier. Duct leakage to attics and crawlspaces results in moisture issues and significant heat loss. Duct sealing should focus on leakage in these areas, as identified using the pressure pan test results. Leakage into basements and other conditioned zones should not be a focus unless visual inspection and CAZ testing indicate that there is return

⁷⁵The NJCP Working Group has changed the calculation of contractor administrative costs so that they are now calculated as a percentage of total measure dollars approved in a month.

⁷⁶Ideally, every attic should have ventilation installed. Installing insulation in a ceiling without ventilating the attic above presents a risk of moisture condensation. However, there are cases where it is impractical to install effective low and high ventilation, such as knee wall attics, houses with no eave overhang, and row houses with parapet walls.

In these cases, it may still be desirable to install insulation, but the contractors should have clear guidelines about completing pressure testing to ensure that the attic has been thoroughly air-sealed from the living space. This testing can be difficult because the readings will be difficult to interpret due to the lack of existing ventilation.

One viable approach is to have the program QA contractor complete a study on program houses. They can measure the house-to-attic pressure, note whether the attics are vented and apply a qualitative assessment of the air sealing work. Once adequate data has been collected, a minimum allowable attic-to-house pressure threshold can be established for both vented and unvented attics. Additional detail on the importance of attic ventilation is available at: <http://www.buildingscience.com/documents/digests/bsd-102-understanding-attic-ventilation>

⁷⁷This was not emphasized by the auditors in our observations. In many cases, the auditor asked the customer about comfort issues and wrote the information down on the data collection form, but did not use that information when developing the proposed work scope. It was rare to see insulation, air sealing, or distribution modifications specifically targeted at comfort complaints. It was also rare for an auditor to follow up with the customer at the end of the audit and explain what the program might be able to do to help resolve the comfort issues that were noted by the customer.

⁷⁸This is not what was observed. The auditors and crews routinely took pressure pan readings. It was clear that they knew that they had to collect the data and write it down on the forms. However, in many cases, they didn't use that information to ensure effective work. For example, auditors were observed measuring low pressure pan readings on first floor registers, but still specifying sealing of basement supply ducts in the work scopes. And crews were observed getting (post-duct sealing) pressure pan readings nearly identical to those on the audit report, but not investigating to see why their work had not resulted in an appreciable performance improvement.

leakage creating substantial depressurization of the CAZ. Post testing should be used to confirm the leaks have been sealed.

3. Work Order - Require use of a work order that provides clear direction on work to be done.

The current manual contains a data collection form that is also used as a work order. The program should develop and require the use of a work order that provides clear directions to the installers on what measures are to be installed and where they should be installed. The work order should also include air sealing and duct sealing targets.

4. Health and Safety – Provide clear guidance to contractors on work to be done.

A judgment call is required when determining whether work should proceed if there are existing Health and Safety issues in a home, but the program should provide better guidance in this area and should collect information to provide more complete and consistent tracking of these issues. Homes seem to be deferred too often because of asbestos, mold/moisture, or knob and tube wiring issues that are not serious enough to prevent all work.

- Provide a stand-alone worksheet for health and safety items where the auditor and installers will inspect, and repair or replace any item on that checklist. This could be the Health and Safety Condition and Findings form with moisture, asbestos, and other appropriate sections added.⁷⁹
- Provide a systematic way to address minor health and safety issues, such as removing or encapsulating small amounts of asbestos and treating small regions of mold-like substances.⁸⁰ Perhaps this can be done cost-effectively using existing or other pre-approved contractors with set rates for small work scopes. This process should increase the productivity of contractors by reducing “unable to proceed” conditions and increasing the useful work that can be done.
- Develop a systematic means for tracking issues that are not addressed so that deferred homes are not again treated by the program unless the issue(s) have been resolved.⁸¹

⁷⁹We recommend that NJCP develop a checklist that is part of the project documentation that gets passed along from the auditor to the installers and final inspector. The current health and safety protocols are resulting in confusion throughout the process that results in major measures not being installed, installers having to abort installation visits, and homes deferred in the past reentering the program with the problems still existing. Having a checklist will allow the decision process to be clear and should be monitored to see that everyone has the same view of a home so that missed opportunities and disruptions to measure installations can be reduced. Deferred customers should be flagged, allowing those that resolve the problem back into the program before five years and stopping deferred customers that still have problems from reentering. The current NJCP list of health and safety issues is good. The checklist should show whether an issue exists and if it does the location(s) should be indicated.

⁸⁰ \$500 is available for minor health and safety issues.

⁸¹ We found that the program returned to homes that had previously been identified as having health and safety issues even when those issues had not been resolved.

5. Spending Guidelines – Refine the guidelines to provide better relation to savings opportunities.

Usage-based spending guidelines can be an excellent tool for focusing program resources on retrofits that are likely to provide the most cost-effective energy savings. The guidelines have several advantageous characteristics.

- **Structure:** Ramping up spending at an increasing rate (i.e., more than linear) as usage increases is a good approach.
- **Flexibility:** The guidelines are appropriately flexible by their presentation as an average target and the allowance for spending to exceed the guideline by \$500 on any given home without any advance permission.

However, the guidelines exhibit some features that have potential for improvement.

- **Large Fluctuations at Discrete Points:** The spending guideline as a function of annual usage has large jumps at specific values. While this structure has the advantage of simplicity, a smoother structure may produce better results. We have provided a proposed spending guideline (in a separate Excel document) that approximates the current guideline but provides a smoother structure.
- **For attic air sealing and insulation,** the guidelines have similar sharp cutoffs to the spending guidelines. Consider allowing all attics to be air sealed and insulated to current Code levels (IECC 2009). This is a 10 year plus (potentially lifetime) measure and occupancy can radically change over that time period, so even if the current shell allowance does not support the measures, the next occupant's usage may. This will also provide some assistance to customers who have low usage because they maintain their homes at extreme or uncomfortable temperatures to reduce their utility costs.⁸²
- **Only Usage-Adjusted:** The spending guidelines are currently based on absolute annual usage levels and do not vary by the size of the home. The usage should be weather normalized, and the size of the home should be taken into account.
- **Default Values:** The spending guideline approach instructs contractors to use default values if twelve months of customer usage history is not available.

⁸²The current guidelines only allow attics to be addressed if usage is high enough to create a seasonal spending allowance large enough to cover the cost. Attic air sealing and insulation is a long life measure that has both comfort and energy saving benefits. We are suggesting that the program consider bypassing the spending limits to install this measure even in cases where the current usage is low. We recommend that the NJCP utilities implement a pilot process whereby contractors are not required to request permission from utilities for this measure. The utilities should review the costs of this change after one quarter and determine if the pilot should be continued as a regular program procedure.

The PSE&G method identifies circumstances under which average bill data can be used. We agree that this method will produce more accurate billing history than default values without placing an undue burden on the contractors and should be adopted for use by all utilities and contractors. The method is to substitute for missing data as follows.

- If one month is missing in the four highest months for gas usage, average out the three months with data and use that average number for the month that is missing.
- If one month is missing in the four highest months of electric usage, average out the three months with data and use that average number for the month that is missing.
- If two or more months of heating season data are missing, request to use defaults for gas usage. This is a usage of 1,200 ccf resulting in a seasonal spending guideline of \$4,212.
- If two or more months of cooling season data are missing, request to use defaults for electric usage. This is as follows.
 - All electric with air conditioning: 8,000 kWh = \$3,280 spending guideline
 - All electric without air conditioning: 6,000 kWh = \$2,460 spending guideline
 - Gas heat with air conditioning: 3,200 kWh = \$736 spending guideline
 - Gas heat without air conditioning: 1,200 kWh = \$0 spending guideline
- If there is one month of baseload only usage data, use that data for each of the missing baseload only months. If there are two or more months of baseload only usage data, average those months together and use that average number to populate the missing baseload months.
- End Usage Breakout: the disaggregation of electric and gas bills, and the assignment of usage by end use, i.e. heating, cooling, water heating and baseload, would allow the spending to be more closely aligned with the savings opportunities. For example, determining whether a home with a high gas bill has a high heating load or a high water heating load (or both) would allow the spending to address the appropriate need.

There seemed to be a significant number of homes using electric space heaters and this was rarely directly addressed. Disaggregating electric into both heating and cooling seasonal usage could be helpful if it is used, as the current procedure lumps them together.

6. Manual Organization – Reformat the procedures manual and provide laminated information sheets to use in the field.

Modify the Procedures Manual to make it more useful. The manual has been modified over time and is in need of an overhaul to be useful.

- Simplify and align the Procedures Manual with the data collection form.
- Devise an overall page numbering scheme that includes section and page number and identifies the topic in the footer for reference.
- Organize and relocate worksheets to an Appendix.
- Simplify complex decision making processes to make them useful in the field. Provide a limited number of laminated sheets with critical information for the field work.
- Reference third party standards, where possible, for work and audit scopes to allow for the updating of ‘best practices’.
- Use a consistent format for each section and include key information. This will improve the understanding of the expectations at all steps in the process and increase accountability.

7. Wall Insulation and Kneewalls – Require insulation work to be encapsulated.⁸³

Insulation on vertical surfaces is fully effective only if it is protected from air movement. For fiberglass insulation, it must be enclosed on all six sides (encapsulated). Program contractors often leave the exterior side of insulation exposed to attics.

We recommend that any wall insulation installed by the program be required to be encapsulated. An air barrier of house-wrap, bubble-wrap, or rigid foam on the exterior side of wall insulation would greatly improve the effectiveness of the wall insulation.

Kneewall insulation (exposed to attic space) installed as a program measure must be encapsulated at minimum with house wrap, preferably with rigid insulation, and sealed at the edges. Existing exposed kneewall insulation must be encapsulated as part of any attic air sealing or insulation measure.

This treatment is already included in BPI retrofit standards. The Envelope Professional Standard states “Insulation installed in kneewalls or other exposed vertical areas must be covered on the cold side with an air barrier such as plywood or housewrap to protect the insulation from wind-washing and free convection within the insulation. This measure is not necessary if rigid foam insulation is used.” The 2009 IECC also requires in Table 402.4.2 that “Air-permeable insulation is inside of an air barrier.”

⁸³Insulation on vertical surfaces is fully effective only if it is protected from air movement. For fiberglass insulation, it must be enclosed on all six sides (encapsulated). During the evaluation, we frequently saw program contractors leave the exterior side of insulation exposed to attics. We recommend that any wall insulation installed by the program be required to be encapsulated. If cost-control is a concern, the use of house-wrap is the most affordable option.

This treatment is already included in BPI retrofit standards. The Envelope Professional Standard states “Insulation installed in kneewalls or other exposed vertical areas must be covered on the cold side with an air barrier such as plywood or housewrap to protect the insulation from wind-washing and free convection within the insulation. This measure is not necessary if rigid foam insulation is used.” The 2009 IECC also requires in Table 402.4.2 that “Air-permeable insulation is inside of an air barrier.”

8. Programmable Thermostat – Provide guidance on installation determination and models to install.

Too many setback thermostats are installed in homes where the occupants don't understand and can't learn how to program them. The contractor should be required to assess the following.

- Current Behavior – Is the customer effectively practicing manual setback? If yes, a programmable thermostat will not result in savings.
- Interest – Is the customer interested in a programmable thermostat? Many seniors will not want them.
- Are the residents away from the house during a significant percentage of hours each week? Many seniors will not be.
- Is the heating system appropriate for a programmable thermostat? Heat pumps present challenges, due to the possibility of expensive strip heaters being activated. Electric baseboards and steam heat systems can also be troublesome, due to slow recovery times.

Additionally, the thermostats that we observed during installation were not user-friendly. The program should review the June 2014 Consumer Reports list of recommended models and have contractors submit proposed models for approval.⁸⁴

9. Water Heater Wrap – Provide guidance on assessment and installation.

Tank wraps are installed with high frequency (the program database analysis showed that 28 percent of the treatment group and 13 percent of the comparison group received these wraps). The impact is limited, in part because they are installed on tanks that don't need them⁸⁵ and in part because the materials are not installed properly. Reflective insulation requires that an air gap exist between the insulation and the tank. The program should provide guidelines for when to install and require that the installation be done in this manner or remove this type of insulation from the list of acceptable materials.⁸⁶

⁸⁴This is a product category that is currently undergoing considerable market transformation. The NJCP program should periodically review the available models and adjust the program requirements accordingly.

⁸⁵They don't need them because they were manufactured with adequate insulation or because they are installed in conditioned spaces.

⁸⁶ The NJCP manual already states "Install supplemental insulation jackets on electric water heaters if the heater has a manufacturer's insulation that is less than R-12." The form should require the auditor to document this rating. It doesn't specify what to do with gas models, on which the insulation is less useful because most of the heat loss is up the flue. It also states to "Wrap water heaters whether in heated or non-heated areas." This should be reconsidered.

10. Windows and Doors – Provide clear specification on how to address.

Problems with windows and doors related to operation and energy efficiency are common. We recommend the following program changes to better address these issues.

- Perform selective window and door replacement to address performance issues that have a significant impact on comfort, energy use, and/or health and safety.⁸⁷ A window that has deteriorated to the point that it no longer keeps out wind, rain or insects would be an example that meets all three criteria.
- The window sealing work scope should be guided by blower door tests and explicitly describe where to seal. A window schematic in audit form would achieve this purpose. The current work order description “caulk windows” is insufficient direction to a work crew.
- Evaluate cost-effective alternatives to window replacement, such as interior storm products (Quanta Panel is one such product).
- Standardize door weather-stripping (such as Q-lon) to ensure quality, ease of installation and use, and uniformity. It is evident that Q-lon is often inappropriately or incorrectly installed, minimizing its impact on energy consumption. We have seen it installed where it is not needed, such as on an interior door leading to a conditioned basement. Incorrect installation can result in the misalignment of door locks, difficult operation, or weather-stripping that does not touch the door.
- Complaints about drafty windows can be an opportunity for energy education by the auditors. Windows drafts may be caused by internal air currents rather than leaks. The auditors should use the blower door and smoke to evaluate leakage and demonstrate to the customer whether the window is or is not drafty.

C. Contractor Training

Specific recommendations for training are summarized below.

1. Contractors appear to need review of basic building science, the “house as a system”, why the work is being done, and how the measures work.
2. Using testing results to guide work and affirm continuous thermal boundary. This was a weakness that was seen in the observation work.
3. Use of pressure pan testing to guide duct sealing. Problems with this work were found in the observations and inspections of completed jobs.

⁸⁷ This work is done in the NJCP program but inspectors noted instances in which appropriate work was not done. Some contractors are challenged because they do not have carpenters on staff to perform this work.

4. Writing a clear and comprehensive work order that effectively passes information from the auditor to the installation team. Review of the audit forms and the job documentation found that there was a lack of thorough information transfer between the auditors and the installers. Better communication would take advantage of the testing done during the audit and could result in more effective installation work.
5. Customer education, partnership development, action plan, thermostat education, and lighting selection. The auditors should work with the customers to obtain information to help them more effectively diagnose the home. They should use information from the customers to improve service delivery. They should also work with the customers to develop an action plan that can result in effective usage reduction.
6. Diagnosing and addressing high electric baseload usage. Contractors need more guidance on how to diagnose and treat various causes of high electric baseload usage.
7. BPI Credentials - Currently, the primary credential held by the contractors is BPI Building Analyst Professional (BA). It is required for all of the auditors and installation crew leads.

Given that much of the work done by the contractors is insulation and air sealing, and that the program evaluation found that this work often fell short of expectations, it may be sensible to also require auditors to attain BPI Envelope Professional certification. Envelope Professional addresses moisture and thermal boundary issues in more detail than BA does, requiring a deeper understanding of the appropriate materials and methods for solving problems. (Both BA and EP are required for contractors who participate in the NJ Home Performance with Energy Star program).

In some cases, the contractors encounter unusual issues with heating systems that require knowledge beyond what a BA must know. It would be useful for each contractor to have a certified BPI Heating Professional on staff who could serve as a resource for their other staff members.

D. Customer Targeting

The NJCP program has faced challenges in continuing to find high usage customers to serve. The program should reassess outreach procedures and consider the following options.

1. Health and Safety Issues – Many homes do not receive comprehensive services due to health and safety issues. In rare cases, the customer resolves these issues and the contractor has refused to return to the home. The NJCP program should require that contractors follow-up on these jobs. In other cases, the customer does not have the resources to address the identified issues. The NJCP should investigate whether the program can cost-effectively resolve a greater percentage of these issues.

The NJCP Working Group has already identified a plan to address these issues. Honeywell will now request a price quote for one of their approved vendors when they identify a home with moisture or mold that needs to be remediated prior to NJ CP work being performed. Following approval from the utility, this work will be implemented and then the NJ CP energy conservation work will proceed. The Working Group has also hired an additional contractor that will address health and safety issues. GreenLife Energy Solutions will eliminate moisture problems that are the source of the mold growth and then proceed with energy efficiency measures.

2. USF Participants – Many USF participants refuse to participate in the NJCP program. The utilities should investigate whether they can provide greater encouragement for these customers to participate in an audit and perhaps be convinced to move forward with service delivery.⁸⁸
3. Previously Treated Homes – The NJCP program returns to many homes that were treated more than five years ago but still do not have cost-effective energy-saving opportunities. The NJCP program should consider a more extensive analysis of usage and opportunities prior to returning to these homes.

E. Quality Control

Utilities revised the third party quality control inspection process in August 2012 so that jobs with “non-critical problems” passed inspections rather than failing. The inspection scoring was revised in August 2012, right at the end of the Comparison Period, when the quality control procedures were revised. While 33 percent of the jobs in the Treatment Group failed, 20 percent of jobs in the Comparison Group failed.

The evaluation found (as a result of observations, inspections, and usage impacts) that better work quality should be demanded of the contractors. Based on initial evaluation findings, the Working Group has already refined the quality assurance plan. They hired a new quality assurance contractor that will implement additional quality assurance procedures and contractor training beginning in 2015.

F. Program Improvement Process

We recommend that the NJCP program undertake a quality improvement process with the following steps.

1. Refine – Review and refine the program procedures. Train the contractors on areas of key weakness.

⁸⁸Some vendors have used gift cards as an incentives. Call center personnel have been trained on how to engage these low-income customers.

2. Pilot program changes – Pilot a new process for compensating contractors to achieve results. Pilot new procedures for treating different types of homes, including homes with low usage, high baseload usage, health and safety problems, and homes previously treated by the NJCP program.
3. Conduct quality control – Continue to observe work in the field and conduct inspections of completed jobs. Review all aspects of the work, including audits, documentation of the work scope, and installation. Continue to require contractors to return to any homes that do not meet the NJCP program standards.
4. Hold contractors accountable – Periodically review work at the contractor level. Remove contractors or require remedial training and improved results for continued participation in the NJCP program.
5. Assess results – Conduct analysis of the energy saving results on a regular basis. One evaluation every ten years is not sufficient to ensure that the program is achieving the expected results. If done on a regular basis, utilities could develop procedures to more easily extract usage data and the impact evaluation could be completed at much lower cost. Compare results over time, assess what is working, and refine the program again.