Existing Homes
EM&V Report

Jersey Central Power & Light

PY22: July 1, 2021 – June 30, 2022

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Contents

1 Abstract

On May 23, 2018, NJ Governor signed into law the Clean Energy Act of 2018[1] (CEA). It calls for a significant overhaul of New Jersey's energy systems while growing the economy, building sustainable infrastructure, creating well-paying local jobs, reducing carbon emissions, and improving public health to ensure a cleaner environment for current and future residents. The CEA plays a key role in achieving the State's goal of 100 percent clean energy by 2050 by establishing aggressive energy reduction requirements, among other clean energy strategies. Specifically, the CEA directs the New Jersey Board of Public Utilities (BPU) to require that:

- Each electric public utility to achieve annual reductions of at least 2 percent of the average annual electricity usage in the prior three years within five years of implementation of its electric energy efficiency program.
- Each natural gas public utility to achieve annual reductions in the use of natural gas of at least 0.75 percent of the average annual natural gas usage in the prior three years within five years of implementation of its gas energy efficiency program.

The CEA requires that evaluation, measurement, and verification (EM&V) activities are used to review the electric and gas energy usage reductions and peak demand reductions for the utility's energy efficiency programs. A Statewide Evaluator (SWE), hired by the BPU to coordinate the evaluations for all utilities, provided guidelines for basic and advanced rigor evaluations that apply to new or changed programs and established programs, respectively. The SWE also required at least two full impact and process evaluations during the first triennium, with the CEA required triannual report due at the end of the first triennium. This report conforms to the SWE's basic rigor guidance for evaluations for all Jersey Central Power & Light (JCP&L) programs and aligns with approved EM&V plans from June 2, 2022.

For programs that produce both electricity and gas savings, the lead utility is responsible for evaluating both fuels, and reported savings that are held on behalf of the partner utility will be passed via the Statewide Coordinator system in 2023. Therefore, program gas savings are included in this report.

ADM is under contract with JCP&L to provide EM&V services for its energy efficiency programs. The contract provides for annual EM&V reporting covering a three-year period from July 1, 2021, through June 30, 2024, culminating in a final report that covers the

[1] P.L. 2018, c.17 (N.J.S.A. 48:3-87.8 et seq.)

triennium to be delivered to the BPU. This report summarizes findings from an initial evaluation of the program, covering activities in the first year of implementation (PY22).

Both reported (or *ex-ante*) and verified (or *ex-post*) impacts in this report are constructed with calculation methods prescribed in the NJ Coordinated Measures List (NJ CML or CML)[2]. The NJ CML serves as the technical reference manual (TRM) for the CEA's first triennium. The NJ FY20 Protocols and the FY21 Protocols Addendum are the primary documents referenced in the CML. The CML also prescribes sections from other TRMs for measures that are not yet included in the NJ Protocols.

1.1 PY22 Achievements

The reported and verified annual electric energy, electric demand, and gas energy impacts[3] for the program are shown in Table 1-1. The negative gas energy savings reflect heating interactive effects associated with lighting upgrades within conditioned spaces.

Table 1-1: Existing Homes PY22 Gross Energy and Demand Impacts

Impact	Reported	Verified
Electric Energy (kWh)	727,501	739,159
Demand (kW)	49.88	49.64
Gas Energy (Therms)	(2,462)	(2,575)

1.2 PY22 Evaluation Results

1.2.1 Gross Verified Impacts and Realization Rates

The Existing Homes Program contains three program components: Home Performance with Energy Star (HPwES, a direct-installation program that focuses on capital cost projects), Quick Home Energy Checkup (QHEC, a direct-installation program that focuses on low-cost and readily-installed measures), and Moderate Income Weatherization (MIW, an income-restricted weatherization program). These program components are described in Section 2.2 of this report. Gross impact evaluation results by program component are reported in Table 1-2 and Table 1-3.

[2] Per BPU DOCKET NOS. QO19010040. Agenda Date: 10/12/2022. Agenda Item: 8D. Page 7: "Calculations used by the utilities to determine program savings counted toward compliance are cataloged in the Joint Utility Coordinated Measures List, which references the FY20 Protocols, the FY21 Protocols Addendum, and TRMs from other states when no applicable New Jersey specific measure calculation was available."

[3] Evaluated therms and MMBtus include heating penalties where included in applicable protocols.

Table 1-2: Existing Homes PY22 Gross Annual Retail kWh Savings and kW Demand Reduction

Program	Ex-ante kWh	Ex-post kWh	RR kWh	Ex-ante kW	Ex-post kW	RR kW
HPwES	112,116	112,116	100%	-	-	-
QHEC	564,809	576,541	102%	45.97	45.74	100%
MIW	50,576	50,502	100%	3.91	3.90	100%
Total	**727,501**	**739,159**	**102%**	**49.88**	**49.64**	**100%**

Table 1-3: Existing Homes PY22 Gross Annual Retail Therms and MMBtu Savings

Program	Ex-ante Therms	Ex-post Therms[3]	Ex-ante MMBtu	Ex-post MMBtu	RR
HPwES	3,688.36	3,688.36	368.84	368.84	100%
QHEC	(5,495.96)	(5,611.51)	(549.60)	(561.15)	102%
MIW	(654.14)	(651.66)	(65.41)	(65.17)	100%
Total	**(2,461.74)**	**(2,574.81)**	**(246.17)**	**(257.48)**	**105%**

1.2.2 Summary of Key Parameters Collected by the Evaluation Effort

The gross impact evaluation effort also collected and analyzed important data related to measure installation rates or in-service rates (ISRs). This parameters can inform the ongoing updates to the New Jersey Technical Reference Manual (TRM), formerly known as the Protocols to Measure Resource Savings (New Jersey Protocols).
Table 1-4 shows PY22 evaluation findings on measure installation rates. The first two columns of the table list the program component and measure. The third column denotes the measured parameter, which is the ISR. It takes on the value 1 if the measure is verified to be installed, and 0 otherwise. The next two columns show the mean and standard deviation for each parameter, while the final two columns show the number of sample points and relative precision at the 90 percent confidence limit for the parameter. ADM has separately provided tables similar to Table 1-4 to the New Jersey Statewide Evaluator (SWE) to support the ongoing TRM update process. Note that the Moderate Income Weatherization (MIW) and Home Performance with Energy Star (HPwES) program components had a combined 136 participants in PY22. Due to the low participation rates, ADM did not conduct any data gathering to calculate in-service rates for those programs but noted that the ISRs for those types of programs tend to be at or near 100%. The PY23 impact evaluation focused on ensuring that measures are

correctly characterized in the tracking system and that their impacts are correctly calculated and tracked.

Table 1-4: Summary of Installation or Verification Rates

Program Component	Measure	Parameter	Mean	Standard Deviation	N Sample Points	RP at 90% CL
QHEC	LEDs	ISR	0.97	0.18	45	0.05
QHEC	Aerators	ISR	1.00	0.00	7	0.00
QHEC	Showerheads	ISR	1.00	0.00	4	0.00
QHEC	Advanced Power Strips	ISR	1.00	0.00	29	0.00
QHEC	Domestic Hot Water Setback	ISR	1.00	0.00	11	0.00

1.3 Evaluation Recommendations

ADM provides the recommendations summarized in Table 1-5 and Table 1-6 for continued improvement of tracking and reporting for the Existing Homes Program. The recommendations address opportunities to improve tracking for existing measures and summarize corrections to the NJ FY2020 protocols that, as of this writing, have been incorporated into the NJ CML.

1.3.1 Tracking and Reporting Updates

Table 1-5: Summary of Tracking and Reporting Recommendations

Recommendation	Status
For pipe insulation measure: Retain data related to linear length, insulation thickness, and nominal pipe diameter in preparation for M&V data requests. Tracking data for PY22 did not include these values that are required to calculate savings, as indicated in the NJ Protocols.	In process: communicated to implementer
For lighting measures: Retain data related to efficient bulb wattages . The data do not need to be present in the tracking and reporting system if data request responses will contain this information.	In process: communicated to implementer
For low-flow showerheads: Retain data related to efficient flow rates in gallons per minute. The data do not need to be present in the tracking and reporting system if data request responses contain this information. .	In process: communicated to implementer
Use the following effective useful life values (EUL) from NJ Protocols: gas power vented water heater, 11 years; gas furnace, 20 years; insulation, 30 years; air sealing, 15 years; duct sealing, 18 years. EULs other than these were used for lifetime saving in PY22.	In process: communicated to implementer
For domestic water heater setback measure: retain data related to water heater capacity or use the default value (50 gallons) provided in the NJ CML	In process: communicated to implementer

1.4 TRM Updates

Recommendations for TRM updates and evaluation data collected to support the effort are included in the Cross Cutting Program Results document submitted in conjunction with this report. All of the recommendations listed below have been accepted and incorporated into the CML for use in the first triennium.

Table 1-6: Summary of TRM Update Recommendations

Measure	Recommendation
Pipe insulation	Correct the calculation in the FY2020 Protocols to include the constant (1,000,000 BTU per MMBTU) in the denominator of the formula.
Aerators	Correct the aerator savings equation in the NJ FY2020 Protocols that uses hours instead of minutes as unit of time for hours of use.
HPwES	Add kW peak demand reduction calculation to HPwES savings modeling application Snugg Pro.

1.5 Process Evaluation Activity Summary

To date, process evaluation activities have served two objectives. The first objective is to ensure that program tracking and reporting systems and processes are established, accurate, and contain sufficient information to support upcoming enhanced-rigor evaluations. The second objective is to gather information and develop sufficient context to conduct deeper process evaluation activities in PY23. The first objective was accomplished through active participation in the launch of the data tracking and reporting systems. The ADM team reviewed all measure attributes that should be tracked and recorded and helped in the implementation of quality assurance rules related to key data fields for each measure. JCP&L has developed a process which applies logical and quantitative quality assurance rules to incoming program tracking data. Any outliers are flagged for further review and investigated to resolution by JCP&L's evaluation and implementation staff.

To build context for upcoming process evaluations, the ADM team has reviewed documentation such as policy documents drafted by BPU staff, evaluation guidance documents drafted by the SWE, and JCP&L's Energy Efficiency and Conservation plan. The ADM team has also conducted initial interviews with JCP&L's Energy Efficiency program managers and overall implementation managers to identity researchable issues for process evaluation.

2 Executive Summary

2.1 Introduction

The CEA requires that EM&V activities are used to review the electric and gas energy usage reductions and peak demand reductions for the utility's energy efficiency programs. A SWE, hired by the BPU to coordinate the evaluations for all utilities, provided guidelines for basic and advanced rigor evaluations that apply to new or changed programs and established programs, respectively. The SWE also required at least two full impact and process evaluations during the first triennium, with the CEA required triannual report due at the end of the first triennium. This report conforms to the SWE's basic rigor guidance for evaluations for all JCP&L programs and aligns with approved EM&V Plans from June 2, 2022.

For programs that produce both electricity and gas savings, the lead utility is responsible for evaluating both fuels, and reported savings that are held on behalf of the partner utility will be passed via the Statewide Coordinator system in 2023. Therefore, program gas savings are included in this report.

ADM is under contract with JCP&L to provide EM&V services for its energy efficiency programs. The contract provides for annual EM&V reporting covering a three-year period from July 1, 2021, through June 30, 2024, culminating in a final report that covers the triennium to be delivered to the BPU. This report summarizes findings from an initial evaluation of the program, covering activities in the first year of implementation (PY22).

2.2 Program Description

The Existing Homes Program is comprised of three program components which incentivize customers to schedule a home energy audit that may results in the direct installation of low-cost energy savings measures and a plan for a more comprehensive energy efficiency project work plan for the home including financial incentives to install selected energy efficient products. The Existing Homes Program is administered by CLEAResult and includes the following three components:

Home Performance with ENERGY STAR (HPwES). Participants in this program component received an on-site audit that provides incentives for comprehensive, whole-home retrofits. HPwES offered customers an initial energy audit followed by a project work plan that is eligible for a rebate based on the percentage of energy savings achieved in the home.

Quick Home Energy Check-up (QHEC). The QHEC program component offers on-site home energy audits provided by a qualified energy auditor participating contractor, a company employee, or a third-party implementation contractor. Energy auditors can offer and install up to $200 worth of select measures during the audit including energy efficient light bulbs, aerators, showerheads, smart power strips, domestic hot water setbacks, and pipe insulation. Savings for these measures were determined using sources identified in the NJ CML.

In addition to completing the audit and installing select measures, the program's contracted energy advisors provided customers with a written report detailing opportunities for energy-efficiency improvements and information to educate customers about other programs available to them.

Moderate-Income Weatherization (MIW). The MIW Program provides income-eligible customers with a home energy audit and low-cost direct-install measures. Depending on audit findings, the auditor may also offer more comprehensive energy efficiency measures such as weatherization, insulation, heating, ventilation and air conditioning (HVAC), and refrigerator replacement. The program may also cover up to $1,500 of the cost of addressing health and safety issues found in the customer's home. The program covers up to $6,000 of work and has more lenient cost-effectiveness goals than other programs.

Customers with incomes of up to 400% of the Federal Poverty Income Guidelines are eligible for the program. The utility uses census tract data to identify and pre-qualify customers. To prove eligibility, customers must live in a qualified census tract, show participation in New Jersey Shares, or verify income eligibility.

During PY22, participants only received direct install measures; no higher-cost measures or health and safety measures were installed through the program.

2.3 Evaluation Summary

Both reported and verified impacts in this report are constructed with calculation methods prescribed in the NJ CML[4]. The NJ CML serves as the TRM for the CEA's first triennium. The NJ FY20 Protocols and the FY21 Protocols Addendum are the primary documents referenced in the CML. The CML also prescribes sections from other TRMs for measures that are not yet included in the NJ Protocols.

[4] Per BPU DOCKET NOS. QO19010040. Agenda Date: 10/12/2022. Agenda Item: 8D. Page 7: "Calculations used by the utilities to determine program savings counted toward compliance are cataloged in the Joint Utility Coordinated Measures List, which references the FY20 Protocols, the FY21 Protocols Addendum, and TRMs from other states when no applicable New Jersey specific measure calculation was available."

Gross impact evaluations for the three program components generally followed the same logic and process:

- Review program tracking data and identify sampling requirements
- Compute gross impacts in accordance with agreed-upon TRM protocols as specified in the NJ CML
- Calculate gross realization rates as the ratios of reported (ex-ante) and verified (ex-post) impacts for sampled projects (QHEC) or for the census of program component projects (HPwES and MIW)

While gross realization rates are an important evaluation outcome, other key evaluation findings include specific recommendations for implementation, tracking, and reporting in subsequent program years. This initial evaluation yielded the following important information:

- Specific recommendations for additions or enhancements of TRM protocols (whether in the NJ Protocols or other regional TRMs cited by the NJ CML)
- Measured values for key parameters such as measure installation rates, installation locations, and fuel shares for space and water heating

More detailed descriptions of each program component evaluation effort and findings are provided in Section 3, with detailed results provided in subsequent appendices.

This report does not include results from a full round of process evaluations. Process activities to date have been of two kinds. The first kind is *embedded evaluation* in the sense that the evaluation team works closely and concurrently with the implementation and tracking and reporting teams to ensure that important data are collected and saved for each program. The outcome of this effort is that the tracking and reporting process is properly established and maintained. The second kind of process evaluation activity conducted thus far is to gather data to provide context for upcoming process evaluations to be completed in PY23.

2.3.1 Evaluation Methods

HPwES

ADM reviewed Snugg Pro output files for a census of the 33 HPwES projects completed during PY22. Gross savings for HPwES were calculated using Snugg Pro home energy modeling software. Snugg Pro has been an energy software standard in NJ since 2019 and continues to the agreed upon software for use by all the NJ utilities as outlined in the NJ CML. ADM reviewed implementors' reports that indicated which measures were installed, confirmed that the reports matched the inputs for Snugg Pro project files, and verified site-level characteristics included as variables in project models. ADM did not

conduct on-site inspections or billing analysis for PY22 because the small program size did not warrant such enhanced-rigor activities.

QHEC

Savings for QHEC measures were calculated using sources identified in the NJ CML using values included in the tracking data.

MIW

ADM completed a desk audit for a census of line-items in the tracking data for all 103 projects completed during PY22. ADM used the Tracking and Reporting database to determine quantities of measures installed in participants' home. Program savings were calculated according to sources identified in the NJ CML with additional supplemental inputs.

Process Evaluation

For PY22, process evaluation activities consisted of in-depth interviews with JCP&L program staff. Expanded process evaluation activities for PY23 will also include customer surveys and interviews with implementation staff.

2.4 Evaluation Results

Gross impact evaluation results by program component are reported in Table 2-1 and Table 2-2.

Table 2-1: Existing Homes PY22 Gross Annual Retail kWh Savings and kW Demand Reduction

Program	Ex-ante kWh	Ex-post kWh	RR kWh	Ex-ante kW	Ex-post kW	RR kW
HPwES	112,116	112,116	100%	-	-	-
QHEC	564,809	576,541	102%	45.97	45.74	100%
MIW	50,576	50,502	100%	3.91	3.90	100%
Total	**727,501**	**739,159**	**102%**	**49.88**	**49.64**	**100%**

Table 2-2: Existing Homes PY22 Gross Annual Retail Therms and MMBtu Savings

Program	Ex-ante Therms	Ex-post Therms[5]	Ex-ante MMBtu	Ex-post MMBtu	RR

[5] Evaluated therms and MMBtus include heating penalties where included in applicable protocols.

HPwES	3,688.36	3,688.36	368.84	368.84	100%
QHEC	(5,495.96)	(5,611.51)	(549.60)	(561.15)	102%
MIW	(654.14)	(651.66)	(65.41)	(65.17)	100%
Total	**(2,461.74)**	**(2,574.81)**	**(246.17)**	**(257.48)**	**105%**

2.5 Recommendations and Next Steps

The PY22 evaluation found that tracking and reporting systems generally track program impacts with fidelity and detail. Impacts are calculated with the proper protocols defined in the NJ CML, and gas penalties from lighting measures are tracked and utilized in cost-effectiveness calculations. There are several opportunities to enhance the tracking data for this program by adding measure attributes or adjusting parameter values, as discussed below.

2.5.1 Tracking and Reporting Updates

Table 2-3: Summary of Tracking and Reporting Recommendations

Recommendation	Status
For pipe insulation measure: Retain data related to linear length, insulation thickness, and nominal pipe diameter in preparation for M&V data requests. Tracking data for PY22 did not include these values that are required to calculate savings, as indicated in the NJ Protocols.	In process: communicated to implementer
For lighting measures: Retain data related to efficient bulb wattages . The data do not need to be present in the tracking and reporting system if data request responses will contain this information.	In process: communicated to implementer
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Use the following effective useful life values (EUL) from NJ Protocols: gas power vented water heater, 11 years; gas furnace, 20 years; insulation, 30 years; air sealing, 15 years; duct sealing, 18 years. EULs other than these were used for lifetime saving in PY22.	In process: communicated to implementer
For domestic water heater setback measure: retain data related to water heater capacity or use the default value (50 gallons) provided in the NJ CML	In process: communicated to implementer

2.5.2 TRM Updates

Recommendations for TRM updates and evaluation data collected to support the effort are included in the Cross Cutting Program Results document submitted in conjunction

with this report. Since the initial draft of this report, many draft TRM sections have been made available to utilities and their evaluators for review. ADM can confirm that the first two issues have been addressed in the draft TRM for the next triennium. The Electric Distribution Companies (EDCs) have agreed to a single, uniform statewide coincident factor to apply to kWh to obtain kW in Snugg Pro, perhaps that can serve as a starting point for the second triennium TRM update. All of the recommendations listed below have been accepted and incorporated into the CML for use in the first triennium, and ex-post results herein reflect these recommendations.

Table 2-4: Summary of TRM Update Recommendations

Measure	Recommendation
Pipe insulation	Correct the calculation in the FY2020 Protocols to include the constant (1,000,000 BTU per MMBTU) in the denominator of the formula.
Aerators	Correct the aerator savings equation in the NJ FY2020 Protocols that uses hours instead of minutes as unit of time for hours of use.
HPwES	Add kW peak demand reduction calculation to HPwES savings modeling application Snugg Pro.

2.5.3 Next Steps

The ADM team is carrying out a second round of basic-rigor evaluations for the program. In PY23, the ADM team will also conduct process evaluations and enhanced-rigor studies for all Existing Homes program components that are expected to continue into PY24.

3 Evaluation Methods

This section discusses gross impact evaluation approaches and process evaluation activities for each program component. The ADM team relied primarily on participant surveys for measure verification and determination of key parameter values. Project documents such as invoices, Air Conditioning, Heating, and Refrigeration Institute (AHRI) certificates, and references to the ENERGY STAR database also served to determine and verify key attributes of the efficient equipment rebated or distributed by the program.

Both reported (or *ex-ante*) and verified (or *ex-post*) impacts in this report are constructed with calculation methods prescribed in the NJ CML[6]. The NJ CML serves as the TRM for the CEA's first triennium. The NJ FY20 Protocols and the FY21 Protocols Addendum are the primary documents referenced in the CML. The CML also prescribes sections from other TRMs for measures that are not yet included in the NJ Protocols.

3.1 Description of the Existing Homes Program

The Existing Homes Program includes the following three program components:

- **Home Performance with ENERGY STAR**. Participants in this program component received an on-site audit that provides incentives for comprehensive, whole-home retrofits. HPwES offers customers an initial energy audit followed by project work that is eligible for a rebate based on the percentage of energy savings achieved in the home.
- **Quick Home Energy Check-up.** The QHEC program component offers on-site home energy audits provided by a qualified energy auditor participating contractor, a company employee, or a third-party implementation contractor. Energy auditors can offer and install up to $200 worth of select measures during the audit including energy efficient light bulbs, aerators, showerheads, smart power strips, domestic hot water setbacks, and pipe insulation. Savings for these measures were determined using sources identified in the NJ CML.
- In addition to completing the audit and installing select measures, the program contractor energy advisors provide customers with a written report detailing opportunities for energy-efficiency improvements and information to educate customers about other programs available to them.

[6] Per BPU DOCKET NOS. QO19010040. Agenda Date: 10/12/2022. Agenda Item: 8D. Page 7: "Calculations used by the utilities to determine program savings counted toward compliance are cataloged in the Joint Utility Coordinated Measures List, which references the FY20 Protocols, the FY21 Protocols Addendum, and TRMs from other states when no applicable New Jersey specific measure calculation was available."

- **Moderate-Income Weatherization** The MIW Program provides income-eligible customers with a home energy audit and low-cost direct-install measures. Depending on audit findings, the auditor may also offer more comprehensive energy efficiency measures such as weatherization, insulation, HVAC, and refrigerator replacement. The program may also cover up to $1,500 of the cost of addressing health and safety issues found in the customer's home. The program covers up to $6,000 of work and has more lenient cost-effectiveness goals than other programs.
- Customers with incomes of up to 400% of the Federal Poverty Income Guidelines are eligible for the program. The utility uses census tract data to identify and pre-qualify customers. To prove eligibility, customers must live in a qualified census tract, show participation in New Jersey Shares, or verify income eligibility.
- During PY22, participants only received direct install measures; no higher-cost measures or health and safety measures were installed through the program.

All program components are administered by CLEAResult.

Each program component is addressed in detail in the following sections.

3.2 Gross and Net Savings

Gross savings reflect the change in energy consumption directly resulting from program-related actions taken by participants, regardless of why they participated. Net savings refer to savings that are attributed to the program efforts after accounting for free ridership (the portion of gross energy impacts that would have occurred even in the absence of the program) and spillover (additional program-induced energy savings, generated by both participants and non-participants, for which the program didn't provide any specific financial incentive). Net savings are calculated by multiplying gross savings by a net-to-gross (NTG) ratio. NTG equals one minus free ridership plus spillover.

The New Jersey Board of Public Utilities has stipulated that NTG is set to 1.0[7] for the first triennium of the program. The data to calculate a NTG to be used in the second triennium will be collected using an approved battery of free ridership and spillover questions in customer surveys that are run during the first triennium.

3.3 Home Performance with ENERGY STAR

[7] BPU Docket Nos. QO1901040, QO19060748 & QO17091004 pg. 31.

ADM evaluated the Home Performance with ENERGY STAR program component using program tracking data and Snugg Pro output files as primary data sources.

3.3.1 Sampling

ADM reviewed Snugg Pro output files for a census of the 33 HPwES projects completed during PY22.

3.3.2 Gross Verified Savings Calculation

Gross savings for HPwES were calculated using Snugg Pro home energy modeling software by the implementer CLEAResult. Snugg Pro has been an energy software standard in NJ since 2019 and continues to the agreed upon software for use by all the NJ utilities as outlined in the NJ CML. ADM reviewed reports written by the implementors that detailed site-level characteristics as well as information on what measures were implemented.

The Snugg Pro software serves both as a data entry tool for home energy auditors, and a building simulation engine. The software also generates reports which summarize energy savings by fuel type, cooling and heating loads (both baseline and post-retrofit), and an itemized measure list with associated costs. For each project completed in PY22, ADM accessed and reviewed the Snugg Pro model and the associated site report. Due to the low participation level in PY22, ADM did not conduct on-site inspections for the 33 participants, but rather reviewed the Snugg Pro model inputs and outputs and corroborated them with information such as assessor's records. ADM also compared program tracking data to Snugg Pro outputs and found that impacts were accurately reported in the tracking and reporting system. The auditors entered baseline annual electric and gas energy usages into the Snugg Pro tool. ADM compared simulated electric and gas energy usages to billed amounts and found good correspondence overall, as shown in Figure 3-1 and Figure 3-2.

Figure 3-1 – Simulated vs. billed electric usage for participating households in HPwES

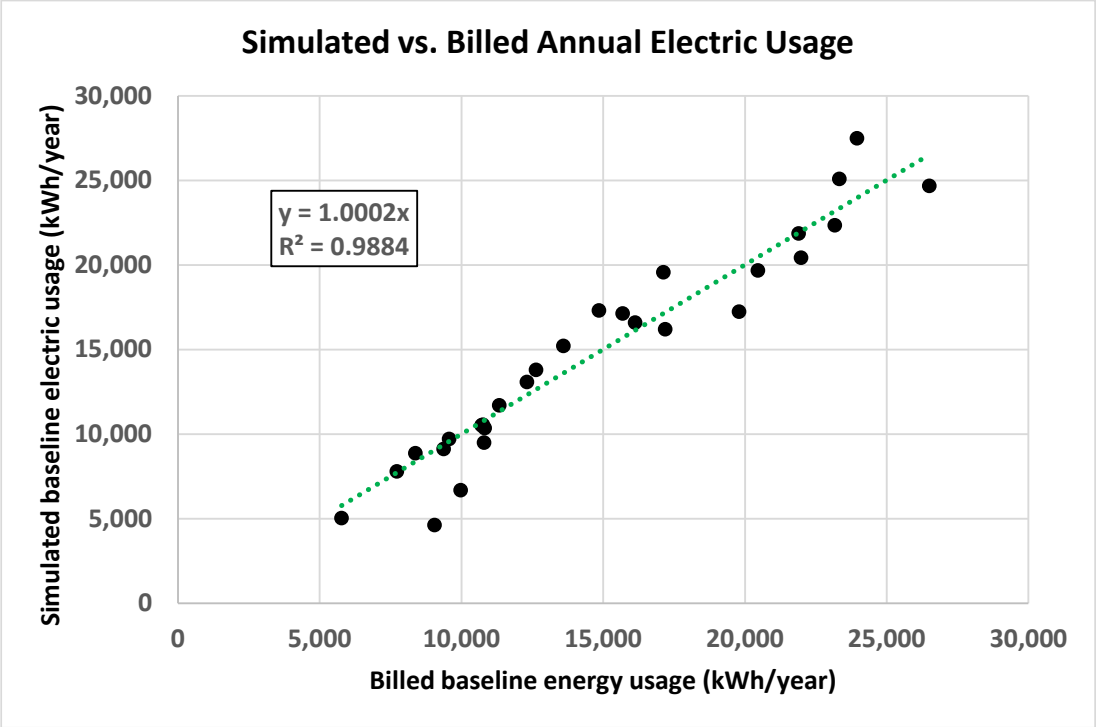
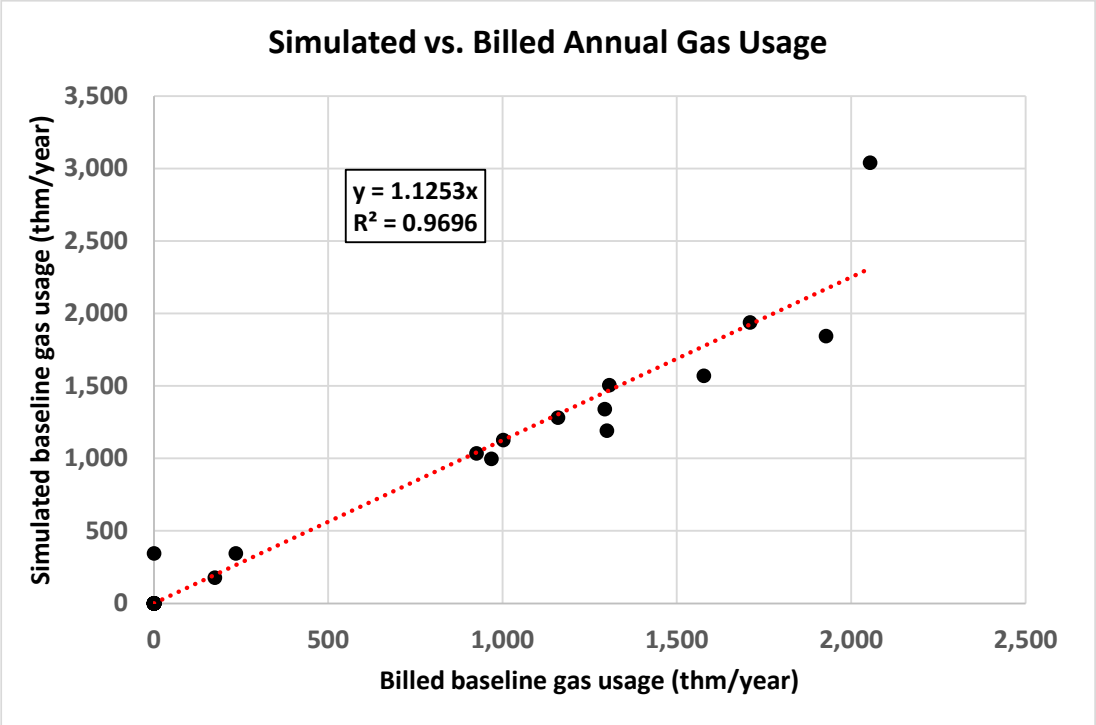


Figure 3-2 – Simulated vs. billed electric usage for participating households in HPwES



3.3.3 Process Evaluation Activities

For PY22, the process evaluation consisted of an in-depth interview with JCP&L's program manager and the overall residential implementation manager. Expanded process evaluation activities for PY23 will also include customer surveys and interviews with implementation staff, trade allies, and retailers. Appendix D includes PY23 process evaluation research questions. As part of initial process evaluation activities, the ADM team confirmed that the program's established business practices and tracking and reporting systems will allow for in-depth impact and process evaluation. In addition to details necessary for impact evaluation, the implementation team retains records of the project pipeline, including data necessary to identify "near participants", or program leads that did not materialize into completed projects.

3.4 Quick Home Energy Check-up

ADM evaluated the Quick Home Energy Check-up program component using program tracking data and verification reports from the implementer as primary data sources. Verification reports document the findings of on-site inspections completed by the implementer after the contractor completed the work on the project. Verification reports include quantities of confirmed installed measures.

3.4.1 Sampling and Surveying

The program provided energy audits for 581 homes during PY22. The program implementer completed on-site inspections on a randomly selected 10 percent (59) of the projects. ADM reviewed all 59 inspection reports and ultimately used 58 of them, discarding one inspection report that could not be mapped to a project in the tracking data. Table 3-1 below shows the relative precision on a measure-by-measure basis.

Table 3-1: Sampling summary for the QHEC program component.

Measure	Number of sites with measure	Number of sampled sites with measure	ISR	Ex-Ante kWh	Ex-Post kWh	Relative Precision
LEDs	442	45	97%	454,327	436,171	5%
Aerators	37	7	100%	160	9,617	0%
Showerheads	56	4	100%	4,673	19,979	0%
Advanced Power Strips	207	29	100%	104,968	104,968	0%
Pipe Insulation	1	0	0%	-	-	100%
Domestic Hot Water Setback	98	11	100%	680	734	0%
Total	**841**	**96**		**564,809**	**571,468**	**3.5%**

The ISRs were found to be 100% for all non-lighting measures, which led to the low relative precision shown in Table 3-1. The counts in the third column include all homes

that were inspected with at least one instance of the stated measure. Since most homes had multiple measures, the total count exceeds the count of inspected homes.

3.4.2 Gross Verified Savings Calculation

Savings for QHEC measures were calculated using the sources identified in the NJ CML using values included in the tracking data all except for the domestic hot water (DHW) Setback measure as noted in Table 3-2 below. Table 3-2 includes the TRM version used to calculate savings for each measure. The CML defaults to NJ TRM; when the NJ TRM does not include a specific program measure, the CML identifies the agreed upon TRM reference used for it.

Table 3-2: QHEC TRM Summary[8]

Measure	TRM
LEDs	NJ FY2020 algorithm (Pg. 64) + NY Baselines for those not in the NJ Protocols table. NJ Addendum for comparison.
Aerators	NJ FY2020 (Pg. 182) w/ correction from NJ FY2021 (Pg. 84)
Showerheads	NJ FY2021 (Pg. 32)
Smart Power Strips	NJ FY2020 (Pg. 53)
Pipe Insulation	NJ FY2020 (Pg. 186)
DHW Setback	Mid-Atlantic TRM V10 (Pg. 160)

ADM calculated unit savings for installed measures using variable values from the tracking data, when available, and otherwise from the TRM cited above. ISRs were calculated using verification reports.

The impact calculations have several types of variable input parameters:

- The measure installation rate
- Equipment-specific parameters such as lumen outputs, flow rates, and watts
- Baseline equipment efficiencies
- Water heater fuel type for certain measures such as shower heads and aerators
- Faucet location for aerators (kitchen vs. bathroom)

[8] Source: NJ CML.

- For smart power strips, type of equipment plugged into strip (office, entertainment, etc.)

3.4.3 Process Evaluation Activities

For PY22, the process evaluation consisted of an in-depth interview with JCP&L's program manager and the overall residential implementation manager. Expanded process evaluation activities for PY23 will also include customer surveys and interviews with implementation staff, trade allies, and retailers. Appendix D includes PY23 process evaluation research questions.

3.5 Moderate-Income Weatherization Program

ADM evaluated the Moderate-Income Weatherization program component using program tracking data as the primary data source.

3.5.1 Sampling and Surveying

ADM reviewed a census of tracking data for all 103 projects completed during PY22.

3.5.2 Gross Verified Savings Calculation

ADM calculated gross verified energy impacts (also referred to as ex-post savings throughout the report) for measures in this program component using savings algorithms from the NJ Protocols as listed in Table 3-3. The CML defaults to NJ TRM; when the NJ TRM does not include a specific program measure, the CML identifies the agreed upon TRM reference used for it.

Table 3-3: MIW TRM and Supplemental Sources Summary[9]

Measure	Source
LED lightbulbs	NJ FY2020 Protocols (pg.64) + NY Baselines for those not in the NJ Protocols table (See "Lighting" tab for additional baseline information). If in situ wattage is available, it should be used in lieu of baselines.
Faucet aerators	NJ FY2020 Protocols (pg. 182) See FY2021 NJ Protocols Pg. 84 for correction in the formula error in FY2021 NJ Protocols
Low Flow Showerheads	FY2021 NJ Protocols Residential Low Flow Showerhead (pg. 32)
Smart Power Strips	NJ FY2020 Protocol (pg. 53)

[9] Source: NJ CML.

Domestic Hot Water Setback	Mid-Atlantic TRM V10 (Pg. 160)

ADM calculated unit savings for installed measures using variable value from the tracking data, when available, and otherwise from the TRM cited above. ISRs were calculated using verification reports.

The impact calculations have several types of variable input parameters:

- Equipment-specific parameters such as lumen outputs, flow rates, and watts
- Baseline equipment efficiencies
- Water heater fuel type for shower heads and aerators
- Faucet location for aerators (kitchen vs. bathroom)
- For smart power strips, type of equipment plugged into strip (office, entertainment, etc.)

3.5.3 Process Evaluation Activities

For PY22, the process evaluation consisted of an in-depth interview with JCP&L's program manager and the overall residential implementation manager. Expanded process evaluation activities for PY23 will also include customer surveys and interviews with implementation staff, trade allies, and retailers. Appendix D includes PY23 process evaluation research questions.

4 Process Evaluation

For PY22, the process for Existing Homes Program consisted of an in-depth interview with JCP&L program staff. Program staff reported a number of challenges related to the Existing Homes program and, specifically, the HPwES and MIW offerings.

Several factors contributed to the program falling short of implementation estimates in JCP&L's EE&C plan. It is important to note that the EE&C plan was developed during a time of considerable economic uncertainty. Moreover, there was little history of comparable energy efficiency program implementation available to JCP&L since this is the first phase of implementation for this program. Due to these reasons, it is plausible that the plan estimates may simply be higher than what is achievable for certain program components. On the whole, JCP&L overperformed relative to the EE&C plan – a phenomenon that was driven by the need to overdrive programs that distributed general service lighting before code changes eroded the measure's applicability. Several themes emerge when comparing portfolio results to the EE&C plan:

- Programs that distributed large quantities of general-service LEDs overperformed
- Programs that require relatively high amounts of labor per kWh of energy savings, such as direct-install programs, fell well short of EE&C plan estimates
- Programs that require capital cost measures, particularly HVAC and custom commercial projects, fell somewhat short of EE&C plan estimates
- The implementation team prioritize high-impact programs and program components during the PY22 launch process.

The latter two themes listed above imply labor and supply-chain shortages, which have also impacted the implementation rates of energy efficiency programs in neighboring states.

PY22 was the first year of utility program implementation for the CEA. As such, coordinated program launch activities among the utilities took a prolonged and concerted effort. This also led to some delays in program launches, particularly those with varied measures.

In this context, the Existing Homes program falls in the spectrum of programs that would be slowest to launch and ramp up. As of this writing, all three program components have significantly increased implementation rates and the QHEC program component is now trending in excess of the EE&C estimates for PY23.

The program team reported that it is challenging to identify homes that will result in substantial electricity savings since many of the homes in their territory use gas for home and water heating. This challenge reinforces the need for collaboration with the gas utilities. Further, there are opportunities for fuel switching, such as to heat pumps. JCP&L,

as an electric utility, accounts for fuel-switching measures by comparing a given equipment's efficiency to the applicable baseline. The assertion is that the customer has already decided on the fuel type for their equipment, and JCP&L's program influences that customer to purchase a more efficient variant of that equipment (e.g., a SEER 16 heat pump).

4.1 HPwES

This offering helps customers invest in energy efficiency holistically through an energy audit and support for making recommended home improvements. The program is designed to holistically review the efficiency of a home, including home appliances and the building envelope, to achieve deeper energy savings.

All participants in this offering receive a Building Performance Institute (BPI) certified energy audit performed directly by a qualified HPwES contractor or auditor. The auditor develops an energy efficiency action-plan that includes recommendations for upgrades and available incentives. Contractors charge their own prices for implementing improvements.

Customers receive rebates for completing projects recommended by the energy audit. Rebates are calculated based on the percentage of a household's energy use that was saved by the projects implemented through participation. Savings are considered the percentage saved above a baseline of 5 percent. Participants receive $2,000 plus $150 for each percentage point of savings above 5 percent. The program offers rebates up to $5,000, not to exceed half of the project's cost. Though there is not a flat rebate amount, the program team believes that the contractors do a good job of explaining the incentive structure to customers since the team has not received complaints from customers stemming from confusion over rebate amounts.

Customers cannot receive incentives from other programs in addition to this one for the same equipment (i.e., they could not receive a HVAC rebate from the Residential Rebate program on top of a HPwES rebate). All HPwES projects must include air sealing and insulation to qualify for a rebate. The program does not include any direct-install measures.

All the utilities in New Jersey run this program the same way, including using the same software and contractor network. Any program changes must be uniform across all utilities in the state.

The network of participating contractors is required to be BPI-certified. The utility provides contractors with training, support materials, and project leads. They also have monthly touchpoints with contractors to gather their feedback. CLEAResult, as the implementer,

has a relationship with the contractors. JCP&L has 20 participating contractors in its service territory.

To ensure the upgrades are accessible to customers, JCP&L offers 0 percent financing through the National Energy Improvement Fund (NEIF) for loans from $2,500 to $15,000. Customers can include $2,000 of financing for health and safety measures that are not tied to savings. The utility has not heard any complaints about financing.

The utility invested time in coordinating with other utilities, getting programs up and running, and onboarding contractors. The program's first-year implementation rate fell short of the estimates in JCP&L's energy efficiency and conservation plan (EE&C plan), but program staff are hopeful that this will improve now that the program setup is done. Each offering has its own savings targets, which are based on JCP&L's EE&C plan.

For PY22, the process evaluation consisted of an in-depth interview with JCP&L program staff. Expanded process evaluation activities for PY23 will also include customer surveys and interviews with implementation staff.

4.2 QHEC

The utility invested time in coordinating with other utilities, getting programs up and running, and onboarding contractors. It did not meet savings milestones from JCP&L's EE&C plan for the first year of the program, but program staff are hopeful that this will improve now that the program setup is done.

4.3 MIW

During the facilitated discussion, program staff expressed concern that different contractor networks and capabilities for each of the program components in the Existing Homes Program might limit the customers that participate in each program or add roadblocks for contractors. Ideally, the utility would like to train contractors to understand each subprogram and allow them to participate in any program. This way, the contractors can help customers understand their options and allow them to participate in whichever program fits their needs best. Additionally, the utility expressed concern about migration of customers from one program to another (i.e., someone is participating in HPwES, but learns that they are qualified for MIW).

The utility invested time in coordinating with other utilities, getting programs up and running, and onboarding contractors. Overall, the Existing Homes Program had a slower launch than assumed in the EE&C plan, but program staff are hopeful that this will improve now that the program setup is completed.

5 Key Findings and Recommendations

5.1 Energy Impacts Achieved in PY22

Gross impact evaluation results by program component are reported in Table 5-1 and Table 5-2.

Table 5-1: Existing Homes PY22 Gross Annual Retail kWh Savings and kW Demand Reduction

Program	Ex-ante kWh	Ex-post kWh	RR kWh	Ex-ante kW	Ex-post kW	RR kW
HPwES	112,116	112,116	100%	-	-	-
QHEC	564,809	571,468	101%	46.0	44.6	97%
MIW	50,576	50,502	100%	3.9	3.9	100%
Total	**727,501**	**734,087**	**101%**	**50**	**49**	**97%**

Table 5-2: Existing Homes PY22 Gross Annual Retail Therms and MMBtu Savings

Program	Ex-ante Therms	Ex-post Therms[3]	Ex-ante MMBtu	Ex-post MMBtu	RR
HPwES	3,688	3,688	369	369	100%
QHEC	(5,496)	(4,509)	(550)	(451)	82%
MIW	(654)	(652)	(65)	(65)	100%
Total	**(2,462)**	**(1,472)**	**(246)**	**(147)**	**60%**

Existing Homes programs accounted for 0.78 percent of the total portfolio kWh savings during the first year of operation.

5.2 Program Launch

Participation for the first year fell below expected levels (see Table 5-3).

Table 5-3: PY22 Expected versus Actual Participation

Offering	Expected PY22 Participation[10]	Actual PY22 Participation
HPwES	500	33
QHEC	1,500	581
MIW	300	103

Several factors contributed to the program falling short of implementation estimates in JCP&L's EE&C plan. It is important to note that the EE&C plan was developed during a time of considerable economic uncertainty. Moreover, there was little history of comparable energy efficiency program implementation available to JCP&L since this is the first phase of implementation for this program. Due to these reasons, it is plausible that the plan estimates may simply be higher than what is achievable for certain program components. On the whole, JCP&L overperformed relative to the EE&C plan – a phenomenon that was driven by the need to overdrive programs that distributed general service lighting before code changes eroded the measure's applicability. Several themes emerge when comparing portfolio results to the EE&C plan:

- Programs that distributed large quantities of general-service LEDs overperformed
- Programs that require relatively high amounts of labor per kWh of energy savings, such as direct-install programs, fell well short of EE&C plan estimates
- Programs that require capital cost measures, particularly HVAC and custom commercial projects, fell somewhat short of EE&C plan estimates
- The implementation team prioritize high-impact programs and program components during the PY22 launch process.

In this context, the Existing Homes program falls in the spectrum of programs that would be slowest to launch and ramp up. As of this writing, all three program components have significantly increased implementation rates and the QHEC program component is now trending in excess of the EE&C estimates for PY23. The QHEC program tends to require the least labor per kWh saved and is not reliant on capital cost measures. These design elements are proving to be more robust with respect to any labor or supply chain shortages. On the other side of the spectrum, the HPwES program had the lowest participation of the three components in PY22. The utility evaluators' benchmarking effort identified five programs, and each comparison program had much higher implementation rates than HPwES. However, it is important to note that all the comparison programs were mature programs. When Act 129 launched in Pennsylvania in 2010, the only

[10] Source: Quarterly Progress Report of Jersey Central Power & Light Company – 3rd Quarter Program Year 2022

residential direct-install programs to have any implementation were those that essentially subsidized additional implementation of preexisting low-income weatherization programs. The analogs of HPwES did not have any participants in the first year of implementation.

5.3 Key Evaluation Findings

The following are key findings from the PY22 evaluation effort.

- Tracking and reporting systems were established, commissioned, and include sufficient detail to enable upcoming enhanced-rigor evaluations
- Communication channels for fast evaluation impact have been established, and many areas of improvement identified in the PY22 evaluation have been implemented by JCP&L and its implementation and data tracking vendors
- Energy and demand realization rates, on the whole, are near 100 percent
- The utilities that participate in the CEA have launched and managed their programs in close coordination.
    - One of the key startup activities was the establishment of the NJ CML, which support uniform savings calculations and reporting by utilities and incorporates protocols for measures that were not in the New Jersey Protocols

5.4 Recommendations

5.4.1 Home Performance with Energy Star

The PY22 evaluation did not result in any recommendations for this program. Future evaluation efforts will focus on program participation growth and a better understanding of the market for the deep energy retrofits offered by this program.

5.4.2 Quick Home Energy Check-up

Retain LED wattages to supplement tracking data: While baseline lamp wattage is tracked for the program, efficient lamp wattage is given in a narrow range (e.g., 7 to 9 watt general service LED). This is done to avoid numerous degenerate measure items, each corresponding to a particular wattage. While this does not cause significant uncertainty in savings calculations, we recommend that the actual efficient lamp wattage are retained and made available to the evaluator upon a data request.

Retain showerhead flow rates to supplement tracking data: Similarly to LED wattages, we recommend that the ICSP retains the flow rates for showerheads and makes them available upon request.

Retain water heater capacity to supplement tracking data for DHW setbacks: While the capacity can be inferred from the calculated impacts, if the water heater capacity records can be made available upon request this would help enhance evaluability.

5.4.3 Moderate-Income Weatherization Program

The same recommendations as QHEC apply to this program component.

Appendix A: Home Performance with Energy Star

A.1 Gross Impact Evaluation Results

ADM calculated ex-post gross impact savings are summarized in Table A-1 and Table A-2.

Table A-1 HPwES PY22 Annual Gross kWh Savings by Measure

Measure	Ex-ante kWh	Ex-post kWh	RR kWh
Air Sealing	10,315	10,315	100%
Air Source Heat Pump (SEER >=16, EER>= 12.5, HSPF >=9)	66,260	66,260	100%
Attic Insulation	28,146	28,146	100%
Central Air Conditioner (SEER >=16, EER >=12.5)	2,117	2,117	100%
Duct Insulation	392	392	100%
Duct Sealing	3,285	3,285	100%
Gas Boiler - AFUE >= 95%	-	-	-
Gas Furnace - Tier 1 AFUE - 95-96.9%	(350)	(350)	100%
Gas Power Vented Water Heater - Less than 55 gallons, UEF .64	54	54	100%
Insulation - basements/unvented crawl space (walls)	3,177	3,177	100%
Insulation – Ceiling	(15)	(15)	100%
Insulation - Custom	-	-	-
Insulation - floors over garages, outside, vented crawl spaces	14	14	100%
Insulation - Walls, kneewalls, rim band/joists	(60)	(60)	100%
Roof Insulation	(1,232)	(1,232)	100%
Tankless Gas Water Heater - UEF greater than or equal to .87	14	14	100%
Total	**112,116**	**112,116**	**100%**

Table A-2: HPwES PY22 Annual Gross Therms and MMBtu Savings by Measure

Measure	Ex-ante Therms	Ex-post Therms	Ex-ante MMBtu	Ex-post MMBtu	RR
Air Sealing	968.19	968.19	96.82	96.82	100%
Air Source Heat Pump (SEER >=16, EER>= 12.5, HSPF >=9)	-	-	-	-	-
Attic Insulation	1,550.63	1,550.63	155.06	155.06	100%
Central Air Conditioner (SEER >=16, EER >=12.5)	-	-	-	-	
Duct Insulation	69.52	69.52	6.95	6.95	100%
Duct Sealing	191.18	191.18	19.12	19.12	100%
Gas Boiler - AFUE >= 95%	142.50	142.50	14.25	14.25	100%
Gas Furnace - Tier 1 AFUE - 95-96.9%	834.26	834.26	83.43	83.43	100%
Gas Power Vented Water Heater - Less than 55 gallons, UEF .64	204.76	204.76	20.48	20.48	100%
Insulation - basements/unvented crawl space (walls)	91.14	91.14	9.11	9.11	100%
Insulation - Ceiling	-	-	-	-	-
Insulation - Custom	-	-	-	-	-
Insulation - floors over garages, outside, vented crawl spaces	9.01	9.01	0.90	0.90	100%
Insulation - Walls, kneewalls, rim band/joists	71.82	71.82	7.18	7.18	100%
Roof Insulation	(521.57)	(521.57)	(52.16)	(52.16)	100%
Tankless Gas Water Heater - UEF greater than or equal to .87	76.93	76.93	7.69	7.69	100%
Total	**3,688.36**	**3,688.36**	**368.84**	**368.84**	**100%**

A.2 Discussion of Realization Rates

ADM did not find any material errors in the Snugg Pro model inputs or outputs. The models appeared to be well-calibrated to participants' utility bills. Ex-post kWh and therms savings resulted in a 100 percent realization rate for HPwES.

A.3 Lifetime Savings

Lifetime savings were calculated by multiplying ex-post annual savings by measure life sourced from the NJ Protocols. Lifetime savings are reported in Table A-3[11].

[11] Peak demand reductions were not claimed for this program; therefore, no ex-post peak demand reductions were calculated.

Table A-3 - HPwES Lifetime Gross Savings

Measure	Measure Life	Ex-post Lifetime kWh Savings	Ex-post Lifetime Therms Savings	Ex-post Lifetime MMBtu Savings
Air Sealing	15	154,718	14,522.84	1,452.28
Air Source Heat Pump (SEER >=16, EER>= 12.5, HSPF >=9)	15	993,902	-	-
Attic Insulation	30	844,384	46,518.96	4,651.90
Central Air Conditioner (SEER >=16, EER >=12.5)	15	31,747	-	-
Duct Insulation	30	11,748	2,085.54	208.55
Duct Sealing	18	59,125	3,441.24	344.12
Gas Boiler - AFUE >= 95%	20	-	2,850.00	285.00
Gas Furnace - Tier 1 AFUE - 95-96.9%	20	(7,001)	16,685.12	1,668.51
Gas Power Vented Water Heater - Less than 55 gallons, UEF .64	11	596	2,252.31	225.23
Insulation - basements/unvented crawl space (walls)	30	95,319	2,734.20	273.42
Insulation – Ceiling	30	(440)	-	-
Insulation – Custom	30	-	-	-
Insulation - floors over garages, outside, vented crawl spaces	30	426	270.42	27.04
Insulation - Walls, kneewalls, rim band/joists	30	(1,804)	2,154.66	215.47
Roof Insulation	30	(36,966)	(15,647.10)	(1,564.71)
Tankless Gas Water Heater - UEF greater than or equal to .87	20	281	1,538.54	153.85
Total	**-**	**2,146,036**	**79,406.72**	**7,940.67**

A.4 Data Review

ADM reviewed program tracking data and identified the following issues which had minor impact and can be remediated to facilitate ongoing evaluation efforts:

Missing or Incorrect Data

- Measure life values in the tracking data for gas powered vented water heaters (four instances) and gas furnaces (seven instances) did not match measure life values in the NJ Protocols.
- Measure life was not included in the tracking data for insulation measures, air sealing, and duct sealing, although lifetime impacts were reported.
- Savings were not reported for two instances of custom insulation measures.

Opportunity to Improve Realization Rates

The initial evaluation of the HPwES program found that impacts in the tracking and reporting system corresponded to the Snugg Pro model outputs, and that the models appeared to be well-calibrated to participants' billed energy usages. The simulation inputs and outputs were consistent with the energy efficiency measures that were reported to be installed at each home. As such, there are no recommendations related to realization rate improvements at this time. As stated above, measure lives for gas-vented water heaters and furnaces need to be updated to match the values in the NJ Protocols.

Appendix B: Quick Home Energy Check-up

B.1 Gross Impact Evaluation Results

Ex-post savings are reported in Table B-1 and Table B-2.

Table B-1: QHEC PY22 Annual Gross Retail kWh Savings and kW Demand Reduction

Measure	Ex-ante kWh	Ex-post kWh	RR kWh	Ex-ante kW	Ex-post kW	RR kW
LEDs	454,327	436,171	96%	34.1	32.7	96%
Aerators	160	9,617	6000%	-	-	-
Showerheads	4,673	19,979	428%	-	-	-
Smart Power Strips	104,968	104,968	100%	11.8	11.8	100%
Pipe Insulation	-	-	0%	-	-	-
Domestic Hot Water Setback	680	734	108%	0.1	0.1	108%
Total	**564,809**	**571,468**	**101%**	**46.0**	**44.6**	**97%**

Table B-2: QHEC PY22 Annual Gross Retail Therms and MMBtu Savings

Measure	Ex-ante Therms	Ex-post Therms	Ex-ante MMBtu	Ex-post MMBtu	RR
LEDs	(7,121.96)	(6,837.35)	(712)	(683.7)	96%
Aerators	4.26	255.84	0	25.6	6000%
Showerheads	1,275.67	1,733.51	128	173.4	136%
Smart Power Strips	-	-	-	-	0%
Pipe Insulation	29.03	5.03	2.9	0.5	17%
Domestic Hot Water Setback	317.05	334.32	32	33.4	105%
Total	**(5,496)**	**(4,509)**	**(550)**	**(451)**	**82%**

B.2 Discussion of Realization Rates

LEDs

The 96% realization rate is primarily attributable to a 96% ISR, determined from ADM's review of quality assurance on-site inspections. The 96% ISR is similar to ISRs to other programs and may even be within the resolution of the inspections. It is difficult to identify

all LED lamps in all residences, and to attribute them to the program, so house-by-house counts can differ slightly from quantities in tracking data.

Minor differences in the ex-ante and ex-post efficient wattages account for approximately 1% variance between ex-ante and ex-post calculated savings. Exact efficient wattages were not provided in the tracking data, instead a range of wattages is indicated, for example *LED 7-9 watt.* To calculate savings, ex-post efficient wattages were taken as the average wattage for all lamps in the Energy Efficient Product point-of-sale offering, that fell within the wattage range for the given lamp type. For example, the average wattage for a 7 to 9 watt general service LED is 8.3 watts according to sales data tracked by the Energy Efficient Products program.

Smart Power Strips

The realization rate for this measure was 100 percent.

Aerators

Aerator ex-ante savings were calculated using an equation from the TRM that included an error; the unit for Hours of Use was hours when it should have been minutes. Ex-post savings were calculated using minutes as the unit Hours of Use. As a result, ex-post savings are much higher than ex-ante savings, and the realization rates was 6000 percent.

Showerheads

Realization rates for showerheads were high due to misapplication of factors in the NJ FY2021 Protocols. The factors F_{elec} and F_{gas} in those protocols are intended to quantify the percentages of water heaters that are electric or gas-fueled respectively. In the QHEC program, however, the fuel type of the water heater is known and tracked, and thus F_{elec} would take on the value of 1.0 instead of 0.25 for electric water heaters, and 1.0 instead of 0.71 for gas water heaters.

Domestic Hot Water Heater Setbacks

Water heater capacity values were not reported in the tracking data. For all but two projects, the ex-ante savings calculation used a 40-gallon tank capacity. When capacity is unknown, the TRM recommends calculating savings based on a 50-gallon tank, which was used for the ex-post calculation. This difference resulted in realization rates over 100 percent (108 percent for kWh and kW, and 105 percent for therms).

Pipe insulation

Pipe insulation was installed in only one home. The length of installed pipe insulation was not included in the tracking data. ADM determined the installed length of the pipe insulation through a separate data request to the ICSP. The difference between the ex-ante and ex-post savings results was traced to a miscommunication regarding an initial

correction to the ex-ante savings, associated with unit conversion. While this measure is rarely installed, ADM will review the calculation and reporting method during PY23 to reduce variance between ex-ante and ex-post savings values for this measure.

B.3 Lifetime Savings

Lifetime savings were calculated for each measure by multiplying ex-post annual savings by the EUL. EULs were sourced from the NJ CML. Lifetime savings results are reported in Table B-3

Table B-3: QHEC Gross Retail Lifetime Savings

Measure	Ex-post Lifetime kWh Savings	Ex-post Lifetime kW Demand Reduction	Ex-post Lifetime Therms Savings	Ex-post Lifetime MMBtu Savings
LEDs	6,768,488	507.3	(106,102)	(10,610.18)
Aerators	96,167	-	2,558	255.84
Showerheads	99,896	-	8,668	866.76
Smart Power Strips	839,747	94.7	0	-
Pipe Insulation	-	-	55	5.53
Domestic Hot Water Setback	1,467	0.2	669	66.86
Total	**7,805,766**	**602**	**(94,152)**	**(9,415)**

Data Review

ADM reviewed program tracking data for data duplication and data all measures included in Program Year 22 (2022). ADM reviewed tracking data to ensure that no duplicates or otherwise erroneous entries were included in the dataset and calculated ex-post savings using NJ protocols. ADM provides the following findings as part of its review of program tracking data.

Missing or Incorrect Data

The following variable values were not included in the tracking data, but most or all fields exist in the CSP's tracking system and can potentially be added to JCP&L's tracking data. Tracking and reporting conventions for residential direct install residential programs range from the minimalist approach of reporting a single-line impact and cost aggregator for the program (with supplementary documentation retained as workbooks, photos, and documents), to extremely detailed data sets with a line item for each measure, and scores

of columns overall to track attributes for dozens of measures offered by the program. The QHEC program has taken a moderate approach of disaggregating all measures and including key parameters such as water heating fuel. Due to the relative simplicity of the QHEC program, it may be worthwhile to add the following data fields to fully characterize the set of TRM parameters needed to calculate impacts for the program.

- Pipe insulation did not include a variable to indicate insulation thickness. ADM used the ½" insulation thickness in the ex-post gas impact calculation for the one instance of this measure.
- LED efficient bulb wattages were provided in narrow ranges of watts rather than specific wattages. While this only causes a ~1% uncertainty in reported impacts, it may be practicable to add capture and report the efficient lamp's wattage.
- Water heater capacities and initial and final setpoints could be added to the Domestic Hot Water Setback measure tracking data.
- Showerhead flow-rates, at times, are specified in the measure name (e.g., 1.5 GPM), but there are several types of showerheads offered by the program and the flow rates are not always specified in the measure names. Adding the flow-rate would facilitate line-by-line calculations performed on tracking data.
- Tracking data included unit energy savings only. Total energy savings per record was not reported.

Opportunity to Improve Realization Rates

Realization rates reflect the ratio of forecasted savings to verified savings. Realization rates close to 100% reflect an accurate forecast of program performance. ADM provides the following recommendations to improve realization rates.

- For showerheads, remove the F_{elec} and F_{gas} parameters from the calculations, as those are intended for cases where the water heater fuel types are unknown.

Appendix C: Moderate-Income Weatherization Program

C.1 Gross Impact Evaluation Results

ADM reviewed tracking data to ensure that each measure met program qualifications, that each was installed in PY22, and that there were no duplicates or otherwise erroneous entries. ADM calculated ex-post savings as indicated in NJ Protocols. Program savings are summarized in Tables C-1 and C-2.

Table C-1: MIW Annual Gross kWh Retail Savings and kW Gross Demand Reduction

Measure	Quantity[12]	Ex-ante kWh	Ex-post kWh	RR kWh	Ex-ante kW	Ex-post kW	RR kW
LED Lightbulbs	725	46,694	46,620	100%	3.50	3.49	100%
Faucet Aerators	6	17	17	100%	0.00	0.00	-
Low Flow Showerheads	4	242	242	100%	0.00	0.00	-
Smart Power Strips	10	3,460	3,460	100%	0.39	0.39	100%
Domestic Hot Water Setback	13	163	163	100%	0.02	0.02	100%
Total	**758**	**50,576**	**50,502**	**100%**	**3.91**	**3.90**	**100%**

Table C-2: MIW Annual Gross Retail Therms and MMBtu Savings

Measure	Ex-ante Therms	Ex-post Therms	Ex-ante MMBtu	Ex-post MMBtu	RR
LED Lightbulbs	-731.97	-730.81	-73.20	-73.08	100%
Faucet Aerators	0.71	0.71	0.07	0.07	100%
Low Flow Showerheads	38.46	38.46	3.85	3.85	100%
Smart Power Strips	-	-			-
Domestic Hot Water Setback	38.657	39.97	3.87	4.00	103%
Total	**-654.14**	**-651.66**	**-65.41**	**-65.17**	**100%**

[12] In this and subsequent tables, the stated quantities refer to the total number of measures installed, while the electric and gas impacts are the totals associated with the measure. For example, the second lines of this and the following table indicate that there were six aerators installed overall on faucets corresponding to both gas and electric water heaters, with a total electric savings of 17 kWh and total gas savings of 0.71 Therms for the six aerators.

LED Lightbulbs

Energy savings, demand reduction, and gas heating interactive impacts for LED lightbulbs are reported in Tables C-3 and C-4. Note that negative gas energy impacts result from increased heating during winter since LEDs generate less heat than traditional lamps.

Table C-3: MIW LED Annual Gross Retail kWh Savings and kW Demand Reduction

Measure	Quantity	Ex-ante kWh	Ex-post kWh	RR kWh	Ex-ante kW	Ex-post kW	RR kW
LED 7-9W	479	31,182	31,546	101%	2.34	2.36	101%
MIW DI LED < 15W 3-Way	3	337	343	102%	0.03	0.03	102%
MIW DI LED 10-13W	22	1,329	1,424	107%	0.10	0.11	107%
MIW DI LED 11-13W Flood	31	2,064	2,082	101%	0.15	0.16	101%
MIW DI LED 14-17W Flood	2	126	126	100%	0.01	0.01	100%
MIW DI LED 3-4W Candelabra	149	8,930	8,410	94%	0.67	0.63	94%
MIW DI LED 4-6W	24	1,659	1,644	99%	0.12	0.12	99%
MIW DI LED 5-6W Globe	3	203	192	95%	0.02	0.01	95%
MIW DI LED 6-10W Flood	12	865	853	99%	0.06	0.06	99%
Total	**725**	**46,694**	**46,620**	**100%**	**3.50**	**3.49**	**100%**

Table C -4: LED Annual Gross Retail Therms and MMBtu Savings

Measure	Ex-ante Therms	Ex-post Therms	Ex-ante MMBtu	Ex-post MMBtu	RR
LED 7-9W	(488.80)	(494.52)	-48.88	-49.45	101%
MIW DI LED < 15W 3-Way	(5.28)	(5.37)	-0.53	-0.54	102%
MIW DI LED 10-13W	(20.83)	(22.32)	-2.08	-2.23	107%
MIW DI LED 11-13W Flood	(32.35)	(32.64)	-3.24	-3.26	101%
MIW DI LED 14-17W Flood	(1.97)	(1.97)	-0.20	-0.20	100%
MIW DI LED 3-4W Candelabra	(139.98)	(131.83)	-14.00	-13.18	94%
MIW DI LED 4-6W	(26.01)	(25.78)	-2.60	-2.58	99%
MIW DI LED 5-6W Globe	(3.19)	(3.01)	-0.32	-0.30	95%
MIW DI LED 6-10W Flood	(13.57)	(13.37)	-1.36	-1.34	99%
Total	**(731.97)**	**(730.81)**	**-73.20**	**-73.08**	**100%**

Faucet Aerators

Energy savings, demand reduction, and therms savings for faucet aerators are reported in Tables C-5 and C-6.

Table C-5: Faucet Aerator Annual Gross Retail kWh Savings and kW Demand Reduction

Measure	Quantity	Ex-ante kWh	Ex-post kWh	RR kWh	Ex-ante kW	Ex-post kW	RR kW
MIW DI Faucet Aerator	2	6	6	100%	0.00	0.00	-
MIW DI Faucet Aerator w/swivel head	4	11	11	100%	0.00	0.00	-
Total	**6**	**17**	**17**	**100%**	**0.00**	**0.00**	**-**

Table C-6: Faucet Aerator Annual Gross Retail Therms Savings

Measure	Ex-ante Therms	Ex-post Therms	Ex-ante MMBtu	Ex-post MMBtu	RR
MIW DI Faucet Aerator	0.24	0.24	0.02	0.02	100%
MIW DI Faucet Aerator w/swivel head	0.47	0.47	0.05	0.05	100%
Total	**0.71**	**0.71**	**0.07**	**0.07**	**100%**

Low Flow Showerheads

Energy savings, demand reduction, and therms savings for low flow showerheads are reported in Table C-7 and C-8.

Table C-7: Low Flow Showerhead Annual Gross Retail kWh Savings and kW Demand Reduction

Measure	Quantity	Ex-ante kWh	Ex-post kWh	RR kWh	Ex-ante kW	Ex-post kW	RR kW
MIW DI Showerhead <2.5gpm handheld w/ shutoff	1	121	121	100%	0.00	0.00	-
MIW DI Showerhead <2.5gpm w/o shutoff	3	121	121	100%	0.00	0.00	-
Total	**4**	**242**	**242**	**100%**	**0.00**	**0.00**	

Table C-8: Low Flow Showerhead Annual Gross Retail Therms and MMBtu Savings

Measure	Ex-ante Therms	Ex-post Therms	Ex-ante MMBtu	Ex-post MMBtu	RR
MIW DI Showerhead <2.5gpm handheld w/ shutoff	0.00	0.00	0.00	0.00	-
MIW DI Showerhead <2.5gpm w/o shutoff	38.46	38.46	3.85	3.85	100%
Total	**38.46**	**38.46**	**3.85**	**3.85**	**100%**

Smart Power Strips

Energy kWh savings and kW demand reduction for smart power strips or advanced power strips (APSs) are reported in Table C-9. No therms or MMBtu savings were generated by smart power strips.

Table C-9: Smart Power Strips Annual Gross kWh Savings and kW Demand Reduction

Measure	Quantity	Ex-ante kWh	Ex-post kWh	RR kWh	Ex-ante kW	Ex-post kW	RR kW
MIW DI APS Tier–2 – Computer	4	1,384	1,384	100%	0.16	0.16	100%
MIW DI APS Tier–2 – Entertainment	6	2,076	2,076	100%	0.23	0.23	100%
Total	**10**	**3,460**	**3,460**	**100%**	**0.39**	**0.39**	**100%**

Domestic Hot Water Setback

Energy savings, demand reduction, and therms savings for domestic hot water temperature setbacks are reported in Table C-10 and C-11.

Table C-10: Domestic Hot Water Setback Annual Gross Retail kWh Savings and kW Demand Reduction

Measure	Quantity	Ex-ante kWh	Ex-post kWh	RR kWh	Ex-ante kW	Ex-post kW	RR kW
MIW DI DHW Setback	13	163	163	100%	0.02	0.02	100%

Table C-11: Domestic Hot Water Setback
Annual Gross Retail Therms and MMBtu Savings

Measure	Ex-ante Therms	Ex-post Therms	Ex-ante MMBtu	Ex-post MMBtu	RR
MIW DI DHW Setback	38.66	39.97	3.87	4.00	103%

C.2 Discussion of Realization Rates

LED Lightbulbs

While records for LED measures included the as-found baseline wattage and the location of installation, efficient lamp wattages were provided in narrow ranges rather than in exact wattages (e.g., 7-9W general service LEDs). In the given example, ex-ante calculations used 8 watts. While 8 watts is the mode for 7-9 W general service LEDs, ADM used the weighted average wattage for all general service LEDs in that wattage range, as determined from the point-of-sale lighting program's tracking data. This resulted in an ex-post value of 8.3 watts, rather than 8 watts. In general, these small variations between ex-ante and ex-post wattages tended to cancel out (see table C-4).

Domestic Hot Water Heater Setbacks

Capacity values were not included in the tracking data. When the capacity is unknown or not provided, the deemed value is a 50-gallon tank. Therefore, ADM calculated savings using a 50-gallon tank capacity for all records. This resulted in higher ex-post savings than ex-ante savings. This difference resulted in a 103 percent realization rate for therms and a 108 percent realization rate for kWh.

Other Measures

In PY22, Faucet aerators, low flow showerheads, smart power strips, and domestic hot water temperature setbacks for both energy and demand savings all had a 100 percent realization rate.

C.3 Lifetime Savings

Lifetime savings were calculated for each measure by multiplying ex-post annual savings values by measure life. Lifetime kWh and therms savings results are reported in Table C-12. Measure life values were sourced from the NJ CML.

Table C-12: MIW Lifetime Gross Retail Savings

Measure	Measure Life	Ex-post Lifetime kWh Savings	Ex-post Lifetime kW Demand Reduction	Ex-post Lifetime Therms Savings	Ex-post Lifetime MMBtu Savings
LED Lightbulbs	15	699,301	2,530	(10,962)	-1,096.21
Faucet Aerators	10	172	-	7	0.71
Low Flow Showerheads	10	2,417	-	384.6	38.46
Smart Power Strips	8	27,680	4	0	0.00
Domestic Hot Water Temperature Setback	2	326	0	80	8.00
Total	**-**	**729,895**	**2,534**	**-10,490.51**	**-1,049.05**

C.4 Data Review

ADM reviewed program tracking data for duplicate records and inconsistent ex-ante savings and found the following:

Missing or Incorrect Data

- While reporting LED wattages in ranges rather than in exact values did not lead to a significant variance from 100% in the realization rate, it may be beneficial to report the LED wattage as a separate variable in the tracking system. Given the costs and limited benefits associated with this, a practicable recommendation for the first triennium is to retain the wattage data in the ICSP's database and to make the data available upon request.
- Records for low-flow showerhead did not include gallons per minute (GPM). For this program component, the convention is to use the measure name to imply the flow rate. Just as for the QHEC program component, it would be beneficial to include the GPM as a field in the tracking data. Given the costs and limited benefits associated with this, a practicable recommendation for the first triennium is to retain the wattage data in the ICSP's database and to make the data available upon request.
- Records for the DHW Setback measure did not include water heater capacity for each unit in the program. However, the capacity for the DHW Setback measure appears to vary by project, and this information should be reported in

the data to reduce assumptions in the ex-post savings calculations. Given the costs and limited benefits associated with this, a practicable recommendation for the first triennium is to retain the wattage data in the ICSP's database and to make the data available upon request.

Opportunity to Improve Realization Rates

Realization rates reflect the ratio of forecasted savings to verified savings. Realization rates close to 100 percent reflect an accurate forecast of program performance. All measures had an overall realization rate of 100 percent for PY22 and there are no indications of systematic issues in implementation, tracking, or reporting. As such ADM has no recommendations at this time.

Appendix D. Process Evaluation Research Questions for PY23

The following research questions will be addressed through process evaluation activities in PY23. For brevity, the table focuses on questions specific to this program (excluding general process questions such as staffing adequacy and communication across parties, which will be assessed as standard across all programs) and expands on those outlined in the final evaluation plan, updated based on information gathered through project manager interviews. The following activities will be completed in PY23 for each offering.

Table D-1: PY 23 Process Evaluation Activities

Researchable question	Activity to support the question	Relevant Offering		
		HPwES	QHEC	MIW
Program Infrastructure				
What challenges and opportunities exist due to the need to collaborate with other utilities given the statewide nature of the program?	Program staff interviews	✓	✓	✓
What barriers (program infrastructure or otherwise) exist to program participation? What program structure / procedural elements might inhibit participation?	Program staff interviews Participant survey Nonparticipant survey Auditor interview	✓	✓	✓
Customer and market actor experiences				
Marketing and engagement				
How did customers hear about the program? What was their motivation to participate? What concerns or uncertainties did customers have prior to participation? Have there been any changes over time?	Participant survey	✓	✓	✓
How useful or informative are public-facing communications about the program, and what information would	Participant survey	✓	✓	✓

Researchable question	Activity to support the question	Relevant Offering		
be valuable to include and encourage participation?				
To what extent is the QHEC engaging customers that may not otherwise participate in the comprehensive HPwES program?	Participant survey Auditor interviews		✓	
How effectively is the MIW program targeting and reaching moderate income customers?	Participant survey Program staff interviews			✓
How do the programs approach leveraging influential groups of interest, including community partners, to engage customers?	Participant survey Program staff interviews			✓
Are program benefits - financial, energy, non-energy - sufficient to engage participation? Do these benefits as marketed resonate with customers?				✓
To what extent are participants knowledgeable about and taking advantage of the financing options available? Did they eliminate any barriers to participation?	Participant Survey	✓		
Customer experiences				
What are customers' experiences with the program, from scheduling to the comprehensive audit and weatherization services to information provided?	Participant survey Auditor interviews	✓	✓	
Why do customers enter, yet drop out of, various components of the program? Examples include applying but not participating in the audit, receiving the	Participant survey Auditor interviews	✓	✓	

Researchable question	Activity to support the question	Relevant Offering		
audit but not installing recommended measures.				
What is the level of engagement during the audits? How does the level of engagement translate into further action?	Auditor interviews Program staff interviews	✓	✓	✓
What actions are customers taking because of the home energy audits? What measures are customers most likely to install after they receive an audit?	Participant survey	✓	✓	✓
How relevant were the recommendations provided to participants? What recommendations were new, and/or impressed current understanding, for participants?	Participant survey Auditor interviews	✓	✓	
How effective did participants' feel the recommendation and communication strategies were to encourage post-audit actions?	Participant survey Auditor interviews	✓	✓	
What are participants' experiences with the auditor/assessor and contractors? What were customers' experiences in searching for a participating contractor? Did customers have sufficient information to move from the assessment to engaging contractors for installation and purchasing decisions?	Participant survey Auditor interviews	✓	✓	✓
Program impacts and implications (self-reported and non-energy related)				
What benefits are customers realizing from the home energy audits?	Participant survey	✓	✓	✓
What level of influence does the program have on customers' decisions to install program qualifying equipment? What is the extent of free ridership?	Participant survey	✓	✓	✓

Researchable question	Activity to support the question	Relevant Offering		
Did participating in the program lead to installing other energy-efficient measures without assistance from FirstEnergy? What is the extent of participant spillover?	Participant survey	✓	✓	✓
What is the realization / removal rates of direct install equipment, and what is driving those rates?	Participant survey Auditor interviews		✓	✓
Did participating in the program lead to participation in other JCP&L programs? Which programs? Is QHEC working to generate leads for the other offerings?	Participant survey	✓	✓	✓
What are levels of satisfaction with different aspects of the program? How can satisfaction be further improved?	Participant survey Auditor interviews	✓	✓	✓
What benefits did the customers experience beyond direct resource / energy savings benefits? These could include increased education, comfort, etc.	Participant survey Auditor interviews	✓	✓	
Does participation affect customers' perceptions of the utility and, if so, how?	Participant survey	✓	✓	✓
Market actor (auditor, partners) experiences				
What are market actors' experience with the program, and what recommendations do they have for process or other improvements?	Participant survey Auditor interviews Program staff interviews	ü	✓	
Do auditors face any barriers to conducting or completing the in-home audits (e.g., scheduling issues, tracking, software)?	Auditor interviews	✓	✓	✓
What are auditor perceptions of the incentive levels? What are their perceptions of impact of incentive structure on participation?	Auditor interviews	✓		✓

Researchable question	Activity to support the question	Relevant Offering		
Program goals, impacts, and measures				
Are program goals set appropriately?	Program staff interviews	✓	✓	✓
How do incentive level variations affect participation rates?	Program staff interviews Participant survey	✓	✓	✓
What has the program done to adjust direct install measures as LEDs become more mainstream?	Auditor interviews Program staff interviews		✓	✓