



PECO Energy
2016 LIURP Evaluation
Final Report

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Executive Summary

This report presents the findings from the Evaluation of PECO's 2016 Low Income Usage Reduction Program (LIURP). LIURP provides energy efficiency services and energy education to PECO's low-income customers to help them reduce their energy usage and increase the affordability of their energy bills. The Program addresses both electric and gas energy usage. This report describes the LIURP services and analyzes the impact of the Program on customers' energy usage, energy bills, and payments.

Evaluation

The goals of the evaluation were to analyze the LIURP services provided and the impacts of the services on participating customers. The following activities were undertaken.

- *Process Evaluation:* We conducted in-depth telephone interviews with CMC managers and staff; and with six subcontractors who provide weatherization, heating, and electrical program services.
- *Program Database Analysis:* We conducted analysis of 2016 LIURP services, homes, and customer characteristics.
- *Program Impacts Analysis:* We conducted analysis of LIURP's impact on energy usage, energy costs, and bill payment.

PECO's LIURP

The Low Income Usage Reduction Program (LIURP) provides education, conservation, and weatherization measures to reduce electric and gas usage. Customers must meet the following usage and income eligibility criteria for program participation.

- Household usage levels at or above 600 kWh per month for electric baseload, 1,400 kWh per month for electric heat, or 50 ccf per month for gas heat. The definition of high usage for CAP Rate customers is usage that is at or above 500 kWh.
- Residential customers with household income at or below 150 percent of the federal poverty level (FPL), or special needs residential customers with an arrearage and household income between 151 percent and 200 percent of the FPL.

CAP customers are targeted for Program services, but participation in CAP is not required for LIURP services. The CAP rate definition of high usage is 500 kWh. CAP customers are required to participate in LIURP if they are identified as high users.

The number of customers who receive LIURP services each year is largely determined by the annual program budget established in the settlement agreement of PECO's electric restructuring case (PUC Docket Numbers R-00973953 and P-00971265). The annual budget

for 2016 was \$5.6 million for electric and \$2.25 million for gas. In 2016, 8,804 customers received LIURP services.¹

PECO contracts with CMC Energy Services to administer LIURP. PECO provides CMC with a list of potentially eligible customers and their energy usage data. CMC recruits these households in descending order based on highest usage and largest arrearages. CMC also contacts households who are directly referred from external organizations, including social and governmental agencies. CMC conducts an energy audit to determine the behavioral changes and program measures required for usage reduction. Following the audit, CMC technicians and CMC subcontractors schedule appointments to install measures. For one year after LIURP services have been provided, PECO and CMC monitor the customer's monthly energy usage. CMC mails monthly progress letters to customers to highlight any changes in monthly usage, as compared to the customer's individual goal.

Program Statistics

In 2016, 24,560 customers were evaluated for LIURP services. There were 15,103 customers who were cancelled and 653 customers who were ineligible for the program. The cancellations were primarily due to customers' lack of response to contact attempts, moves, refusals, and inactive accounts.² In total, 8,804 customers received LIURP services in 2016, though 697 customers received only education services and no measures, as there were no LIURP opportunities in these homes.

Table ES-1 displays how program funds were expended in 2016. In total \$7.56 million were spent. Approximately 65 percent was for weatherization measures, 31 percent was for audit and education, and four percent was for program administration.

**Table ES-1
2016 LIURP Expenditures
Gas and Electric Treatments
By Category**

Category	Amount Spent	Percent of Funds
Weatherization Measures	\$4,925,383	65%
Audit/Education	\$2,313,545	31%
PECO Administration	\$320,633	4%
Solar Water Maintenance	\$621	<1%
TOTAL	\$7,560,182	100%

¹697 customers did not receive measures. These customers only received education.

² See Table III-3.

Table ES-2 displays the distribution of 2016 LIURP jobs by job type, for both electric and gas accounts. The table shows that 59 percent of jobs were classified as baseload, meaning that measures primarily address electric baseload usage. However, the baseload jobs have lower job costs and represent only 28 percent of total costs. The average cost for measures on these jobs was \$306. Gas heating jobs represented 19 percent of jobs and 49 percent of costs, averaging \$1,658 in measure costs per home. Electric heating jobs averaged \$1,517 per home.

Table ES-2
2016 LIURP Service Delivery and Expenditures
By Job Type

Job Type	# of Jobs	% of Jobs	Total Cost	% of Costs	Average Job Cost
Baseload [†]	5,029	59%	\$1,536,797	28%	\$306
Electric Heating	710	8%	\$1,076,791	20%	\$1,517
Gas Heating	1,624	19%	\$2,692,692	49%	\$1,658
Low Usage	389	5%	\$174,287	3%	\$448
Electric Heat Low Use	101	1%	\$23,776	<1%	\$235
Baseload Addressing Heater	6	<1%	\$11,500	<1%	\$1,917
No LIURP Measure Costs [‡]	697	8%	\$0	0%	\$0
TOTAL*	8,556	100%	\$5,515,842	100%	\$645

*The table excludes 248 accounts (210 Electric Baseload, 18 Electric Heating, 6 Gas Heating, 13 Low Usage, and 1 Electric Heat Low Use) without measures and cost data.

[†]There were 3 accounts all the measures installed were cancelled.

[‡]There were 697 accounts that received education only.

Participant Characteristics

PECO's LIURP database allows for extensive analysis of home and participant characteristics. Some of the important findings from this analysis include the following.

- *Supplemental heating:* Overall, 41 percent of customers who were treated by LIURP used supplemental heat. Forty-seven percent of the customers who had baseload LIURP services used electric supplemental heat.
- *Health and safety:* Over 7,600 smoke detectors were provided in 3,189 homes.
- *Compact fluorescent light bulbs:* CFLs were provided to approximately 69 percent of the homes serviced. On average, 6.2 bulbs were provided to each home serviced.
- *Refrigerator replacement:* Refrigerators were replaced in 1,703 homes.
- *Air conditioner replacement:* Window air conditioners were replaced in 1,288 homes.

- *Aerators and showerheads:* A total of 1,740 aerators were provided in 1,131 homes and 1,484 showerheads were provided in 1,299 homes.
- *Water heaters:* Electric water heater timers were provided in 357 homes and water heater replacements were provided in 235 homes.
- *Air sealing:* Air sealing was provided in 2,642 homes. However, only 803 received a blower door test.
- *Insulation:* Insulation was provided in 668 homes.
- *Heat system repair:* Heating system repair work was provided to 607 homes.
- *Heating system replacement:* Heat pumps were replaced in 26 homes, furnaces in 102 homes, and boilers in 108 homes.

Usage Impacts

Energy usage was analyzed for the year prior to the LIURP visit and for the year after service delivery was completed. The analysis included as close to a full year of data pre- and post-treatment as possible. Data were available for approximately 68 percent of the treated households.

Energy usage data were weather-normalized in the pre- and the post-usage periods to ensure that changes in energy usage were due to changes in usage patterns, rather than due to changes in weather. We used a degree-day normalization process to conduct this analysis.

Table ES-3 summarizes the overall usage impact results.

- *Baseload jobs* had average annual savings of approximately 673 kWh, or 6.4 percent of pre-treatment usage.
- *Electric heat jobs* had average annual savings of approximately 998 kWh, or 5.8 percent of pre-treatment usage.
- *Gas heat jobs* had average annual savings of approximately 31 ccf, or 3.3 percent of pre-treatment usage.

Table ES-3
Average Annual Usage and Savings

	#	Total Savings				LIURP Savings		Act 129 Savings	
		Usage		Annual Savings	% Savings	Annual Savings	% Savings	Annual Savings	% Savings
		Pre	Post						
Electric Baseload (kWh)									
Non Normalized	4,072	10,392	9,792	600	5.8%	536	5.2%	64	0.6%
Degree Day Normalized	4,072	10,557	9,885	673	6.4%	609	5.8%	64	0.6%
Electric Heat (kWh)									
Non Normalized	383	16,220	15,329	891	5.5%	856	5.3%	35	0.2%
Degree Day Normalized	383	17,180	16,182	998	5.8%	963	5.6%	35	0.2%
Gas Heat (ccf)									
Non Normalized	581	871	842	29	3.4%	29	3.4%	0	0.0%
Degree Day Normalized	581	944	914	31	3.3%	31	3.3%	0	0.0%

We compared the usage impact results to historical savings results.³

- **Electric Baseload Jobs:** The 2016 electric baseload jobs had savings that were lower than the 1999-2015 average savings. Savings were 6.4 percent in 2016 compared to the historical average of 8.6 percent.
- **Electric Heating Jobs:** The 2016 electric heating jobs had savings that were lower than the 1999-2015 average. Savings were 5.8 percent in 2016 compared to the historical average of 7.7 percent.
- **Gas Heating Jobs:** The 2016 gas heating jobs had significantly lower savings than the 1999-2015 average, as well as than in other recent years. Savings were 3.3 percent in 2016 compared to the historical average of 8.8 percent.

Measure Savings

The analysis also estimated the impact of specific LIURP measures on kWh and ccf savings. Table ES-4 displays results from this analysis. Savings were computed by running a regression model that predicted savings based on the measures provided and home and customer characteristics.

³Tables IV-3A, 3B, and 3C provide the historical comparison of energy savings by job type.

**Table ES-4
Measure Savings Estimates**

	Savings	Cost/Home	\$/Unit Saved	Measure Life	\$/Unit Saved Over Lifetime
Electric Baseload (kWh)					
CFL Only ¹	593 (±118)	\$3/\$266	\$0.01/\$0.45	5	<\$0.01/\$0.10
CFL	15 (±15)	\$1	\$0.04	5	\$0.01
Refrigerator	352 (±181)	\$656	\$1.86	12	\$0.21
Gas Heat (ccf)					
Gas Furnace	42 (±86)	\$2,802	\$66.71	15	\$6.43
Boiler	66 (±75)	\$3,622	\$54.63	15	\$5.26
Blower Door Air Sealing	21 (±36)	\$623	\$29.82	15	\$2.87
Insulation	52 (±38)	\$717	\$13.72	15	\$1.32
Electric Heat (kWh)					
Insulation	1,106 (±1090)	\$717	\$0.65	15	\$0.06

¹The average number of CFLs provided to these customers was 5.8, for an average savings of 102 kWh per CFL.

**The table excludes 196 Electric Baseload accounts, 16 Electric Heating accounts, and 4 Gas Heating accounts without measures and cost data in 2016.

LIURP Cost Effectiveness

We also analyzed the cost-effectiveness of LIURP by job type. Table ES-5 estimates the cost per unit saved based on different assumptions about measure life. These costs should be compared to retail rates to evaluate the cost-effectiveness of the program at different measure lives. The most reasonable assumption for electric baseload reduction is a five to seven-year measure life. Baseload electric services, at a cost of seven cents per kWh saved with a 10-year measure life, are cost-effective.

Gas heat savings have a 15-year measure life. Under the 15-year measure life assumption, the cost per ccf saved is \$3.11, which is not cost-effective with current gas prices. The cost to save a ccf of gas would need to be lower than the price for a ccf for the program to be cost-effective. Since the current cost per ccf of gas is approximately \$.89 per ccf, the cost of services would need to be significantly lower or savings would need to be significantly greater for the program to be cost-effective. To increase cost-effectiveness, the program would need to reduce spending on gas heating measures and/or increase the savings that were obtained from the measures that were installed.

**Table ES-5
Cost Per Unit Saved
By Measure Life Assumption**

	#	Average Savings	Average Total Cost	Cost Per Unit Saved	5-Year Measure Life	10-Year Measure Life	15-Year Measure Life
Electric Baseload							
Electric (kWh)	3,876	683	\$503	\$0.74	\$0.17	\$0.10	\$0.07
Electric Heat							
Electric (kWh)	367	1,030	\$1,290	\$1.25	\$0.29	\$0.16	\$0.12
Gas Heat							
Electric (kWh)	546	436	\$199	\$0.46	\$0.11	\$0.06	\$0.04
Gas (ccf)	577	31	\$1,001	\$32.28	\$7.46	\$4.18	\$3.11

**The table excludes 196 Electric Baseload accounts, 16 Electric Heating accounts, and 4 Gas Heating accounts without measures and cost data in 2016.

Bill and Payment Impacts

The evaluation also included an analysis of the charges and payments made by customers in the pre and post-treatment periods. Table ES-6 summarizes the results of this analysis. While total bills and charges declined by \$74, total payments and credits declined by \$81 from the pre to post period. The total bill coverage rate increased by 0.4 percentage points.⁴ Customers were paying an average of 102.1 percent of their bills prior to LIURP treatment and an average of 102.5 percent of their bills following LIURP treatment.

**Table ES-6
Bills, Payments, and Coverage Rates
Pre and Post-LIURP Treatment**

	#	Pre	Post	Change	Percent Change
Electric Baseload					
Total Bills and Charges	3,666	\$1,084	\$997	-\$87***	-8.0%
Total Payments and Credits		\$1,075	\$984	-\$91***	-8.5%
Total Coverage Rate		102.4%	103.7%	1.3%*	1.3%
Electric Heat					
Total Bills and Charges	274	\$1,747	\$1,545	-\$201***	-11.5%
Total Payments and Credits		\$1,701	\$1,552	-\$149***	-8.7%
Total Coverage Rate		100.8%	100.9%	0.2%	0.2%

⁴ The total coverage rate is the total of all customer payments, customer assistance, and other credits divided by the bill.

	#	Pre	Post	Change	Percent Change
Gas Heat					
Total Bills and Charges	502	\$1,418	\$1,470	\$52***	3.7%
Total Payments and Credits		\$1,433	\$1,448	\$14	1.0%
Total Coverage Rate		103.4%	99.1%	-4.3%***	-4.2%
Education Only					
Total Bills and Charges	532	\$1,103	\$1,064	-\$39**	-3.5%
Total Payments and Credits		\$1,099	\$1,028	-\$71***	-6.5%
Total Coverage Rate		100.1%	98.6%	-1.5%	-1.5%
All Job Types					
Total Bills and Charges	4,974	\$1,156	\$1,082	-\$74***	-6.4%
Total Payments and Credits		\$1,148	\$1,067	-\$81***	-7.1%
Total Coverage Rate		102.1%	102.5%	0.4%	0.4%

Key Findings and Recommendations

PECO's LIURP delivered usage reduction services and energy education to over eight thousand customers in 2016, many of whom had vulnerable household members. Savings from electric baseload jobs, electric heating jobs, and gas heating jobs all declined as compared to the historical average and declined as compared to 2015 for electric baseload and electric heating jobs.

We have the following recommendations to improve energy savings.

- *Outreach* – CMC is not able to reach 47 percent of targeted customers because these customers make no response to contact attempts. CMC's current procedure is to make at least three phone calls and send a follow-up letter.⁵ They should increase the number of calls to potential customers and pilot additional methods including outreach to targeted neighbors when they are in the field and leaving door hangers when they are in the neighborhood where additional customers are targeted.
- *Previously Treated Customers* – PECO allows customers who were treated more than two years ago to be re-treated by LIURP. Customers in the same home who were treated within the past five years are unlikely to have significant energy-saving opportunities. PECO should consider expanding the length of time before CMC can return to the home to deliver LIURP again.
- *Service Delivery* – APPRISE completed a technical evaluation of PECO's LIURP in 2014 that included on-site observation of service delivery and inspections of completed jobs. The research found that refining current procedures and improved implementation with additional contractor training could have significant positive impacts on the energy

⁵ This is PECO's minimum standard for the number of contact attempts.

savings achieved by LIURP. PECO should continue to observe and inspect LIURP jobs to ensure that higher standards for service delivery are met.

- *CMC Process* – CMC has made improvements to their process over the past few years. It is possible that these changes will result in higher energy savings over time, but such savings have not yet been seen. Additionally, changes in the management at CMC could potentially have a negative impact on the program. Evaluation results should be assessed next year to determine whether additional process changes are needed.
- *CMC Inspections*: CMC aims to inspect all comprehensive jobs and five percent of other jobs. PECO should re-assess whether the time allocated for CMC inspections is adequate and consider utilizing a third-party for these reviews, especially given the trend toward more measure installations being done by CMC staff instead of subcontractors.
- *Measure Opportunities*: Installation of major measures increased in electric heating jobs but remained at the same level in gas heating jobs. PECO should ensure that CMC is pursuing all cost-effective energy-saving opportunities on all job types.
- *Health and Safety Measures*: PECO should investigate whether a small amount spent on additional health and safety measures could lead to additional cost-effective energy efficiency measure installations.
- *Additional Measures*: The 2014 technical evaluation⁶ recommended the replacement of old dehumidifiers, and potentially use of LED bulb replacement (for incandescent bulbs) as their cost continues to decline and the cost-effectiveness is positively evaluated. Smart thermostats have been found to provide significant heating and cooling savings, and PECO should consider piloting this measure. PECO is considering the implementation of mini-split systems. CMC has several other recommendations for potential additional measures that PECO should evaluate.

⁶LIURP On-Site Research Final Report, February 2015.

I. Introduction

This report presents the findings from the 2016 PECO LIURP evaluation. PECO's LIURP provides energy efficiency services and energy education to low-income households to help them reduce their energy usage and increase the affordability of their energy bills. This report describes the Program services and analyzes the impact of the Program on customers' energy usage, energy bills, and payments.

A. *Background*

PECO Energy has implemented a set of Universal Services Programs to meet requirements set by Pennsylvania's electric and gas restructuring legislation and various Public Utility Commission orders and agreements. The Universal Service goals are as follows.

- To protect consumers' health and safety by helping low-income customers maintain affordable utility service.
- To provide affordable utility service by making available payment assistance to low-income customers.
- To help low-income customers conserve energy and reduce residential utility bills.
- To ensure utilities operate universal service and energy conservation Programs in a cost-effective and efficient manner.

The Universal Services Programs include the following four initiatives.

- A CAP payment assistance Program that is designed to make energy bills more affordable by furnishing payment subsidies.
- A LIURP Program that is designed to make energy bills more affordable by helping to reduce usage.
- A CARES Program that is designed to assist households in developing appropriate strategies for maintaining energy service.
- A MEAF hardship fund Program that is designed to furnish emergency payments to households that cannot pay their energy bills.

B. *Evaluation Objectives and Activities*

The goals of the evaluation were to analyze the LIURP services provided and the impacts of the services on participating customers. Three key activities were undertaken as part of this evaluation.

- *Process Evaluation:* We undertook evaluation activities to document and assess the implementation of PECO's LIURP.

In-depth telephone interviews were conducted with CMC managers and staff; and with six subcontractors who provide weatherization, heating, and electrical program services.

The following interviews were conducted.

- CMC LIURP Senior Manager Interview: This interview detailed the changes to CMC staff, the subcontractor management and review process, customer interactions, and quality control.
 - CMC LIURP Manager: This interview documented auditor and subcontractor management, call center operations, and quality control.
 - CMC Quality Control Staff Interviews: These two interviews documented the quality control process, problems found in subcontractor performance, and opportunities for LIURP improvement.
 - CMC Customer Care Supervisor: This interview documented call center staff processes, training, and supervision.
 - Subcontractors: Interviews were conducted with two HVAC subcontractors, one plumbing and heating contractor, two weatherization subcontractors, and one electrical subcontractors to document their experience with LIURP, the supervision and training they received from CMC, and any recommendations they had for the program.
- *Program Database Analysis:* We conducted analysis of the 2016 LIURP Program database, which included data on services delivered, homes serviced, and customers served.
 - *Program Impacts Analysis:* We analyzed billing and transactions data to estimate the impact of the Program on energy usage, energy costs, and bill payment.

C. Organization of the Report

Five sections follow this introduction.

- Section II – Low Income Usage Reduction Program: This section describes PECO's LIURP design and implementation.
- Section III – Program and Participant Statistics: This section provides descriptive statistics on LIURP services delivered in 2016 and the customers who received these services.

- Section IV – Usage Impacts: This section analyzes the impacts of LIURP on customers’ electric and gas usage.
- Section V – Payment Impacts: This section analyzes changes in customers’ bills, payments, and arrearages after receiving Program services.
- Section VI – Summary of Findings and Recommendations: This section provides a summary of the key findings and furnishes recommendations for PECO’s LIURP based on the analyses in this report.

APPRISE prepared this report under contract to PECO. PECO 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 PECO.

II. Low Income Usage Reduction Program

PECO has implemented a set of Universal Service Programs to comply with Public Utility Commission Regulations. The programs are designed for low-income, residential customers. One of these programs is the Low Income Usage Reduction Program (LIURP).

The Pennsylvania Public Utility Commission (PUC) requires that all electric and gas utilities in the state offer a Low-Income Usage Reduction Program (LIURP) to their customers. PECO has contracted with CMC Energy Services (CMC) to administer LIURP since the implementation of the Program in 1991. PECO and CMC worked together to create Program procedures that complied with Chapter 58 guidelines, and continue to work together to design and implement Program changes when necessary. CMC subcontracts with six subcontractors to install major Program measures and an additional subcontractor to deliver energy efficient refrigerators.

The total 2016 LIURP budget was \$7.85 million with \$5.6 million for electric usage reduction and \$2.25 million for gas usage reduction.

A. Program Management and Administration

CMC staff has recently had some turnover in their LIURP management. The following staff members are responsible for the program implementation.

- The Senior Program Manager is responsible for PECO LIURP program delivery, spending, savings and targets. He has worked in this capacity for almost three years.
- The Associate Program Manager is responsible for the day-to-day operation of LIURP. He is responsible for meeting the audit goals and the spending goals. Responsibilities include oversight of program staff, budget management, production goals, monthly reporting, contract/regulatory compliance, subcontractor performance, customer satisfaction and staff training. He has been in this position for approximately one year.
- The Executive Assistant provides support to the Director of Operations. She is responsible for ensuring that subcontractors are in compliance with fitness for duty and insurance requirements, managing access to PECO data, and providing support and ordering program brochures.
- The Quality Control Supervisor is responsible for managing subcontractors and field inspectors, providing technical assistance to inspectors and customer service representatives, resolution of customer inquiries, and monitoring of the quality control procedures. He is responsible for all technical compliance and ensuring that subcontractors complete work within the allotted timeline. He presents a quarterly safety meeting and holds a weekly auditor meeting.
- The Field Services Supervisor is responsible for oversight of the energy auditors, training, and technical support. The Field Services Supervisor is responsible for

ensuring that program measures are installed as recommended by the energy auditor and the energy auditor's analysis is in compliance with the LIURP program guidelines. He reviews the electronic audit results, validates the data, and approves recommendations. In some cases he submits requests to PECO for work that is outside of the normal guidelines.

- The Data Support Technician performs another data validation check after the Field Supervisor verifies the data using reports available in CMC's system. This is the final check to ensure that the data are correct. Following this check, the data are submitted to CMC's finance department.
- CMC's two Field Quality Control Inspectors are responsible for monitoring the work performed by subcontractors and conducting on-site observations and post-treatment inspections.
- The ten BPI-Certified Energy Auditors perform audits for LIURP.
- The Customer Care Manager is responsible for performing the analytics of the phone system, making sure the phone system equipment is running, monitoring calls, and running metrics on the call center.
- The Customer Care Center Supervisor is responsible for the completeness and accuracy of the customer demographic data collected during the appointment scheduling process, coaching Customer Care Representatives, and serving as the main point of contact for PECO when there are PUC inquiries about LIURP customers.
- The ten Customer Care Representatives are responsible for taking incoming calls and scheduling energy audits and inspections.

CMC meets with PECO monthly for performance reviews and bi-monthly for Program review meetings. PECO conducts monthly site visits and inspections and has regular telephone and/or e-mail contact with CMC.

CMC staff conduct the LIURP audit and develop a work order for additional measures to be installed on subsequent visit(s) by the program subcontractors who assist in the implementation of LIURP. Additionally, one of the changes that was made in the middle of 2015 was that CMC began doing minor air sealing measures during the audit visit including door sweeps, weather stripping, plumbing access air sealing, and attic hatch air sealing. They have also gradually expanded the direct installs that the auditor can perform to include certain types of insulation. CMC staff do not blow insulation, perform heating system replacements, or perform electrical work.

CMC has a total of seven subcontractors responsible for the installation of residential air sealing, insulation, house heating, and water heating system repair and replacement, water heater timers, line voltage thermostats, energy efficient refrigerators and room air

conditioners. CMC's subcontractors are required to submit invoices weekly and obtain all required permits for municipal county inspections.

- John Kinkaid & Sons and Alek Air (began working on PECO's LIURP in 2016) perform HVAC work.
- FMG (began working on PECO's LIURP in 2016) and Premier Contractors perform weatherization work.
- Colonial Electrical installs water heater timers and line voltage thermostats.
- Black Horse Pike (began working on PECO's LIURP in 2017) performs plumbing and heating work.
- Lowes delivers energy efficient refrigerators (the change from General Electric to Lowes was made in August 2015).

CMC provides oversight and support to the subcontractors. When there is a customer who is not satisfied with the scope of work that is called for based on the energy-saving opportunities, CMC will speak with the customer and visit the job site if needed. The subcontractors noted that CMC's support is helpful and appreciated.

CMC conducted a complete analysis of the technical specifications required for each subcontractor depending on the measures they were responsible for. CMC updated all technical specifications to ensure they met all program guidelines as a minimum. They also looked at the following requirements.

- Types of materials used.
- Methods for installation.
- Guidelines for how to install the measures.

CMC changed from General Electric to Lowes for refrigerators in 2015 because of frequent customer complaints that were encountered with General Electric and problems with the timeliness of the refrigerator installation. CMC worked closely with Lowes to make this transition successful. Part of the issue was with the GE refrigerators, but the delivery service they were using for the installations was also a problem. After CMC moved over to Lowes, there was a notable decrease in defective or problem units, and CMC found that the delivery service was more willing to go above and beyond. The Lowes delivery service communicates with CMC about issues in the home, and they do what is needed to remove the old unit and get the new one installed properly and safely. Lowes has a higher caliber group installing the appliances and CMC has a much better relationship with Lowes. Customer complaints dropped significantly after this change.

B. LIURP Eligibility and Benefits

PECO customers must meet the following criteria to participate in the Program.

- Residential customer who is not planning to move in the next 12 months

- Income at or below 200 percent of the Federal Poverty Level (FPL)⁷
- Usage requirements
 - At least 500 kWh average monthly usage for CAP customers
 - At least 600 kWh average monthly usage for baseload customers
 - At least 1,400 kWh average monthly usage for electric heating customers
 - At least 50 ccf average monthly usage for gas heating customers

LIURP provides weatherization and conservation measures to promote usage reduction. Energy education tailored to the individual household's energy use is also provided to facilitate usage reduction.

The following measures may be provided.

- Insulation
- Air sealing
- Heating system repair or replacement
- Air conditioner replacement
- Refrigerator replacement
- Freezer replacement (pilot)⁸
- Water heater timer installation
- Water heater and pipe wraps
- Line voltage thermostats
- Faucet aerators
- Showerheads
- Smoke detectors
- Carbon monoxide detectors
- CFL bulbs

PECO and the PUC have pre-approved all of the LIURP measures. They have placed no cap on the amount of money spent per home. Smoke detectors and CFLs are much more commonly provided than some of the more costly measures. CFLs are now provided where bulbs are used for three hours instead of four hours due to the increasing saturation of CFL bulbs.

C. Qualification of Leads

PECO sends a quarterly download of high usage, low-income customers to CMC.⁹ Customers are also referred to LIURP through the following mechanisms.

- PECO Universal Services staff

⁷ Since 1998, LIURP regulations have permitted companies to spend up to 20 percent of their annual Program budgets on customers with income between 150 and 200 percent of the FPL.

⁸ PECO began provider freezer replacement at full scale in 2016.

⁹ This is done through a three step process.

- CAP call center
- Community Based Organizations (CBOs)
- Government agencies
- Prior Program recipients
- Universal Services Cares Unit

The electronic file downloaded from PECO contains high energy users who are also LIHEAP recipients, Customer Assistance Program (CAP) participants, payment-troubled customers, or customers with multiple payment agreements. CMC reviews the lists and eliminates customers who have received LIURP within the past two years, refused Program services, or moved within the past six months. Typically, after these removals, the remaining customers on the downloaded file are eligible for and receive services from LIURP.

CMC screens all referrals from other sources to determine Program eligibility. If income and usage history are available and the customer is determined to be eligible, CMC enrolls the customer immediately. If income eligibility cannot be determined from PECO's system, CMC mails income documentation forms to the customer. Typically, 25 to 30 percent of customers referred through other sources are determined to be eligible for and receive services from LIURP.

Referred customers may not receive LIURP services because of one of the following reasons.

- Refusal of LIURP services
- Insufficient usage history¹⁰
- Inactive account
- Income over the eligibility limit
- Non-responsive to CMC contacts
- Recently moved or is planning to move within one year
- Deceased
- Usage below the required level¹¹
- Tenant with a landlord who will not provide consent

CMC is required to obtain consent from the landlord to provide services to a tenant. A landlord may not provide approval because he or she wants to choose Program measures, is evicting the tenant, or is concerned about potential housing code violations.¹² Some landlords never respond to CMC inquiries. CMC is able to obtain landlord consent for more than 50 percent of renters.

Approximately 90 percent of customers who receive LIURP services are identified through the downloaded list, and about 10 percent through other referrals.

¹⁰This may be the case if the customer recently moved into the home.

¹¹ There are some hardship cases where PECO makes exceptions to the usage requirement.

¹² Landlords are not required to contribute to the cost of LIURP services.

D. Customer Outreach

CMC's customer service representatives contact potential Program participants by telephone to explain Program services, obtain customer information, and confirm or determine eligibility.

If the customer is eligible, an appointment is scheduled for the energy audit. CMC will attempt to make this contact three times by telephone and a minimum of one time by mail over a 90-day period.¹³ Information collected during this contact includes the following.

- Name of person responsible for bill payment
- Age of each household member
- Income sources for each household member
- Income amounts for each household member
- Property status and, if applicable, landlord contact information
- Housing type
- Occupation
- Employment status, marital status and level of education

CMC assigned technical resources to the customer service desk to provide assistance on technical questions and a resource for customer care representatives. CMC also provided regular trainings with some elements of building science, reinforced program guidelines, and retrained on what to do in particular situations. This gave the customer care representatives a better toolbox. CMC feels that any person in customer care should be able to handle any issue, which requires a lot of training.

One of the most challenging responsibilities the customer care representatives have is convincing the customer to allow a stranger to enter their home. CMC feels that their call center representatives do a good job of preparing the customer and making sure that the auditor will have access to all areas of the home.

E. Job Types

There are two different LIURP job types: Baseload and Heating. Baseload jobs focus on a household's lighting and appliances. Heating jobs include weatherization, insulation, and heating system repair or replacement. Both heating and baseload issues in a household are addressed when necessary. Renters do not receive appliance replacement through LIURP, but they do through Act 129.

F. Service Delivery

CMC prioritizes CAP participants for LIURP service delivery. All CAP participants with monthly usage at or above 500 kWh are considered for LIURP. Those with the lowest

¹³This is PECO's minimum standard for the number of contact attempts.

income and the greatest CAP benefits receive the highest priority. CMC prioritizes remaining LIURP participants by energy use and income.

The first step in direct service delivery is the Program audit, performed by CMC staff. The auditor verifies the previously reported household characteristics, including income, number of household occupants, age of home, and years of occupancy. He or she also calculates the average household energy use per day, the energy use for each household appliance, temperature settings, and water temperature. Based on this information, the auditor may wrap the water heater and pipes, and install aerators, smoke detectors, showerheads, and CFLs during this initial audit visit.

CMC provided additional training to their audit staff to increase the thoroughness of directions given to subcontractors, and to provide more documentation for each appointment. CMC started requiring the auditors to provide additional notes, documentation, and photos (if the customer agreed). Because they began using tablets in the field, it became easier to take photos and attach them to the work orders. This provided subcontractors with better information to address each home.

CMC schedules the appropriate subcontractors to complete any necessary major measures, such as insulation, heating system repair or replacement, or new appliances. A work order is sent to the subcontractor to communicate the work that is needed. CMC requires that measures be installed within 30 days of the initial audit.

CMC instituted a process where the subcontractors could talk to a quality control supervisor in a timely fashion about any questions they had on the work orders. Additionally, the work orders were improved because every work order was vetted at the supervisor level to look for missing information and needed documentation or photos. CMC responded to auditor feedback to reduce the number of audits each auditor must complete, which gives the auditor more time to add details to the work orders and improves the overall quality of the audit. CMC makes sure that the auditor provides better notes to help the subcontractor do a better job.

PECO's program review found that there were time delays from when the auditor submitted the work order to the time that the customer was contacted by the subcontractor. PECO worked with CMC to identify processes to reduce the amount of time for this contact and for job completion. CMC hired additional subcontractors and identified more measures that CMC could install with in-house technicians beginning in 2015. CMC began to perform minor air sealing and minor insulation work with their in-house technicians beginning in August 2016.

CMC developed requirements for the timing of when the subcontractor had to schedule an appointment with the customer and when the subcontractor was required to invoice for the work performed. CMC recommends that all work orders are contacted on the day that they are received. This has been successful with the subcontractors that are able to do so. When the customer is contacted within days of their audit, the work is fresh in the customer's mind and they are excited to have it done. This makes it more likely that the subcontractor will

get back into the house. They have greater success getting appointments and improved customer satisfaction.

The subcontractors are required to make three contact attempts within two weeks and have the customer's work scheduled within two weeks. They are required to invoice within 30 days. This has helped to speed up the process. Beginning in the last quarter of 2016, CMC sends a report to subcontractors every three weeks with a list of all open jobs. The subcontractors report back on whether the job is scheduled, the number of contact attempts they have made, or if the job has been cancelled because the phone number is not valid or there was a customer refusal.

G. Energy Education

PECO and CMC designed the energy education portion of LIURP to facilitate customers' clear understanding of the reasons for high energy use, and to communicate how their behaviors contribute to energy use and energy bills. The auditor provides the primary LIURP energy education session during the initial audit visit. This session lasts at least 30 minutes. Further education is often provided by subcontractors when measures are installed, and by other CMC quality control inspectors during quality control inspections and follow-up telephone calls.

During the initial education session, the auditor reviews the customer's audit results and identifies ways that the customer can modify the behaviors of household members to save energy and money. The auditor and the customer set a monthly usage and bill reduction goal for the household. The auditor also provides the customer with an education package, which includes the following materials.

- Tips for saving energy
- An energy calculator
- 'Hazards of Space Heating' pamphlet
- A brochure on CFLs that includes information on how to safely dispose of them
- Energy Savers calendar
- Energy cost estimate form
- Energy saving recommendations list based on the household's energy use
- 'Does Your Money Run Out' booklet
- Referrals to CAP rate and other programs that the customer may be eligible for

PECO also developed additional education materials that began to be used in 2016.

The auditor reviews these educational materials with the customer, and compares the household's energy cost estimate form to the household's actual energy bill. Additionally, the auditor refers the customer to programs and agencies that might help him or her meet household needs, and answers any questions the customer may have about the Program or the education session. The auditor reviews the measures that have been installed and those

that will be installed by subcontractors. In addition, the auditor reviews the LIURP follow-up procedures that the customer can expect.

For one year after LIURP services have been provided, PECO and CMC monitor the customer's monthly energy usage. CMC mails monthly progress letters to customers to highlight any changes in monthly usage, as compared to the customer's individual goal. Each quarter CMC revises the letters to emphasize energy saving tips that are specific to the current season. CMC provides an additional telephone energy education session to customers who do not meet their monthly average usage goal (MAU) after they receive LIURP services. In rare occasions, an auditor is sent back to the home for reinforcement.

H. Quality Control

Three methods are primarily used for LIURP quality control.

- An annual evaluation, conducted by an independent program evaluator.
- Customer satisfaction surveys administered by CMC.
- Inspections by the CMC Quality Control Manager and PECO's LIURP Manager.

Additionally, in 2010 and in 2016, PECO hired Pure Energy to conduct quality control inspections on a sample of approximately 300 completed jobs. The findings from the inspections were generally good, within industry standards.

CMC conducts customer satisfaction surveys during post-delivery site inspections, by telephone, and by mail. CMC reported that the surveys show customers increased their knowledge of energy conservation through Program participation. Customers reported that they were satisfied with LIURP and with the new appliances that the Program provided.

CMC inspects a minimum of five percent of the baseload jobs and tries to inspect all of the heating jobs. It can be challenging to persuade the customer to permit another visit once the installation work has been completed. PECO has worked with CMC to try to reduce the lag time between job completion and inspection to try to increase customer acceptance of the inspection visit.

The inspector works from an inspection checklist, and has the customer satisfaction survey, the home's audit results, and the completed work order to assist in the inspection. The inspector also conducts blower door, heating, and carbon monoxide testing, and confirms the presence of all invoiced measures. In addition to post-completion inspections, the inspector sometimes accompanies CMC staff on audits, and subcontractor staff on installations. CMC has access to the subcontractors' schedules, so if the inspectors have cancelled appointments, they go to observe the work of a subcontractor.

When the inspector finds missed opportunities or small mistakes, he fixes the problem and provides feedback to the individual who performed the work. For larger mistakes, or discrepancies in quantities invoiced and quantities received, the inspector fails the job and allows CMC or subcontractor staff ten business days to fix the problems and send written

confirmation of resolution to the inspector. Depending on the nature of the problem, the inspector may return to the site to re-inspect. Subcontractors noted that the inspections were helpful and resulted in a final job of the highest quality.

CMC developed a monthly scorecard for the subcontractors beginning in August 2016. The scorecard assesses the subcontractors based on the quality of the work, the job turnaround time, accuracy of invoices, response time to change orders and inquiries, and communication. It is based mostly from the post-job inspection review, but in-progress inspections also contributed to the scorecard. CMC found that the subcontractors appreciated the feedback contained in the scorecard and requested information on how they could improve. The scorecards opened up the lines of communication about what the subcontractors can do better.

The PECO LIURP manager also randomly selects homes for visits. She visits these homes and confirms that the work listed on the invoice was performed in the home. She also randomly selects and validates LIURP invoices.

The LIURP inspection process helps to ensure high quality work, and highlights areas for potential improvement. Inspection findings led to the addition of LIURP measures including central AC maintenance and an anti-spill switch for heating systems.

PECO also worked with CMC to improve customer satisfaction. CMC started to trend their customer service problems by attaching codes to every call. For example, a call may be coded as a work order inquiry. CMC can see the time from the audit to when the customer called so they can assess if it is a real problem. CMC has codes for every type of call that comes in, such as an air conditioner service required or a refrigerator service required. They can report on the number of each type of problem and see if it is increasing or decreasing. CMC tracks the issues that arise and works to root out the problems rather than just reacting.

CMC can also provide better identification of potential customer service escalated issues. CMC tracks all of these issues and makes sure they all get a swift resolution. They can closely monitor an issue every step of the way if needed because they are tracked in a different way from normal customer service calls. CMC can also have a different level of staff involved, depending on the type of call.

PECO also worked with CMC to provide additional training to call center staff on handling customer disputes and dealing with difficult customers. CMC monitors call center representatives each month to assess the quality of their interactions.

I. Data and Reporting

LIURP databases contain the following information.

- Personal and household demographics
- Landlord contact information
- Audit results

- Quantity and costs of installed measures
- Referrals made to other programs
- Post treatment follow-up outreach results
- Completion dates and usage history
- Performance scorecard

CMC and PECO check the database for completeness and accuracy. These data are used to generate regular reports, including the following.

- Completed audits compared to projected audits
- Completed jobs compared to projected jobs
- Program costs by category
- Average cost per job
- Completed jobs by type
- Outreach call volume
- Customer demographics

CMC began using tablets in the field in the last quarter of 2014. This has improved the accuracy of data collection because there are checks programmed into the data entry fields and there is also additional post-entry data validation that is conducted.

CMC and PECO monitor Program data monthly and the independent evaluator monitors Program data annually. In addition to this report, CMC and PECO produce an annual report to the PUC.

J. LIURP Training

PECO states in their contract with CMC that they require LIURP staff members to be adequately trained. CMC's Quality Control Manager assesses the training needs of the CMC field and sub-contractor staff. The CMC Office Manager assesses the training needs of the CMC administrative staff. CMC provides full training to each LIURP staff member at the time of hire, and additional training as needed.

CMC provides LIURP technical staff with diagnostic training through the Pennsylvania College of Technology, state certification, and auditor certification. CMC also sends staff members to the Home Performance Conferences and provides field technicians with BPI training. PECO provides LIURP staff with training on mainframe connection and procedures, the Universal Services Programs, customer service procedures, and safety hazards. PECO also provides LIURP staff with the opportunity to attend conferences.

CMC does vetting of potential subcontractors and ensures that they have the proper certifications to perform the work. After the subcontractor is approved, CMC has an Onboarding Process to ensure that the subcontractor understands the process, inspections, work orders, line items, and invoicing.

CMC issues the new subcontractor a handful of jobs and is on the job with the new subcontractor for a minimum of four jobs, to take questions in the field and make sure that the staff are comfortable with testing requirements, clear on all instructions, and that there is no confusion about the work order language.

As long as the first four jobs go well, the subcontractor moves forward with more work. CMC will not have an inspector on site with every job, but they do a regular amount of in-progress inspection. This is used as a training/mentoring opportunity to field questions, make sure that the technician is comfortable doing the work, and confirm that the technician communicates properly with the customer.

One of the final pieces of CMC's contractor mentoring and training process is the regular meeting where CMC will ask one of the subcontractors to perform a demonstration in the field or will ask the subcontractor to meet with the auditors at CMC's Monday morning meeting. This step gives the contractors the opportunity to report on their field experiences and provide the auditors with some feedback. For example, subcontractors may ask for more notes or better photos in certain situations. Auditors can also ask for feedback from the subcontractors about what they feel is needed to get the jobs done well.

CMC also has field demonstrations where one of the subcontractors will do a demonstration for CMC out in the field. Both auditors and subcontractors benefit from the demonstrations because it shows the subcontractors that their work is valuable and it makes subcontractors feel more appreciated.

CMC provides call center staff with training on LIURP procedures, requirements, questions that come into the call center, and sample responses. Training includes practice with sample calls. The new representatives receive a complete review of the LIURP program so they have a clear understanding of what to expect, and also receive information about how to prepare the customer for what to expect when participating in LIURP.

There is also ongoing training for all staff members. CMC has had training provided by an outside professional for the entire call center. They have weekly meetings where they review issues that came up during the week and how unique calls were handled. They record all calls, and they make sure that the customer care representatives follow the script and guidelines. They also provide individual coaching sessions where they review the representative's call quality, readiness to take calls, scheduled appointments, and any errors made that month.

K. Program Coordination

CMC maintains a LIURP referral list consisting of other Universal Services Programs and state and county agencies that provide assistance to low-income customers. CMC staff make referrals during the initial energy audit, as well as during inspection and post-treatment follow-up calls. During the follow-up call, CMC staff members ask customers whether they were able to obtain any benefits from the referrals they were given. Additionally, the CMC

auditor provides CAP and LIHEAP applications to customers at the time of the LIURP audit.

Participation in LIURP is a requirement of PECO's CAP. CAP participants who refuse LIURP receive two letters to remind them of the CAP requirements. Most customers respond to the second letter. PECO's LIURP manager sends the list of customers who do not respond to the second letter (not including tenants) to the CAP Program Manager and Supervisor for a telephone follow-up. If the customer does not respond to this outreach, the customer is removed from CAP. The LIURP refusal rate among CAP participants has declined dramatically since this process was put into place.

III. Program and Participant Statistics

This section provides statistics on the LIURP services that were provided in 2016, as well as the characteristics of the homes and the customers who were served by the Program.

A. Participation

PECO screened 24,560 customers for LIURP services in 2016. Table III-1 shows that 15,103 were cancelled, 653 customers were not eligible, and 8,804 received Program services.

Table III-1
Customers Evaluated for Program Services

Category	Number	Percent of Total
Cancelled	15,103	61%
Ineligible	653	3%
Treated	8,804	36%
TOTAL	24,560	100%

Table III-2 displays the reasons why customers were deemed ineligible for LIURP. While 55 percent were ineligible because they were over the income eligibility limit, 16 percent were ineligible because the scope of work was beyond the program's guidelines, and seven percent were commercial accounts.

Table III-2
Ineligible Customers

Category	Number	Percent of Total
Over Income	361	55%
Scope Of Work Beyond Guidelines	107	16%
Do Not Contact	92	14%
Commercial Account	46	7%
Insufficient Usage History	36	6%
Conversion Error	6	1%
Usage Below Guidelines	5	1%
TOTAL	653	100%

Table III-3 displays reasons why customers were cancelled. The largest group of customers, 76 percent, made no response to contact attempts. Nine percent had a planned move, nine percent refused services, and four percent had an inactive account.

**Table III-3
Cancelled Customers**

Category	Number	Percent of Total
No Response To Contact Attempts	11,497	76%
Customer Moving	1,327	9%
Customer Refused	1,294	9%
Inactive Account	670	4%
Renovations In Progress	103	1%
No Landlord Consent	93	1%
Do Not Contact	92	1%
Cancelled Due To Unsafe Environment	17	<1%
Cancelled At The Door Due To Inactive Account	10	<1%
TOTAL	15,103	100%

B. LIURP Services

This section describes LIURP services that were delivered in 2016. The total budget was \$7.85 million with \$5.6 million for electric usage reduction and \$2.25 million for gas usage reduction. Table III-4 shows the distribution of this spending. Sixty-five percent was spent on weatherization measures and labor, 31 percent was spent on audits and education, four percent was spent on PECO administration, and less than one percent was spent on solar water heating pilot maintenance.

**Table III-4
2016 LIURP Expenditures
By Category**

Category	Amount Spent	Percent of Funds
Weatherization Measures	\$4,925,383	65%
Audit/Education	\$2,313,545	31%
PECO Administration	\$320,633	4%
Solar Water Maintenance	\$621	<1%
TOTAL	\$7,560,183	100%

Table III-5A displays the distribution of LIURP jobs and expenditures by job type. Jobs are classified as baseload, electric heating, or gas heating. While 64 percent of the jobs were classified as baseload, they represented 30 percent of the total costs. The average cost for measures on these jobs was \$306. Gas heating jobs represented 20 percent of jobs and 50 percent of costs, averaging \$1,640 in measure costs per home. Electric heating jobs averaged \$1,501 per home.

Table III-5A
2016 LIURP Service Delivery and Expenditures
By Job Type

Job Type	# of Jobs	% of Jobs	Total Cost	% of Costs	Average Job Cost
Baseload [†]	5,452	64%	\$1,669,839	30%	\$306
Electric Heating	737	9%	\$1,106,598	20%	\$1,501
Gas Heating	1,670	20%	\$2,739,404	50%	\$1,640
No LIURP Measure Costs [‡]	697	8%	\$0	0%	\$0
TOTAL*	8,556	100%	\$5,515,842	100%	\$645

*The table excludes 248 accounts (222 Electric Baseload, 18 Electric Heating, and 8 Gas Heating) without measures and cost data.

[†]There were 3 accounts all the measures installed were cancelled.

[‡]There were 697 accounts that received education only.

Table III-5B displays jobs by type, but lists the low usage and prior year jobs separately, as these jobs are not included in the impact analysis.

Table III-5B
2016 LIURP Service Delivery and Expenditures by Job Type
Low Usage and Prior Year Jobs Separated

Job Type	# of Jobs	% of Jobs	Total Cost	% of Costs	Average Job Cost
Baseload [†]	5,029	59%	\$1,536,797	28%	\$306
Electric Heating	710	8%	\$1,076,791	20%	\$1,517
Gas Heating	1,624	19%	\$2,692,692	49%	\$1,658
Low Usage	389	5%	\$174,287	3%	\$448
Electric Heat Low Use	101	1%	\$23,776	<1%	\$235
Baseload Addressing Heater	6	<1%	\$11,500	<1%	\$1,917
No LIURP Measure Costs [‡]	697	8%	\$0	0%	\$0
TOTAL*	8,556	100%	\$5,515,842	100%	\$645

*The table excludes 248 accounts (210 Electric Baseload, 18 Electric Heating, 6 Gas Heating, 13 Low Usage, and 1 Electric Heat Low Use) without measures and cost data.

[†]There were 3 accounts all the measures installed were cancelled.

[‡]There were 697 accounts that received education only.

Table III-6 provides a more detailed breakdown of the type of work done in LIURP jobs, based on CMC's classification of measure types. Many jobs received more than one type of service. Eighty-six percent of the customers received baseload services, but only 20 percent received a refrigerator replacement. Thirteen percent received air sealing and twelve percent received weatherization. Eleven percent received a heating system tune-up, and seven percent received insulation.

**Table III-6
2016 LIURP Service Delivery and Expenditures**

Work Type	# of Jobs	% of Jobs	Total Cost	% of Costs	Average Cost
Baseload	7,400	86%	\$306,474	6%	\$52
Refrigerator Replacement	1,707	20%	\$1,116,820	20%	\$755
Air Sealing	1,127	13%	\$581,731	11%	\$516
Weatherization	994	12%	\$247,698	4%	\$249
Insulation	572	7%	\$468,628	8%	\$819
Electrical	538	6%	\$303,219	5%	\$564
Heating System Tune Up	975	11%	\$312,926	6%	\$321
Heating System Replacement	242	3%	\$1,118,747	20%	\$4,623
Air Conditioner Replacement	1,288	15%	\$791,509	14%	\$615
Water Heater Replacement	237	3%	\$225,496	4%	\$951
Water Heater Service	281	3%	\$41,971	1%	\$149
Solar Water Heating System Repair	3	<1%	\$621	<1%	\$207
TOTAL*	8,556	100%	\$5,515,842	100%	\$645

*The table excludes 248 accounts (210 Electric Baseload, 18 Electric Heating, 6 Gas Heating, 13 Low Usage, and 1 Electric Heat Low Use) without measures and cost data.

†5,920 of the 7,400 jobs with baseload measures had one or more baseload measures funded through LIURP. The other jobs had all baseload measures funded through Act 129. Average costs for the 20,853 baseload measures funded through LIURP are shown in this table.

‡1,480 of the 1,707 jobs with a refrigerator replaced had that refrigerator replacement funded through LIURP. The other jobs had the refrigerator replacement funded through Act 129. Average costs for the 1,756 refrigerator replacements (a few jobs had more than one refrigerator replaced) funded through LIURP are shown in this table.

Table III-7A provides information on the frequency of individual measures installed through LIURP. Some of the key pieces of information from this table are described below.

- *Health and safety:* Over 7,600 smoke detectors were provided in 3,189 homes.
- *Compact fluorescent light bulbs:* CFLs were provided to 69 percent of the homes serviced. On average, 6.2 bulbs were provided to each home serviced.
- *Refrigerator replacement:* Refrigerators were replaced in 1,703 homes.
- *Air conditioner replacement:* Window air conditioners were replaced in 1,288 homes.
- *Aerators and showerheads:* A total of 1,740 aerators were provided in 1,131 homes and 1,484 showerheads were provided in 1,299 homes.
- *Water heaters:* Electric water heater timers were provided in 357 homes and water heater replacements were provided in 235 homes.

- *Air sealing*: Air sealing was provided in 2,642 homes. However, only 803 received a blower door test.
- *Insulation*: Insulation was provided in 668 homes.
- *Heat system repair*: Heating system repair work was provided to 607 homes.
- *Heating system replacement*: Heat pumps were replaced in 26 homes, furnaces in 102 homes, and boilers in 108 homes.

Table III-7A
2016 LIURP Service Delivery and Expenditures
By Measure Type

Measure*	Number of Jobs	% of Jobs	Total Number
Smoke Detector	3,189	37%	7,622
Smoke Detector Battery	392	5%	867
Other Health and Safety	1,077	13%	1,081
CFLs	5,872	69%	36,412
Refrigerator Replacement	1,703	20%	1,703
Refrigerator Removal	10	<1%	10
Air Conditioner Replacement	1,288	15%	2,314
AC Maintenance	9	<1%	9
Aerator	1,131	13%	1,740
Showerhead	1,299	15%	1,484
Water Heater Pipe Insulation	645	8%	645
Electric Water Heater Timer	357	4%	357
Water Heater Replacement	235	3%	235
Water Heater Labor	311	4%	311
Water Heater Part	58	1%	60
Air Sealing	2,642	31%	2,642
Blower Door Test	803	9%	803
Insulation	668	8%	668
Weatherization	677	8%	677
Duct/Pipe Insulation	151	2%	151
Electric Labor	169	2%	169
Electric Part	120	1%	168
Line Voltage Thermostat	230	3%	822
Manual Thermostat	204	2%	220

Measure*	Number of Jobs	% of Jobs	Total Number
Programmable Thermostat	89	1%	92
Other Thermostat	4	<1%	4
Clean and Tune	734	9%	734
Heating System Labor	607	7%	607
Heating System Part	156	2%	319
Electric Baseboard	17	<1%	27
Gas Boiler	108	1%	108
Furnace	102	1%	102
Furnace Filter	11	<1%	11
Heat Pump	26	<1%	26
Solar Water Heater Repair	3	<1%	3

*The table excludes 248 accounts (210 Electric Baseload, 18 Electric Heating, 6 Gas Heating, 13 Low Usage, and 1 Electric Heat Low Use) without measures and cost data.

Table III-7B displays the measure installation rates by job type. The table shows that 65 percent of gas heat jobs and 56 percent of electric heat jobs received air sealing and that 26 percent of gas heat jobs and 32 percent of electric heat jobs received insulation.

Table III-7B
2016 LIURP Service Delivery
Measure Frequency by Job Type

Measure	All Participants			Analysis Group		
	Baseload	Electric Heat	Gas Heat	Baseload	Electric Heat	Gas Heat
Number of Customers*	5,029	710	1,624	3,876	367	577
Smoke Detector	43%	27%	42%	41%	25%	36%
Smoke Detector Battery	4%	2%	11%	3%	2%	13%
Other Health and Safety	0%	5%	62%	0%	6%	56%
CFLs	79%	59%	68%	81%	54%	62%
Refrigerator Replacement	22%	19%	22%	18%	16%	16%
Refrigerator Removal	<1%	<1%	0%	<1%	<1%	0%
Air Conditioner Replacement	18%	8%	16%	7%	4%	5%
AC Maintenance	0%	0%	<1%	0%	0%	0%
Aerator	6%	25%	37%	6%	26%	36%
Showerhead	6%	37%	39%	6%	38%	41%
Water Heater Pipe Insulation	3%	19%	19%	3%	16%	16%
Electric Water Heater Timer	2%	23%	4%	2%	22%	2%
Water Heater Replacement	<1%	2%	12%	<1%	1%	8%

Measure	All Participants			Analysis Group		
	Baseload	Electric Heat	Gas Heat	Baseload	Electric Heat	Gas Heat
Water Heater Labor	<1%	1%	17%	<1%	0%	15%
Water Heater Part	<1%	<1%	3%	0%	<1%	2%
Air Sealing	21%	56%	65%	19%	41%	50%
Blower Door Test	<1%	30%	35%	0%	19%	21%
Insulation	<1%	32%	26%	0%	23%	17%
Weatherization	<1%	26%	29%	0%	16%	14%
Duct/Pipe Insulation	0%	3%	8%	0%	1%	4%
Electric Labor	1%	14%	1%	1%	13%	2%
Electric Part	1%	9%	1%	1%	7%	1%
Line Voltage Thermostat	<1%	25%	1%	<1%	22%	1%
Manual Thermostat	0%	1%	12%	0%	1%	6%
Programmable Thermostat	0%	3%	4%	0%	1%	2%
Other Thermostat	0%	0%	<1%	0%	0%	<1%
Clean and Tune	0%	2%	44%	0%	1%	37%
Heating System Labor	0%	19%	28%	0%	13%	18%
Heating System Part	0%	1%	9%	0%	0%	5%
Electric Baseboard	0%	2%	<1%	0%	2%	0%
Gas Boiler	0%	<1%	7%	0%	0%	2%
Furnace	0%	1%	5%	0%	1%	2%
Furnace Filter	0%	<1%	1%	0%	<1%	<1%
Heat Pump	0%	3%	<1%	0%	1%	0%
Solar Water Heater Repair	<1%	<1%	0%	<1%	0%	0%

*The table excludes 248 accounts (210 Electric Baseload, 18 Electric Heating, 6 Gas Heating, 13 Low Usage, and 1 Electric Heat Low Use) without measures and cost data.

Table III-7C displays the key measure installation rates for electric baseload jobs from 2011 through 2016. The table shows that the refrigerator replacement rate has declined since its increase in 2014.

Table III-7C
2011-2016 LIURP Measure Frequency
Electric Baseload Jobs

Measure	Electric Baseload - All Participants						Electric Baseload - Analysis Group					
	2011	2012	2013	2014	2015	2016	2011	2012	2013	2014	2015	2016
# of Customers*	4,175	5,475	6,163	6,159	6,688	5,029	2,440	3,982	4,781	4,798	4,971	3,876
Refrigerator Remove	<1%	<1%	<1%	<1%	0%	<1%	<1%	<1%	<1%	<1%	0%	<1%
Refrigerator Replace	11%	9%	15%	27%	26%	22%	12%	10%	16%	25%	16%	18%
CFLs	88%	86%	85%	79%	71%	79%	87%	86%	84%	79%	73%	81%
Average # CFLs	8.0	7.0	4.7	6.6	4.4	6.3	7.9	7.1	4.6	6.6	4.6	6.2

*The table excludes 210 Electric Baseload accounts without measures and cost data in 2016.

Table III-7D shows that electric heating jobs with a blower door test increased from 20 percent in 2015 to 30 percent in 2016, jobs with air sealing increased from 45 percent in 2015 to 56 percent in 2016, and insulation increased from 23 percent in 2015 to 32 percent in 2016. This is due to increased requirements implemented by PECO for CMC to focus on the comprehensiveness of service delivery following the decline of these measures in previous evaluations.

Table III-7D
2011-2016 LIURP Measure Frequency
Electric Heating Jobs

Measure	Electric Heating - All Participants						Electric Heating - Analysis Group					
	2011	2012	2013	2014	2015	2016	2011	2012	2013	2014	2015	2016
# of Customers*	265	494	743	981	777	710	134	309	485	593	373	367
CFLs	68%	82%	71%	67%	64%	59%	65%	84%	71%	64%	67%	54%
Refrigerator Removal	0%	0%	0%	0%	0%	<1%	0%	0%	0%	0%	0%	<1%
Refrigerator Replace	12%	6%	11%	21%	22%	19%	14%	7%	11%	19%	12%	16%
Blower Door Test	40%	32%	30%	27%	20%	30%	48%	34%	30%	28%	10%	19%
Air Sealing	49%	48%	42%	45%	45%	56%	54%	49%	41%	44%	31%	41%
Duct/Pipe Insulation	3%	3%	4%	5%	2%	3%	3%	4%	4%	6%	1%	1%
Weatherization	28%	24%	21%	21%	17%	26%	26%	22%	19%	21%	8%	16%
Insulation	39%	37%	29%	31%	23%	32%	44%	37%	27%	32%	9%	23%
Line Voltage Therm	36%	30%	29%	29%	33%	25%	33%	28%	27%	25%	24%	22%
Heating Labor	19%	10%	9%	12%	16%	19%	23%	12%	8%	11%	10%	13%
Heating System Part	2%	2%	1%	2%	1%	1%	1%	2%	1%	2%	0%	0%
Electric Baseboard	7%	9%	10%	5%	5%	2%	5%	8%	9%	4%	3%	2%

Measure	Electric Heating - All Participants						Electric Heating - Analysis Group					
	2011	2012	2013	2014	2015	2016	2011	2012	2013	2014	2015	2016
Heat Pump	7%	3%	4%	3%	3%	3%	7%	4%	4%	3%	1%	1%

*The table excludes 18 Electric Heating accounts without measures and cost data in 2016.

Table III-7E shows that gas heating job installation rates were approximately the same in 2016 as they were in 2015.

Table III-7E
2011-2016 LIURP Measure Frequency
Gas Heating Jobs

Measure	Gas Heating - All Participants						Gas Heating - Analysis Group					
	2011	2012	2013	2014	2015	2016	2011	2012	2013	2014	2015	2016
# of Customers*	1,668	1,282	1,623	1,222	1,303	1,624	1,211	833	1,170	845	551	577
Blower Door Test	60%	60%	41%	40%	35%	35%	60%	59%	38%	39%	25%	21%
Air Sealing	76%	74%	57%	61%	64%	65%	76%	74%	55%	58%	51%	50%
Duct/Pipe Insulation	12%	15%	13%	15%	12%	8%	12%	15%	13%	12%	7%	4%
Weatherization	45%	41%	31%	32%	28%	29%	45%	42%	30%	30%	15%	14%
Insulation	54%	46%	30%	35%	27%	26%	54%	45%	30%	33%	15%	17%
Heating Labor	30%	23%	17%	23%	28%	28%	31%	22%	15%	17%	19%	18%
Heating Part	25%	20%	13%	12%	8%	9%	25%	21%	11%	7%	5%	5%
Furnace	14%	10%	4%	4%	5%	5%	14%	10%	3%	3%	3%	2%
Gas Boiler	13%	7%	5%	4%	5%	7%	13%	6%	4%	3%	2%	2%

*The table excludes 6 Gas Heating accounts without measures and cost data in 2016.

Table III-7F displays the number of major measures installed in electric and gas heating jobs from 2011 through 2016. Electric major measures include refrigerator replacement, air conditioner replacement, water heater replacement, heat pumps, electric baseboards, insulation, and blower door guided air sealing. Gas major measures include furnace replacement, water heater replacement, insulation, and blower door guided air sealing. The table shows that the percentage of electric heating jobs with no major measures declined from 73 percent in 2015 to 59 percent in 2016 and the percent with one or more major measures increased. There was no change seen from 2015 for the gas heating jobs.

Table III-7F
2011-2016 Number of Major Measures Installed

	Electric Heating – Analysis Group							Gas Heating - Analysis Group					
	2011	2012	2013	2014	2015	2016		2011	2012	2013	2014	2015	2016
Number of Customers	134	309	485	593	373	367	Number of Customers	1,211	833	1,170	845	552	577
# Major Measures							# Major Measures						
0	37%	49%	51%	50%	73%	59%	0	17%	27%	49%	49%	67%	68%
1	17%	17%	23%	21%	17%	21%	1	28%	29%	25%	23%	18%	17%
2	35%	27%	18%	23%	8%	17%	2+	54%	44%	26%	28%	15%	15%
3+	11%	8%	8%	6%	1%	4%							
Total	100%	100%	100%	100%	100%	100%	Total	100%	100%	100%	100%	100%	100%

*The table excludes 16 Electric Heating and 4 Gas Heating accounts without measures and cost data in 2016.

C. Home Characteristics

CMC collects detailed information on customers who receive LIURP services, which allows for an in-depth analysis of the homes treated by the Program. We first examine the weather-normalized pre-treatment usage of customers who received LIURP treatments. Table III-8A shows that customers who received baseload services had average usage of 10,430 kWh, electric heating customers had average usage of 17,150 kWh, and gas heating customers had average gas usage of 944 ccf.

Table III-8A
Pre-Treatment Weather Normalized Usage

Job Type	Number of Jobs	Jobs with Usage Data	Electric Use (kWh)	Gas Use (ccf)
Baseload	5,674	4,345	10,430	884 ²
Electric Heating	755	384	17,150	910 ³
Gas Heating	1,678	604	8,787 ¹	944 ⁴
Total Excluding Those Without LIURP Measures	8,107	5,333	10,742	919
No LIURP Measures	697	611	9,857	942
Total Including Those Without LIURP Measures	8,804	5,944	10,651	921

¹There are only 567 gas heating jobs with electric usage. ²There are only 426 baseload jobs with gas usage. ³There are only 27 electric heating jobs with gas usage. ⁴There are only 600 gas heating jobs with gas usage. (These jobs are originally classified as “low usage.”)

Table III-8B lists those with low usage and baseload jobs that addressed the heater separately.

Table III-8B
Pre-Treatment Weather Normalized Usage
Low Usage and Prior Year Jobs Separated

Job Type	Number of Jobs	Jobs with Usage Data	Electric Use (kWh)	Gas Use (ccf)
Baseload	5,239	4,072	10,557	881 ³
Electric Heating	728	383	17,180	910 ⁴
Gas Heating	1,630	581	8,917 ¹	944
Low Usage	402	209	5,251 ²	960
Electric Heat Low Use	102	86	15,376	-
Baseload Addressing Heater	6	2	7,381	-
Total Excluding Those Without LIURP Measures	8,107	5,333	10,742	919
No LIURP Measures	697	611	9,857	942
TOTAL Including Those Without LIURP Measures	8,804	5,944	10,651	921

¹There are only 550 gas heating jobs with electric usage. ²There are only 201 low usage jobs with electric usage. ³There are only 420 baseload jobs with gas usage. ⁴There are only 27 electric heating jobs with gas usage. ⁵There are only 25 low usage jobs with gas usage.

Table III-9 displays the primary heating source for LIURP jobs by job type and overall. Approximately 82 percent of the homes served had utility gas as their primary heating source. Nine percent used fuel oil and nine percent had electric heat. Baseload jobs were distributed similarly, though less than one percent had electric heat.

Table III-9
Primary Heating Source

Primary Heating Source	Baseload		Electric Heat		Gas Heat		Low Use ¹		All Jobs	
	# of Jobs	% of Jobs	# of Jobs	% of Jobs	# of Jobs	% of Jobs	# of Jobs	% of Jobs	# of Jobs	% of Jobs
Gas	4,960	85%	152	20%	1,645	99%	440	75%	7,197	82%
Fuel Oil	731	13%	14	2%	0	0%	48	8%	793	9%
Electric	73	1%	588	78%	13	<1%	89	15%	763	9%
Other	44	<1%	1	<1%	0	0%	6	1%	51	<1%
TOTAL	5,808	100%	755	100%	1,658	100%	583	100%	8,804	100%

¹Six of the jobs in this group were baseload jobs that addressed the heater.

Table III-10 describes the use of supplemental heating by jobs treated through LIURP. Overall, 41 percent of the customers who were treated by LIURP used supplemental heat,

virtually all of whom used electric supplemental heat. Forty-seven percent of the customers who had baseload services used electric supplemental heat.

**Table III-10
Supplemental Heating**

Supp. Heating Source	Baseload		Electric Heat		Gas Heat		Low Use ¹		All Jobs	
	# of Jobs	% of Jobs	# of Jobs	% of Jobs	# of Jobs	% of Jobs	# of Jobs	% of Jobs	# of Jobs	% of Jobs
None Used	3,022	52%	607	80%	1,119	67%	383	66%	5,131	58%
Electric	2,728	47%	120	16%	521	31%	195	33%	3,564	40%
Other	58	1%	28	4%	18	1%	5	<1%	109	1%
TOTAL	5,808	100%	755	100%	1,658	100%	583	100%	8,804	100%

¹Six of the jobs in this group were baseload jobs that addressed the heater.

Table III-11 displays the type of air conditioning that LIURP recipients used. Most of the LIURP recipients, 97 percent, used some form of air conditioning. The most common type, with 65 percent, was a window unit. Twenty-one percent had central air conditioning.

**Table III-11
Air Conditioning**

Air Conditioning	Number of Jobs	% of Jobs
Window Unit	5,682	65%
Central	1,850	21%
Wall Unit	613	7%
Central Heat Pump	226	3%
Portable Unit	165	2%
None Used	268	3%
TOTAL	8,804	100%

Table III-12 shows the home ownership characteristics of LIURP recipients. This table shows that 16 percent of the LIURP recipients were renters. Renters are not eligible for refrigerator replacement, air conditioner replacement, or furnace replacement.

**Table III-12
Home Ownership**

	Number of Jobs	% of Jobs
Own	7,372	84%
Rent	1,432	16%

Homes treated by LIURP were fairly old. The average age of homes treated was 79 years, and 65 percent were more than 75 years old.

Table III-13
Home Age

	Number of Jobs	% of Jobs
≤ 25 Years	280	3%
26 – 50 Years	625	7%
51 – 75 Years	2,202	25%
76 Years or Older	5,697	65%
Mean	79 Years	

Table III-14A displays the dwelling type for the homes served under LIURP. The most common type was a row home, with 78 percent of homes served. Sixteen percent lived in other types of single family homes, another four percent lived in multi-family homes, and one percent lived in mobile homes.

Table III-14A
Dwelling Type

	Number of Jobs	% of Jobs
Row	6,833	78%
Other Single Family	1,420	16%
Multi	338	4%
Mobile	111	1%
Duplex	86	<1%
Other	16	<1%
TOTAL	8,804	100%

Table III-14B displays the housing structure type for the homes served under LIURP. The most common type was wood with a full basement and an open joist attic.

Table III-14B
Type of Housing Structure

	Number of Jobs	% of Jobs
Wood, full basement, open joist attic	7,813	89%
Wood, slab foundation, open joist attic	280	3%
Wood, full basement, knee wall attic	151	2%
Wood, crawl space, open joist attic	148	2%

	Number of Jobs	% of Jobs
Wood, crawl space/basement, open joist attic	111	1%
Mobile home, post foundation	110	1%
Other	191	2%
TOTAL	8,804	100%

Table III-15 describes the heated square footage of the homes treated by LIURP. Homes averaged 1,325 square feet. Fifty-four percent of the homes were greater than 1,200 square feet.

Table III-15
Heated Square Footage

	Number of Jobs	% of Jobs
≤ 800	503	6%
801 - 1,000	1,037	12%
1,001 - 1,200	2,538	29%
1,201 or More	4,726	54%
Mean	1,325	

D. Participant Characteristics

The Program also captures detailed information on the characteristics of households who participate in the Program. Table III-16 shows that 75 percent of the households were female-headed, 44 percent contained at least one child, and 34 percent contained at least one elderly member.

Table III-16
Household Composition

	Number of Jobs	% of Jobs
Female Household Head	6,633	75%
Male Household Head	2,170	25%
Child in Household (<18)	3,876	44%
Elderly in Household (>62)	2,957	34%

*One customer had a missing value for the gender variable.

Table III-17 shows that the mean annual household income level was \$11,372. Approximately 48 percent of the households served had annual income below \$10,000. Only 12 percent had gross annual income above \$20,000.

Table III-17
Annual Income

	Number of Jobs	% of Jobs
≤ \$5,000	1,657	19%
\$5,001 - \$10,000	2,591	29%
\$10,001 - \$15,000	2,328	26%
\$15,001 - \$20,000	1,169	13%
\$20,001 or More	1,058	12%
Mean	\$11,372	

*One customer had a missing value for the annual income variable.

Table III-18 displays the household poverty level. Approximately 35 percent of the households had income below 50 percent of the Federal Poverty Level (FPL) and approximately three percent had income above 150 percent of the FPL.

Table III-18
Poverty Level

	Number of Jobs	% of Jobs
≤ 25%	1,683	19%
26% - 50%	1,409	16%
51% - 100%	3,890	44%
101% - 150%	1,605	18%
151% - 175%	139	2%
>175%	77	<1%
Mean	65%	

*One customer had a missing value for the poverty level variable.

Table III-19 describes the account type of households who participated in the Program. Approximately 89 percent were CAP participants and seven percent were Customer Choice participants.

Table III-19
Account Type

	Number of Jobs	% of Jobs
CAP	7,824	89%
Customer Choice	591	7%

Table III-20 displays the education level of the head of household. The majority of participants, 67 percent, had a high school education. Seven percent had some high school, ten percent had some college, and ten percent had a college degree.

Table III-20
Education Level

	Number of Jobs	% of Jobs
No Formal Education	216	2%
Some Grade School	68	<1%
Grade School	65	<1%
Some High School	655	7%
High School	5,933	67%
Some College	886	10%
College Degree	904	10%
Some Graduate Work	14	<1%
Graduate Degree	62	<1%

*One customer had a missing value for the education level variable.

Table III-21 displays the primary income source for the LIURP participants. The table shows that the largest sources of income were public assistance, pension or retirement, full-time work, dependent on another, and part-time work. Thirty-five percent had public assistance as their primary source of income, 17 percent had a pension and/or retirement, 14 percent had full-time work, 14 percent were dependent on another, and 12 percent had part-time work.

Table III-21
Income Source

	Number of Jobs	% of Jobs
Public Assistance	3,096	35%
Pension/Retirement	1,537	17%
Full Time	1,244	14%
Dependent on Another	1,225	14%

	Number of Jobs	% of Jobs
Part-Time Work	1,096	12%
Self-Employment	77	<1%
Seasonal Employment	22	<1%
Other	506	6%
Missing	1	<1%

IV. Usage Impacts

This section of the report provides analysis of the impacts of LIURP on participants' annual electric and gas usage. The section describes the methodology for the analysis, the results for all participants by job type, and the results by type of service. We then provide estimates of the impacts of individual measures and the cost-effectiveness of LIURP.

A. Methodology

Customers who received LIURP services in 2016 were treated as the analysis group for this evaluation. We focus on the electric impacts for customers who were treated as electric baseload and electric heating jobs, and the gas impacts for customers who were treated as gas heating jobs.

Energy usage was analyzed for the year prior to the LIURP audit visit and the year after service delivery was completed. The analysis included as close to a full year of data pre and post-treatment as possible. Table IV-1 displays the attrition statistics for the usage analysis. Customers were included in the analysis if their pre- and post-usage data each spanned between 270 and 390 days. Some additional customers were removed from the analysis if their usage was below 1,200 kWh or 300 ccf, or if their change in usage was greater than 65 percent. After these eliminations, we included 68 percent of the treated population in the usage analysis. A lower percentage of the heating participants were available for inclusion in the analysis, primarily due to a lack of pre-treatment usage data.

**Table IV-1
Usage Impact Data Attrition**

	Electric Baseload	Electric Heating	Gas Heating	Education Only (kWh)	Education Only (ccf)	All Jobs
Original Population*	5,237	727	1,630	694	130	8,418
Not Enough Pre-Treatment Days	807	278	824	31	2	1,942
Not Enough Post-Treatment Days	201	31	48	25	4	309
All Estimated Reads in Pre or Post	3	0	3	0	0	6
Pre Usage Below 1200 kWh or 300 ccf	0	0	30	1	12	43
Post Usage Below 1200 kWh or 300 ccf	1	0	15	1	3	20
Change in Total Usage>65%	123	15	29	13	1	181
Additional Outliers	30	20	100	19	15	184
Final Sample	4,072	383	581	604	93	5,733
% Included in Analysis	78%	53%	36%	87%	72%	68%

*As program data did not furnish rate types (electric or gas), only the customers with usage data were included in the number of original population for Education Only groups.

Energy usage data were weather normalized in the pre- and the post-usage period to ensure that changes in energy usage were due to changes in usage patterns, rather than due to changes in weather. We used a degree-day normalization process to conduct this analysis. This process involved the following steps.

1. Calculate the heating and cooling degree-days that are included in each usage period.
2. Determine whether periods should be classified as baseload periods, heating periods, or cooling periods, based on the number of heating and cooling degree-days in the period.
3. Calculate the total baseload period usage, heating period usage, and cooling period usage.
4. Calculate the relationship between heating usage minus baseload usage and degree-days. Use that slope and the average long-term heating degree-days to calculate normalized heating period usage.
5. Follow the same method to calculate normalized cooling period usage.
6. Add up the baseload usage, heating period usage, and cooling period usage to obtain the normalized annual usage.

The degree day analysis allowed for a higher percentage of cases to be included, due to fewer restrictions on data availability, and the fact that cases did not need to be removed because the model did not run or the model had a poor fit.

While the PUC does not require that baseload usage is normalized, we conducted the normalization process on the baseload usage as well as the heating and cooling usage. Baseload usage may vary with weather because of the use of air conditioning, the gas furnace's electric fan, the refrigerator, and use of electric space heaters.

B. Energy Savings Impacts

This section of the report provides the average weather-normalized usage for the pre- and post-treatment periods and the average energy savings. Table IV-2 displays these results by job type.

The table shows the following degree-day normalized savings.

- Baseload jobs had average annual savings of approximately 673 kWh, or 6.4 percent of pre-treatment usage.
- Electric heat jobs had average annual savings of approximately 998 kWh, or 5.8 percent of pre-treatment usage.

- Gas heat jobs had savings of 31 ccf, or 3.3 percent of pre-treatment usage. Gas heat jobs also had electric savings of 427 kWh, or 4.8 percent of pre-treatment usage.
- Education only jobs had average savings of 260 kWh, or 2.6 percent of pre-treatment usage.

**Table IV-2
Average Annual Usage and Savings**

	#	Total Savings				LIURP Savings		Act 129 Savings	
		Usage		Annual Savings	% Savings	Annual Savings	% Savings	Annual Savings	% Savings
		Pre	Post						
Electric Baseload (kWh)									
Non Normalized	4,072	10,392	9,792	600	5.8%	536	5.2%	64	0.6%
Degree Day Normalized	4,072	10,557	9,885	673	6.4%	609	5.8%	64	0.6%
Degree Day-PRISM cases	3,758	10,526	9,896	630	6.0%	566	5.4%	64	0.6%
PRISM Normalized	3,758	10,420	9,849	570	5.5%	506	4.9%	64	0.6%
Electric Heat (kWh)									
Non Normalized	383	16,220	15,329	891	5.5%	856	5.3%	35	0.2%
Degree Day Normalized	383	17,180	16,182	998	5.8%	963	5.6%	35	0.2%
Degree Day-PRISM cases	357	17,122	16,231	891	5.2%	856	5.0%	35	0.2%
PRISM Normalized	357	17,450	16,411	1,039	6.0%	1,004	5.8%	35	0.2%
Gas Heat (ccf)									
Non Normalized	581	871	842	29	3.4%	29	3.4%	0	0.0%
Degree Day Normalized	581	944	914	31	3.3%	31	3.3%	0	0.0%
Degree Day-PRISM cases	577	941	912	29	3.1%	29	3.1%	0	0.0%
PRISM Normalized	577	963	934	29	3.0%	29	3.0%	0	0.0%
Gas Heat (kWh)									
Non Normalized	550	8,883	8,470	413	4.6%	361	4.1%	52	0.6%
Degree Day Normalized	550	8,917	8,490	427	4.8%	375	4.2%	52	0.6%
Degree Day-PRISM cases	502	8,847	8,471	376	4.2%	324	3.7%	52	0.6%
PRISM Normalized	502	8,848	8,445	403	4.6%	351	4.0%	52	0.6%
Education Only (kWh)									
Non Normalized	604	9,914	9,583	331	3.3%	331	3.3%	0	0.0%
Degree Day Normalized	604	9,857	9,597	260	2.6%	260	2.6%	0	0.0%
Degree Day-PRISM cases	565	9,806	9,553	254	2.6%	254	2.6%	0	0.0%
PRISM Normalized	565	9,744	9,463	281	2.9%	281	2.9%	0	0.0%

	#	Total Savings				LIURP Savings		Act 129 Savings	
		Usage		Annual Savings	% Savings	Annual Savings	% Savings	Annual Savings	% Savings
		Pre	Post						
Education Only (ccf)									
Non Normalized	93	801	869	-68	-8.5%	-68	-8.5%	0	0.0%
Degree Day Normalized	93	942	935	6	0.7%	6	0.7%	0	0.0%
PRISM Normalized	92	966	955	10	1.1%	10	1.1%	0	0.0%

Table IV-2A displays average heating and cooling degree days in the pre- and post-treatment usage periods for the 2016 LIURP participants, compared to the 20-year average that was used in the normalization process. The table shows that the post-treatment heating degree days were nine percent higher than the pre-treatment heating degree days for the electric heating jobs and eight percent higher for the gas heating jobs. The colder winter in the post-treatment year resulted in increased heating usage after LIURP services, and a non-normalized saving estimate that underestimated the savings from LIURP. This led to a small weather-normalization adjustment to savings for the heating jobs.

Table IV-2A
Average Heating and Cooling Degree Days
Relative to 20-year Average

Job Type	#	Pre-CDD	Post-CDD	CDD Difference		Pre-HDD	Post-HDD	HDD Difference	
				#	%			#	%
Electric Baseload	4,072	855	854	0	0	3,382	3,641	258	8%
Electric Heat	383	828	857	29	3%	3,255	3,562	307	9%
Gas Heat	581	809	855	45	6%	3,322	3,594	272	8%
Education Only (kWh)	604	941	918	-23	-2%	3,330	3,489	158	5%
Education Only (ccf)	93	963	967	4	0%	3,234	3,647	413	13%
20-Year Average (1997-2016)	-	797				4,398			

Another important factor in estimating energy savings is the degree to which the final analysis group, with enough usage data to include in the results, is comparable to the full population of treated households. The previous section showed that the customers in the analysis group were less likely to have major measures installed than the overall treatment group. This can bias the savings results downward.

While a later section in the report provides a detailed analysis of savings by several population subgroups, this section includes an analysis of how differential attrition provides a downward bias to the savings estimates. This should be taken into account when assessing the overall savings results.

Table IV-2B shows that electric baseload customers with major measures are underrepresented in the analysis group. While 35 percent of all electric baseload jobs had a major measure, only 23 percent of the electric baseload analysis group had a major measure. When accounting for this difference, the savings estimate increases from 683 kWh or 6.4 percent to 721 kWh or 6.8 percent.

Table IV-2B
Electric Baseload Savings
By Level of Service

	All Customers		Analysis Group		Savings		Unweighted Savings		Weighted Savings	
	#	%	#	%	kWh	%	kWh	%	kWh	%
Basic	3,291	65%	2,970	77%	607	5.7%	683	6.4%	721	6.8%
Major	1,738	35%	906	23%	933	8.9%				

*The table excludes 210 Electric Baseload accounts without measures and cost data in 2016.

Table IV-2C shows that electric heating customers with major measures are underrepresented in the analysis group. While 28 percent of all electric heating jobs had one major measure and 30 percent had two or more major measures, only 21 percent of the electric heating analysis group had one major measure and only 21 percent had two or more major measures. When accounting for this difference, the savings estimate increases from 1,030 kWh or 5.7 percent to 1,214 kWh or 6.6 percent.

Table IV-2C
Electric Heating Customers Savings
By Number of Major Measures

Number of Major Measures	All Customers		Analysis Group		Savings		Unweighted Savings		Weighted Savings	
	#	%	#	%	kWh	%	kWh	%	kWh	%
0	299	42%	215	59%	600	3.7%	1,030	5.7%	1,214	6.6%
1	198	28%	76	21%	1,040	6.0%				
2 or More	213	30%	76	21%	2,237	11.2%				

*The table excludes 18 Electric Heating accounts without measures and cost data in 2016.

Table IV-2D shows that gas heating customers with major measures are underrepresented in the analysis group. While 28 percent of all gas heating jobs had one major measure and 26 percent had two or more major measures, only 17 percent of the gas heating analysis group had one major measure and only 15 percent had two or more major measures. Accounting for this change increases the savings estimate from 30 ccf or 3.2 percent to 37 ccf or 3.8 percent.

Table IV-2D
Gas Heating Customers Savings
By Number of Major Measures

Number of Major Measures	All Customers		Analysis Group		Savings		Unweighted Savings		Weighted Savings	
	#	#	#	%	ccf	%	ccf	%	ccf	%
0	749	46%	390	68%	21	2.3%	30	3.2%	37	3.8%
1	452	28%	98	17%	20	2.1%				
2 or More	423	26%	89	15%	83	8.3%				

*The table excludes 6 Gas Heating accounts without measures and cost data in 2016.

The rest of the report focuses on the degree day normalized savings. Tables IV-3A, 3B, and 3C provide the historical comparison of energy savings by job type. Table IV-3A displays historical savings of electric baseload jobs. The table shows that the 2016 jobs had savings that were lower than the 1999-2015 average savings. Savings were 6.4 percent in 2016 compared to the historical average of 8.6 percent.

The 2016 jobs had pre-treatment usage and spending that were approximately the same as the historical average.

Table IV-3A
Time-Series Comparison of Annual Usage and Savings
Electric Baseload Jobs

	Pre-Use	Post-Use	Savings	Percent Savings	Wx Cost
2016*	10,557	9,885	673	6.4%	\$213
1999-2015 Average	10,592	9,684	908	8.6%	\$210
2015	10,035	9,226	809	8.1%	\$173
2014	9,969	9,120	849	8.5%	\$161
2013	10,707	9,877	830	7.7%	\$182
2012	11,461	10,911	550	4.8%	\$161
2011	10,758	10,148	610	5.7%	\$258
2010	11,370	10,147	1,223	10.8%	\$201
2009	12,144	11,090	1,054	8.7%	\$186
2008	10,990	10,276	714	6.5%	\$191
2007	10,919	10,032	887	8.1%	\$240
2006	10,695	9,953	742	6.9%	\$214
2005	11,188	10,073	1,115	10.0%	\$208
2004	9,309	8,384	925	9.9%	\$215
2003	10,040	8,679	1,361	13.6%	\$214

	Pre-Use	Post-Use	Savings	Percent Savings	Wx Cost
2002	10,591	9,687	904	8.5%	\$192
2001	10,821	9,722	1,099	10.2%	\$296
2000	9,741	8,843	898	9.2%	\$268
1999	9,324	8,460	864	9.3%	\$206

*The table excludes weatherization costs for 196 Electric Baseload accounts without measures and cost data in 2016.

Table IV-3B displays historical savings of electric heating jobs. The table shows that the 2016 jobs had savings that were lower than the 1999-2015 average. Savings were 5.8 percent in 2016 compared to the historical average of 7.7 percent. The electric heating pre-treatment usage was significantly lower than in the past, averaging 17,180 kWh, compared to the historical average of 20,931 kWh. Additionally, the cost of measures was only about 60 percent of the historical average.

Table IV-3B
Time-Series Comparison of Annual Usage and Savings
Electric Heating Jobs

	Pre-Use	Post-Use	Savings	Percent Savings	Wx Cost
2016*	17,180	16,182	998	5.8%	\$991
1999-2015 Average	20,931	19,303	1,628	7.7%	\$1,701
2015	14,760	13,653	1,106	7.5%	\$622
2014	16,263	15,150	1,113	6.8%	\$1,301
2013	21,350	19,416	1,934	9.1%	\$1,310
2012	20,700	19,465	1,235	6.0%	\$1,430
2011	19,402	17,899	1,503	7.7%	\$1,798
2010	19,662	18,534	1,128	5.7%	\$2,094
2009	23,179	21,493	1,686	7.3%	\$2,514
2008	20,786	18,614	2,172	10.4%	\$2,332
2007	21,017	19,888	1,129	5.4%	\$1,735
2006	21,890	20,458	1,433	6.5%	\$1,643
2005	21,956	20,326	1,629	7.4%	\$1,824
2004	23,449	21,148	2,301	9.8%	\$1,782
2003	22,510	20,220	2,290	10.2%	\$1,646
2002	22,745	21,441	1,304	5.7%	\$1,753
2001	22,825	20,469	2,356	10.3%	\$2,234
2000	21,368	19,724	1,644	7.7%	\$1,521

	Pre-Use	Post-Use	Savings	Percent Savings	Wx Cost
1999	21,970	20,251	1,719	7.8%	\$1,377

*The table excludes weatherization costs for 16 Electric Heating accounts without measures and cost data in 2016.

Table IV-3C displays historical savings of gas heating jobs. The 2016 gas heating jobs saved an average of 31 ccf, compared to average savings of 101 ccf from 1999-2015. Pre-treatment usage in 2016 was about 16 percent lower than the historical average and spending in 2016 was only about 54 percent of the historical average. The 2016 gas heating jobs were less likely to have a blower door test, weatherization, and insulation than in previous years.

Table IV-3C
Time-Series Comparison of Annual Usage and Savings
Gas Heating Jobs

	Pre-Use	Post-Use	Savings	Percent Savings	Wx Cost
2016	944	914	31	3.3%	\$918
1999-2015 Average	1,119	1,018	101	8.8%	\$1,714
2015	977	946	31	3.2%	\$934
2014	906	879	27	2.9%	\$1,117
2013	1,022	945	77	7.5%	\$1,086
2012	989	924	65	6.6%	\$1,820
2011	1,025	959	67	6.5%	\$2,410
2010	1,052	991	61	5.8%	\$2,253
2009	1,090	998	92	8.4%	\$2,100
2008	1,087	984	103	9.5%	\$2,016
2007	1,054	965	89	8.4%	\$1,914
2006	1,128	1,037	91	8.0%	\$1,640
2005	1,206	1,039	168	13.9%	\$1,643
2004	1,205	1,037	168	13.9%	\$1,789
2003	1,227	1,086	141	11.5%	\$1,422
2002	1,253	1,159	94	7.5%	\$1,488
2001	1,262	1,097	165	13.1%	\$2,003
2000	1,265	1,106	159	12.6%	\$1,763
1999	1,273	1,148	125	9.8%	\$1,741

*The table excludes weatherization costs for 4 Gas Heating accounts without measures and cost data in 2016.

Table IV-4 displays the seasonal analysis of energy savings by job type. The table shows that jobs achieved savings from baseload and heating usage.

**Table IV-4
Seasonal Usage Analysis**

	#	Total Savings					LIURP Savings		Act 129 Savings	
		Usage		Annual Savings	% Savings	Share of Savings	Annual Savings	% Savings	Annual Savings	% Savings
		Pre	Post							
Electric Baseload (kWh)										
Baseload	4,072	6,782	6,211	571	8.4%	84.9%	507	7.5%	64	0.9%
Heating		2,049	1,902	147	7.2%	21.9%	147	7.2%	0	0.0%
Cooling		1,726	1,771	-45	-2.6%	-6.7%	-45	-2.6%	0	0.0%
Electric Heat (kWh)										
Baseload	383	8,242	7,496	745	9.0%	74.7%	710	8.6%	35	0.4%
Heating		7,959	7,651	308	3.9%	30.8%	308	3.9%	0	0.0%
Cooling		980	1,035	-55	-5.6%	-5.5%	-55	-5.6%	0	0.0%
Gas Heat (ccf)										
Baseload	581	220	202	19	8.5%	60.7%	19	8.5%	0	0.0%
Heating		724	712	12	1.7%	39.3%	12	1.7%	0	0.0%
Education Only (kWh)										
Baseload	604	6,268	6,046	223	3.6%	85.6%	223	3.6%	0	0.0%
Heating		1,826	1,732	95	5.2%	36.5%	95	5.2%	0	0.0%
Cooling		1,762	1,819	-57	-3.3%	-22.1%	-57	-3.3%	0	0.0%

Energy efficiency program savings are often found to correlate with the level of pre-treatment usage. This is because households with higher pre-treatment usage have greater opportunities for energy savings and often receive greater energy efficiency investments. Table IV-5 shows that the 2016 savings were generally consistent with this expectation.

- Baseload jobs with pre-treatment usage over 12,000 kWh had savings of 10.0 percent, compared to savings of 4.8 percent for baseload jobs with pre-treatment usage between 8,000 and 12,000 kWh, and savings of 2.1 percent for baseload jobs with pre-treatment usage below 8,000 kWh.
- Electric heat jobs with pre-treatment usage over 26,000 kWh had average savings of 12.2 percent, while those jobs with pre-treatment usage between 16,000 and 26,000 kWh had savings of 4.6 percent, and jobs with usage below 16,000 kWh had savings of 3.3 percent.
- Gas heat jobs with pre-treatment usage over 1,400 ccf saved an average of 142 ccf or 8.9 percent, those with pre-treatment usage between 800 and 1,400 ccf saved an average of 3.2 percent, and those with pre-treatment usage below 800 ccf did not save.

**Table IV-5
Change in Annual Usage
By Pre Program Usage**

	#	Total Savings					LIURP Savings		Act 129 Savings	
		Usage		Annual Savings	% Savings	Measure Cost	Annual Savings	% Savings	Annual Savings	% Savings
		Pre	Post							
Electric Baseload (kWh)										
< 8,000 kWh	1,169	6,762	6,622	140	2.1%	\$196	76	1.1%	64	0.9%
8,000 – 12,000 kWh	1,615	9,717	9,251	466	4.8%	\$226	397	4.1%	69	0.7%
> 12,000 kWh	1,092	15,929	14,343	1,585	10.0%	\$211	1,515	9.5%	70	0.4%
Electric Heat (kWh)										
< 16,000 kWh	187	11,516	11,134	381	3.3%	\$728	342	3.0%	39	0.3%
16,000 – 26,000 kWh	132	20,349	19,403	946	4.6%	\$1,227	917	4.5%	29	0.1%
> 26,000 kWh	48	31,116	27,329	3,787	12.2%	\$1,363	3,739	12.0%	48	0.2%
Gas Heat¹ (ccf)										
< 800 ccf	222	662	666	-4	-0.6%	\$669	-4	0.6%	0	0.0%
800 – 1,400 ccf	293	1,020	987	33	3.2%	\$825	33	3.2%	0	0.0%
> 1,400 ccf	62	1,604	1,461	142	8.9%	\$697	142	8.9%	0	0.0%

¹Measure costs for gas heat jobs exclude the costs for the measures targeted at reducing electric usage.

*The table excludes 196 Electric Baseload accounts, 16 Electric Heating accounts, and 4 Gas Heating accounts without measures and cost data in 2016.

Table IV-6 displays usage impacts by job type and by whether the household participated in CAP in the pre- or post-treatment period. Electric baseload savings were higher for the non-CAP participants who had higher pre-treatment usage. Gas heating savings were higher for the CAP participants.

**Table IV-6
Change in Annual Usage
By CAP Participation**

	#	Total Savings					LIURP Savings		Act 129 Savings	
		Usage		Annual Savings	% Savings	Measure Cost	Annual Savings	% Savings	Annual Savings	% Savings
		Pre	Post							
Electric Baseload (kWh)										
CAP	3,484	10,397	9,753	644	6.2%	\$206	575	5.5%	69	0.7%
Non-CAP	392	12,161	11,133	1,028	8.5%	\$270	974	8.0%	54	0.4%
Electric Heat (kWh)										
CAP	329	17,135	16,091	1,043	6.1%	\$944	1,004	5.9%	39	0.2%
Non-CAP	38	18,311	17,396	915	5.0%	\$1,390	897	4.9%	18	0.1%

	#	Total Savings					LIURP Savings		Act 129 Savings	
		Usage		Annual Savings	% Savings	Measure Cost	Annual Savings	% Savings	Annual Savings	% Savings
		Pre	Post							
Gas Heat¹ (ccf)										
CAP	516	948	914	34	3.6%	\$740	34	3.6%	0	0.0%
Non-CAP	61	923	919	4	0.4%	\$839	4	0.4%	0	0.0%
Education Only (kWh)										
CAP	553	9,832	9,580	252	2.6%	-	252	2.6%	0	0.0%
Non-CAP	51	10,126	9,776	350	3.5%	-	350	3.5%	0	0.0%

¹Measure costs for gas heat jobs exclude the costs for the measures targeted at reducing electric usage.

*Difference in savings between the groups for electric baseload is statistically significant at the 99% level.

**The table excludes 196 Electric Baseload accounts, 16 Electric Heating accounts, and 4 Gas Heating accounts without measures and cost data in 2016.

Table IV-7 displays the change in usage by whether the customer had selected an alternate supplier in the pre or post period. Only a small percentage of customers served by LIURP were Customer Choice. The electric baseload Customer Choice jobs had higher pre-treatment usage and greater savings than the non-choice customers. The electric heating Choice jobs had higher pre-treatment usage but lower savings than the non-choice customers. The gas heating choice jobs had higher savings than the non-choice jobs.

**Table IV-7
Change in Annual Usage
By Customer Choice**

	#	Total Savings					LIURP Savings		Act 129 Savings	
		Usage		Annual Savings	% Savings	Measure Cost	Annual Savings	% Savings	Annual Savings	% Savings
		Pre	Post							
Electric Baseload (kWh)										
Choice	250	11,474	10,711	763	6.7%	\$224	704	6.1%	59	0.5%
Non-Choice	3,626	10,514	9,836	678	6.4%	\$212	610	5.8%	68	0.6%
Electric Heat (kWh)										
Choice	22	18,036	17,592	444	2.5%	\$945	411	2.3%	33	0.2%
Non-Choice	345	17,207	16,139	1,067	6.2%	\$994	1,030	6.0%	37	0.2%
Gas Heat (ccf)										
Choice	36	977	928	49	5.1%	\$647	49	5.1%	0	0.0%
Non-Choice	541	943	914	29	3.1%	\$758	29	3.1%	0	0.0%

	#	Total Savings					LIURP Savings		Act 129 Savings	
		Usage		Annual Savings	% Savings	Measure Cost	Annual Savings	% Savings	Annual Savings	% Savings
		Pre	Post							
Education Only (kWh)										
Choice	28	9,701	9,857	-156	-1.6%	-	-156	-1.6%	0	0.0%
Non-Choice	576	9,864	9,584	280	2.8%	-	280	2.8%	0	0.0%

*The table excludes 196 Electric Baseload accounts, 16 Electric Heating accounts, and 4 Gas Heating accounts without measures and cost data in 2016.

Table IV-8 displays the change in usage by home ownership status. Baseload job renters had savings that averaged 5.1 percent, compared to average savings of 6.6 percent for owners. Electric heating renters had savings that averaged 7.1 percent compared to savings of 5.6 percent for owners. Gas heating renters and owners had savings that were approximately the same.

**Table IV-8
Change in Annual Usage
By Home Ownership**

	#	Total Savings					LIURP Savings		Act 129 Savings	
		Usage		Annual Savings	% Savings	Measure Cost	Annual Savings	% Savings	Annual Savings	% Savings
		Pre	Post							
Electric Baseload (kWh)										
Owner	3,443	10,657	9,952	705	6.6%	\$224	637	6.0%	68	0.6%
Renter	433	9,932	9,422	510	5.1%	\$124	442	4.5%	68	0.7%
Electric Heat (kWh)										
Owner	259	17,945	16,948	996	5.6%	\$953	958	5.3%	38	0.2%
Renter	108	15,605	14,495	1,110	7.1%	\$1,080	1,076	6.9%	34	0.2%
Gas Heat¹ (ccf)										
Owner	456	935	906	30	3.2%	\$807	30	3.2%	0	0.0%
Renter	121	982	948	34	3.5%	\$538	34	3.5%	0	0.0%
Education Only (kWh)										
Owner	519	9,997	9,669	328	3.3%	-	328	3.3%	0	0.0%
Renter	85	8,999	9,156	-157	-1.7%	-	-157	-1.7%	0	0.0%

¹Measure costs for gas heat jobs exclude the costs for the measures targeted at reducing electric usage.

*Difference in savings between the groups for electric baseload is statistically significant at the 90% level.

**Difference in savings between the groups education only (kWh) are statistically significant at the 95% level.

***The table excludes 196 Electric Baseload accounts, 16 Electric Heating accounts, and 4 Gas Heating accounts without measures and cost data in 2016.

Table IV-9 displays energy savings by whether the customer used supplemental heat. Customers with supplemental heat had a greater reduction in electric usage. Baseload jobs

with supplemental heat had average savings of 8.4 percent, compared to average savings of 4.2 percent for baseload jobs without supplemental heat and electric heating jobs with supplemental heat had average savings of 9.2 percent compared to 5.1 percent for those without supplemental heat. Education Only customers with supplemental heat had electric savings of 5.9 percent compared to savings of only 0.5 percent for those without supplemental heat, indicating that these savings are coming from changes in the use of this heating source.

**Table IV-9
Change in Annual Usage
By Supplemental Heat**

	#	Total Savings					LIURP Savings		Act 129 Savings	
		Usage		Annual Savings	% Savings	Measure Cost	Annual Savings	% Savings	Annual Savings	% Savings
		Pre	Post							
Electric Baseload (kWh)										
Supplemental Heat	1,852	11,801	10,809	992	8.4%	\$212	925	7.8%	67	0.6%
No Supp Heat	2,024	9,454	9,054	401	4.2%	\$213	333	3.5%	68	0.7%
Electric Heat (kWh)										
Supplemental Heat	75	18,272	16,588	1,684	9.2%	\$1,199	1,652	9.0%	32	0.2%
No Supp Heat	292	16,995	16,133	862	5.1%	\$937	824	4.8%	38	0.2%
Gas Heat¹ (ccf)										
Supplemental Heat	160	1,009	969	39	3.9%	\$851	39	3.9%	0	0.0%
No Supp Heat	417	921	893	27	3.0%	\$712	27	3.0%	0	0.0%
Education Only (kWh)										
Supplemental Heat	218	10,918	10,279	639	5.9%	-	639	5.9%	0	0.0%
No Supp Heat	386	9,257	9,211	46	0.5%	-	46	0.5%	0	0.0%
Education Only (ccf)										
Supplemental Heat	27	1,018	1,023	-5	-0.5%	-	-5	-0.5%	0	0.0%
No Supp Heat	66	910	899	11	1.2%	-	11	1.2%	0	0.0%

¹Measure costs for gas heat jobs exclude the costs for the measures targeted at reducing electric usage.

*Differences in savings between the groups for electric baseload and education only (kWh) are statistically significant at the 99% level. Difference in savings between the groups for electric heating is statistically significant at the 90% level.

**The table excludes 196 Electric Baseload accounts, 16 Electric Heating accounts, and 4 Gas Heating accounts without measures and cost data in 2016.

C. Measure Specific Savings

This section of the report attributes savings to specific measures that were provided through LIURP. We begin by analyzing savings by whether major measures are provided. Major measures are defined as the following.

- Baseload Jobs: Major measures include refrigerator replacement, air conditioner replacement, and water heater replacement.
- Electric Heat Jobs: Major measures include refrigerator replacement, air conditioner replacement, water heater replacement, heat pumps, electric baseboards, insulation, and blower door guided air sealing.
- Gas Heat Jobs – Gas Measures: Major measures include furnace replacement, water heater replacement, insulation, and blower door guided air sealing.
- Gas Heat Jobs – Electric Measures: Major measures include refrigerator replacement and air conditioner replacement.

Homes that did not receive one of the major measures listed above were considered to have basic measures.

Table IV-10 displays energy savings by whether the job received one or more major measures.

- Baseload Jobs: Savings for baseload jobs with major measures averaged 8.9 percent, as compared to savings that averaged 5.7 percent for baseload jobs that did not receive major measures.
- Electric Heat Jobs: Savings for jobs that received major measures averaged 8.8 percent, compared to average savings of 3.7 percent for jobs that did not receive major measures. Spending on jobs that received major measures averaged \$1,996, compared to average spending of \$280 for jobs that did not receive major measures.
- Gas Heat Jobs – Gas Measures: Gas savings for jobs with major measures averaged 5.2 percent, compared to savings of 2.3 percent for jobs that did not receive major measures. Costs for gas jobs with major measures averaged \$1,926 compared to average costs of \$188 for jobs that did not receive major measures.
- Gas Heat Jobs – Electric Measures: Electric savings for gas heat jobs that received major electric measures were 9.1 percent compared to 3.8 percent for those who received only basic electric measures.

**Table IV-10
Change in Annual Usage
By Level of Service**

	#	Total Savings					LIURP Savings		Act 129 Savings	
		Usage		Annual Savings	% Savings	Measure Cost	Annual Savings	% Savings	Annual Savings	% Savings
		Pre	Post							
Electric Baseload (kWh)										
Basic	2,970	10,600	9,993	607	5.7%	\$36	542	5.1%	65	0.6%
Major	906	10,495	9,563	933	8.9%	\$790	857	8.2%	76	0.7%
Electric Heat (kWh)										
Basic	215	16,319	15,719	600	3.7%	\$280	566	3.5%	34	0.2%
Major	152	18,582	16,944	1,638	8.8%	\$1,996	1,597	8.6%	41	0.2%
Gas Heat¹ (ccf)										
Basic	390	932	911	21	2.3%	\$188	21	2.3%	0	0.0%
Major	187	973	922	50	5.2%	\$1,926	50	5.2%	0	0.0%
Gas Heat² (kWh)										
Basic	441	8,798	8,462	335	3.8%	\$16	292	3.3%	43	0.5%
Major	105	9,396	8,540	857	9.1%	\$706	765	8.1%	92	1.0%

¹Measure costs for gas heat (ccf) jobs exclude the costs for the measures targeted at reducing electric usage.

²Measure costs for gas heat (kWh) jobs exclude the costs for the measures targeted at reducing gas usage.

*Differences in savings between the groups for electric baseload, electric heat, and gas heat (kWh) are statistically significant at the 99% level. Differences in savings between the groups for gas heat (ccf) are statistically significant at the 95% level.

**The table excludes 196 Electric Baseload accounts, 16 Electric Heating accounts, and 4 Gas Heating accounts without measures and cost data in 2016.

Table IV-11A displays savings for electric heat jobs by the number of major measures installed. The table shows that customers who received more major measures had higher pre-treatment usage and higher savings.

Table IV-11A
Change in Annual Electric Heat Usage (kWh)
By Number of Major Measures

Major Measures	#	Total Savings					LIURP Savings		Act 129 Savings	
		Usage		Annual Savings	% Savings	Measure Cost	Annual Savings	% Savings	Annual Savings	% Savings
		Pre	Post							
0	215	16,319	15,719	600	3.7%	\$280	566	3.5%	34	0.2%
1	76	17,246	16,207	1,040	6.0%	\$1,357	993	5.8%	47	0.3%
2 or More	76	19,917	17,680	2,237	11.2%	\$2,365	2,203	11.1%	34	0.2%

*The table excludes 16 Electric Heating accounts without measures and cost data in 2016.

Table IV-11B displays savings for gas heat jobs by the number of major measures installed. The table shows that customers who received two or more major measures had only slightly higher pre-treatment usage than the other groups, but had savings averaging 8.3 percent, compared to much lower savings for the other groups.

Table IV-11B
Change in Annual Gas Heat Usage (ccf)
By Number of Major Measures

Major Measures	#	Pre-Use	Post-Use	Savings	% Savings	Measure Cost ¹
0	390	932	911	21	2.3%	\$188
1	98	943	923	20	2.1%	\$1,659
2 or More	89	1,005	921	83	8.3%	\$2,219

¹Measure costs for gas heat (ccf) jobs exclude the costs for the measures targeted at reducing electric usage.

*The table excludes 4 Gas Heating accounts without measures and cost data in 2016.

Table IV-12 displays energy savings by whether or not participants received particular measures. Some of the key findings were as follows.

- *Refrigerator*: Baseload participants who received a refrigerator had higher savings (9.4%) than those who did not (5.8%). Electric heat customers who received a refrigerator had higher electric savings (7.5%) than those who did not (5.7%). Gas heat customers who received a refrigerator had higher electric savings (10.0%) than those who did not (3.9%).
- *Electric Water Heater Timer*: Of those who received electric heating measures, participants who received an electric water heater timer also had higher savings (8.0%) than those who did not (5.2%).
- *Blower Door Guided Air Sealing*: Gas heating customers who received blower door guided air sealing had savings of 6.5% compared to savings of 2.3% for those who

did not. Electric heating customers who received blower door guided air sealing had higher savings (9.4%) than those who did not (5.0%).

- *Insulation:* Gas heating customers who received insulation had savings of 8.6 percent compared to savings of two percent for those who did not receive insulation. Electric heating customers who received insulation had higher savings (10.5%) than those who did not (4.3%).
- *Furnace:* Gas heating customers who received a new furnace had savings of 6.1 percent compared to 3.2 percent for those who did not.

Table IV-12
Change in Annual Usage
By Major Measures

	#	Total Savings					LIURP Savings		Act 129 Savings	
		Usage		Savings	% Savings	Total Measure Cost	Annual Savings	% Savings	Annual Savings	% Savings
		Pre	Post							
Electric Baseload (kWh)										
Air Conditioner	265	10,838	9,913	925	8.5%	\$917	859	7.9%	66	0.6%
No Air Conditioner	3,611	10,556	9,891	665	6.3%	\$161	597	5.7%	68	0.6%
Refrigerator	704	10,406	9,426	980	9.4%	\$803	901	8.7%	79	0.8%
No Refrigerator	3,172	10,613	9,996	617	5.8%	\$82	552	5.2%	65	0.6%
Air Conditioner/ Refrigerator	67	11,250	9,632	1,618	14.4%	\$1,436	1,545	13.7%	73	0.6%
Air Conditioner/ No Refrigerator	198	10,699	10,009	690	6.5%	\$742	627	5.9%	63	0.6%
No Air Conditioner/ Refrigerator	637	10,317	9,404	913	8.8%	\$736	833	8.1%	80	0.8%
No Air Conditioner/ No Refrigerator	2,974	10,608	9,995	612	5.8%	\$38	547	5.2%	65	0.6%
Electric Water Heater Timer	70	14,702	13,680	1,022	7.0%	\$600	959	6.5%	63	0.4%
No Electric Water Heater Timer	3,806	10,500	9,823	677	6.4%	\$206	609	5.8%	68	0.6%
Electric Heat (kWh)										
Refrigerator	58	17,371	16,073	1,298	7.5%	\$1,636	1,233	7.1%	65	0.4%
No Refrigerator	309	17,235	16,255	980	5.7%	\$869	948	5.5%	32	0.2%
Blower Door Test	71	19,304	17,483	1,821	9.4%	\$2,334	1,797	9.3%	24	0.1%
No Blower Door Test	296	16,765	15,925	840	5.0%	\$669	800	4.8%	40	0.2%
Electric Water Heater Timer	82	20,170	18,553	1,617	8.0%	\$1,464	1,577	7.8%	40	0.2%
No Electric Water Heater Timer	285	16,418	15,557	861	5.2%	\$854	825	5.0%	36	0.2%

	#	Total Savings					LIURP Savings		Act 129 Savings	
		Usage		Savings	% Savings	Total Measure Cost	Annual Savings	% Savings	Annual Savings	% Savings
		Pre	Post							
Insulation	86	19,349	17,313	2,036	10.5%	\$2,543	2,002	10.3%	34	0.2%
No Insulation	281	16,616	15,894	722	4.3%	\$516	684	4.1%	38	0.2%
Gas Heat¹ (ccf)										
Blower Door Test	120	986	922	64	6.5%	\$1,564	64	6.5%	0	0.0%
No Blower Door Test	457	934	913	22	2.3%	\$537	22	2.3%	0	0.0%
Insulation	100	993	907	86	8.6%	\$1,979	86	8.6%	0	0.0%
No Insulation	477	935	916	19	2.0%	\$493	19	2.0%	0	0.0%
Furnace	12	822	772	50	6.1%	\$5,514	50	6.1%	0	0.0%
No Furnace	565	948	917	30	3.2%	\$650	30	3.2%	0	0.0%
Gas Heat² (kWh)										
Refrigerator	87	9,233	8,307	926	10.0%	\$695	826	9.0%	100	1.1%
No Refrigerator	459	8,852	8,509	343	3.9%	\$45	299	3.4%	44	0.5%
Air Conditioner	25	10,472	9,705	767	7.3%	\$980	715	6.8%	52	0.5%
No Air Conditioner	521	8,838	8,418	420	4.8%	\$109	367	4.2%	53	0.6%

¹Measure costs for gas heat (ccf) jobs exclude the costs for the measures targeted at reducing electric usage.

²Measure costs for gas heat (kWh) jobs exclude the costs for the measures targeted at reducing gas usage.

*For electric baseload, differences in savings between the refrigerator groups, the neither/refrigerator only groups, the neither/both refrigerator and air conditioner groups, the air conditioner only/air conditioner and refrigerator groups, the refrigerator only/both air conditioner and refrigerator groups are significant at the 99% level, differences in savings between the air conditioner groups are significant at the 90% level. For electric heat, difference in savings between the insulation groups are statistically significant at the 95% level, differences in savings between the blower door guided air sealing groups are statistically significant at the 95% level, and differences in savings between the electric water heater timer groups are statistically significant at the 90% level. For gas heat, differences in savings between blower door guided air sealing groups, insulation groups, and refrigerator groups are statistically significant at the 99% level.

**The table excludes 196 Electric Baseload accounts, 16 Electric Heating accounts, and 4 Gas Heating accounts without measures and cost data in 2016.

Table IV-13 displays measure-specific savings estimates. These savings were calculated by running a regression model that predicted savings based on the measures that were provided and other household characteristics.

In 2016, savings averaged 593 kWh for customers who only received CFLs and they received 5.8 bulbs on average and no other measures. The resulting estimate of average CFL savings was 102 kWh per CFL. We estimated cost and cost-effectiveness using only the CFL costs and using both the CFL and the audit/education costs. Even when including the entire education and audit cost, the cost per kWh saved over the lifetime of the bulbs was only \$0.10.

A regression-based estimate of CFL savings was also developed, as there was variation in the number of CFLs provided to program participants. The regression-based estimate was

15 kWh per bulb. This estimate is lower than the other estimate because it does not include the savings that accrue from education. However, this estimate still shows the CFLs to be cost-effective, at a cost of \$0.01 per kWh with a 5-year measure life.

The table also shows that refrigerators saved an average of 352 kWh per home, much lower than the 900 kWh estimated in 2015, and that this measure was no longer cost-effective.

**Table IV-13
Measure Savings Estimates**

	Savings	Cost/Home	\$/Unit Saved	Measure Life	\$/Unit Saved Over Lifetime
Electric Baseload (kWh)					
CFL Only ¹	593 (±118)	\$3/\$266	\$0.01/\$0.45	5	<\$0.01/\$0.10
CFL	15 (±15)	\$1	\$0.04	5	\$0.01
Refrigerator	352 (±181)	\$656	\$1.86	12	\$0.21
Gas Heat (ccf)					
Gas Furnace	42 (±86)	\$2,802	\$66.71	15	\$6.43
Boiler	66 (±75)	\$3,622	\$54.63	15	\$5.26
Blower Door Air Sealing	21 (±36)	\$623	\$29.82	15	\$2.87
Insulation	52 (±38)	\$717	\$13.72	15	\$1.32
Electric Heat (kWh)					
Insulation	1,106 (±1090)	\$717	\$0.65	15	\$0.06

¹The average number of CFLs provided to these customers was 5.8, for an average savings of 102 kWh per CFL.

**The table excludes 196 Electric Baseload accounts, 16 Electric Heating accounts, and 4 Gas Heating accounts without measures and cost data in 2016.

D. Cost Effectiveness

This section examines the cost-effectiveness of the Program services delivered by job type. Audit and administrative costs were assigned to electric and gas costs in the same proportion as the measure costs. Table IV-14 shows the measure costs, audit/education costs, and administrative costs by job type and electric and gas reduction. Cost per unit saved was calculated as the average total cost divided by the unit savings. The cost per kWh saved was \$0.74 for baseload jobs, \$1.25 for electric heat jobs, and \$0.46 for gas heat jobs. The cost per ccf saved was \$32.28 for gas heat jobs.

**Table IV-14
Cost per Unit Saved**

	#	Average Savings	Average Measure Cost	Average Audit/ Education Cost	Average Admin Cost	Average Total Cost	Cost Per Unit Saved
Electric Baseload							
Electric (kWh)	3,876	683	\$204	\$262	\$36	\$503	\$0.74
Electric Heat							
Electric (kWh)	367	1,030	\$991	\$263	\$36	\$1,290	\$1.25
Gas Heat							
Electric (kWh)	546	436	\$149	\$44	\$6	\$199	\$0.46
Gas (ccf)	577	31	\$751	\$219	\$30	\$1,001	\$32.28

**The table excludes 196 Electric Baseload accounts, 16 Electric Heating accounts, and 4 Gas Heating accounts without measures and cost data in 2016.

The previous analysis displayed the total job cost divided by the total savings as an indicator of how cost-effective the services were. Table IV-15 displays the discounted present value of the job savings under 5-year, 10-year and 15-year measure life assumptions. The costs per unit saved should be compared to retail rates to evaluate the cost-effectiveness of the program at different measure lives. This table shows that the electric baseload investments were cost-effective at current retail rates if the measures have a life of at ten years. For example, assuming a 10-year measure life, electric baseload services cost ten cents for each kWh saved.

**Table IV-15
Cost Per Unit Saved
By Measure Life Assumption**

	#	Average Savings	Average Total Cost	Cost Per Unit Saved	5-Year Measure Life	10-Year Measure Life	15-Year Measure Life
Electric Baseload							
Electric (kWh)	3,876	683	\$503	\$0.74	\$0.17	\$0.10	\$0.07
Electric Heat							
Electric (kWh)	367	1,030	\$1,290	\$1.25	\$0.29	\$0.16	\$0.12
Gas Heat							
Electric (kWh)	546	436	\$199	\$0.46	\$0.11	\$0.06	\$0.04
Gas (ccf)	577	31	\$1,001	\$32.28	\$7.46	\$4.18	\$3.11

**The table excludes 196 Electric Baseload accounts, 16 Electric Heating accounts, and 4 Gas Heating accounts without measures and cost data in 2016.

V. Bill and Payment Impacts

This section of the report examines the bill and payment impacts for the 2016 LIURP participants. We review the methodology used in the analysis, and then analyze the billing and payment impacts.

A. Methodology

Billing and payment transactions data were used to analyze the pre- and post-treatment billing and payment statistics. Accounts were required to have between 300 and 390 days of transactions data in both the pre and post periods to be included in the analysis.

Table V-1 displays the data attrition statistics. Overall, sufficient data were available for 60 percent of program participants. A lower percentage were available for the heating participants as many of these customers did not have sufficient data prior to the LIURP treatments.

**Table V-1
Payment Impact Data Attrition**

	Electric Baseload	Electric Heating	Gas Heating	Education Only	All Jobs
Original Population	5,235	726	1,630	695	8,286
Not Enough Pre-Treatment Days	1,103	369	1,038	56	2,566
Not Enough Post-Treatment Days	300	32	48	39	419
Data Outliers	166	51	42	68	327
Final Sample	3,666	274	502	532	4,974
% Included in Analysis	70%	38%	31%	77%	60%

B. Billing and Payment Impacts

Table V-2 displays the billing revenue data obtained from the usage file. These data show the changes in charges that were associated with electric and gas usage only. For example, charges related to service agreements or late payment charges would not be included in this table.

Table V-2 shows that electric revenue declined by an average of \$44 for baseload jobs and declined by \$148 for electric heat jobs. Gas revenue increased by \$60 for gas heat jobs.

**Table V-2
Billing Revenue**

	#	Pre	Post	Change	Percent Change
Electric Baseload					
Electric Revenue	3,666	\$891	\$847	-\$44 ^{***}	-4.9%
Gas Revenue		\$63	\$72	\$9 ^{***}	14.2%
Total Revenue		\$954	\$919	-\$35 ^{***}	-3.7%
Electric Heat					
Electric Revenue	274	\$1,516	\$1,368	-\$148 ^{***}	-9.8%
Gas Revenue		\$67	\$73	\$6	8.2%
Total Revenue		\$1,583	\$1,441	-\$143 ^{***}	-9.0%
Gas Heat					
Electric Revenue	502	\$788	\$850	\$63 ^{***}	8.0%
Gas Revenue		\$504	\$564	\$60 ^{***}	11.8%
Total Revenue		\$1,292	\$1,414	\$122 ^{***}	9.5%
Education Only					
Electric Revenue	532	\$915	\$896	-\$19	-2.0%
Gas Revenue		\$114	\$117	\$3	3.1%
Total Revenue		\$1,029	\$1,014	-\$15	-1.5%
All Job Types					
Electric Revenue	4,974	\$918	\$882	-\$36 ^{***}	-3.9%
Gas Revenue		\$113	\$126	\$13 ^{***}	11.7%
Total Revenue		\$1,031	\$1,008	-\$23 ^{***}	-2.2%

^{***}Denotes significance at the 99 percent level. ^{**}Denotes significance at the 95 percent level.

^{*}Denotes significance at the 90 percent level.

Table V-3A displays the change in customer electric and gas bills and total charges, between the pre- and the post-treatment periods, based on analysis of the transactions file. Total charges declined by 8.0 percent for electric baseload jobs, by 11.5 percent for electric heat jobs, and increased by 3.7 percent for gas heat jobs.

**Table V-3A
Bills and Total Charges**

	#	Pre	Post	Change	Percent Change
Electric Baseload					
Electric and Gas Charges	3,666	\$1,063	\$983	-\$80 ^{***}	-7.6%
Other Charges		\$21	\$14	-\$7 ^{***}	-32.7%
Total Charges		\$1,084	\$997	-\$87 ^{***}	-8.0%
Electric Heat					
Electric and Gas Charges	274	\$1,725	\$1,532	-\$193 ^{***}	-11.2%
Other Charges		\$22	\$14	-\$8 ^{**}	-36.1%
Total Charges		\$1,747	\$1,545	-\$201 ^{***}	-11.5%
Gas Heat					
Electric and Gas Charges	502	\$1,402	\$1,458	\$57 ^{***}	4.0%
Other Charges		\$16	\$11	-\$5 [*]	-29.6%
Total Charges		\$1,418	\$1,470	\$52 ^{***}	3.7%
Education Only					
Electric and Gas Charges	532	\$1,090	\$1,054	-\$36 ^{**}	-3.3%
Other Charges		\$13	\$10	-\$3 [*]	-22.2%
Total Charges		\$1,103	\$1,064	-\$39 ^{**}	-3.5%
All Job Types					
Electric and Gas Charges	4,974	\$1,137	\$1,069	-\$68 ^{***}	-6.0%
Other Charges		\$20	\$13	-\$6 ^{***}	-31.9%
Total Charges		\$1,156	\$1,082	-\$74 ^{***}	-6.4%

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

Table V-3B displays bills and total charges for customers who had CAP rates for the full pre-period and for the full post-treatment period. The table shows that across all job types, total charges declined by 11.1 percent for this population, compared to the 6.4 percent decline overall, as shown in the previous table.

Table V-3B
Bills and Total Charges
Customers with CAP Rates In All Pre and Post Periods

	#	Pre	Post	Change	Percent Change
Electric Baseload					
Electric and Gas Charges	2,562	\$1,005	\$875	-\$131 ^{***}	-13.0%
Other Charges		\$20	\$12	-\$8 ^{***}	-40.2%
Total Charges		\$1,025	\$886	-\$139 ^{***}	-13.5%
Electric Heat					
Electric and Gas Charges	194	\$1,654	\$1,377	-\$277 ^{***}	-16.7%
Other Charges		\$21	\$13	-\$8	-36.0%
Total Charges		\$1,674	\$1,390	-\$284 ^{***}	-17.0%
Gas Heat					
Electric and Gas Charges	338	\$1,304	\$1,355	\$51 ^{**}	3.9%
Other Charges		\$16	\$8	-\$8 ^{***}	-48.2%
Total Charges		\$1,321	\$1,363	\$43 [*]	3.2%
Education Only					
Electric and Gas Charges	365	\$1,018	\$958	-\$60 ^{***}	-5.8%
Other Charges		\$10	\$7	-\$3 [*]	-31.2%
Total Charges		\$1,028	\$965	-\$63 ^{***}	-6.1%
All Job Types					
Electric and Gas Charges	3,459	\$1,072	\$959	-\$114 ^{***}	-10.6%
Other Charges		\$18	\$11	-\$7 ^{***}	-40.1%
Total Charges		\$1,091	\$970	-\$121 ^{***}	-11.1%

^{***}Denotes significance at the 99 percent level. ^{**}Denotes significance at the 95 percent level. ^{*}Denotes significance at the 90 percent level.

Differences in results between the revenue analysis from the billing data (shown in Table V-2) and the billing analysis from the transactions data (shown in Table V-3A) are due to the fact that the transactions data include all charges, while the revenue data only include charges for electric and gas usage.

Table V-4 displays payment statistics for the 2016 LIURP participants. Across all job types, credits declined by about \$81 from the pre-treatment year to the post-treatment year.

Table V-4
Annual Payments
Pre and Post-LIURP Treatment

	#	Pre	Post	Change	Percent Change
Electric Baseload					
# Payments	3,666	9.0	8.8	-0.2***	-2.1%
Cash Payments		\$1,013	\$918	-\$95***	-9.4%
Assistance Payments		\$54	\$48	-\$5**	-9.8%
Other Credits		\$8	\$17	\$9***	106.8%
Total Credits		\$1,075	\$984	-\$91***	-8.5%
Electric Heat					
# Payments	274	9.0	8.9	-0.1	-0.9%
Cash Payments		\$1,551	\$1,392	-\$160***	-10.3%
Assistance Payments		\$136	\$132	-\$4	-3.1%
Other Credits		\$13	\$28	\$16***	120.1%
Total Credits		\$1,701	\$1,552	-\$149***	-8.7%
Gas Heat					
# Payments	502	9.1	9.1	0	-0.4%
Cash Payments		\$1,290	\$1,297	\$7	0.5%
Assistance Payments		\$133	\$132	-\$1	-0.7%
Other Credits		\$11	\$19	\$8***	74.0%
Total Credits		\$1,433	\$1,448	\$14	1.0%
Education Only					
# Payments	532	9.4	9.2	-0.2*	-1.8%
Cash Payments		\$1,046	\$960	-\$85***	-8.2%
Assistance Payments		\$46	\$58	\$11**	24.7%
Other Credits		\$7	\$10	\$3*	40.1%
Total Credits		\$1,099	\$1,028	-\$71***	-6.5%
All Job Types					
# Payments	4,974	9.0	8.9	-0.2***	-1.8%
Cash Payments		\$1,074	\$987	-\$87***	-8.1%
Assistance Payments		\$65	\$62	-\$3	-4.5%
Other Credits		\$9	\$17	\$9***	97.9%
Total Credits		\$1,148	\$1,067	-\$81***	-7.1%

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

* Denotes significance at the 90 percent level.

Table V-5 displays payments for CAP and Non-CAP customers in the year prior to and after receipt of LIURP. Both groups had small changes in these indicators.

Table V-5
Payments for CAP Customers
Pre and Post-LIURP Treatment

	#	Pre	Post	Change	Percent Change
CAP Customers – All Job Types					
# Payments	4,486	9.0	8.8	-0.2***	-1.8%
Cash Payments		\$1,007	\$925	-\$82***	-8.1%
Assistance Payments		\$70	\$67	-\$4	-5.0%
Other Credits		\$9	\$18	\$9***	98.2%
Total Credits		\$1,086	\$1,010	-\$76***	-7.0%
Non-CAP Customers – All Job Types					
# Payments	488	9.6	9.4	-0.1	-1.5%
Cash Payments		\$1,689	\$1,554	-\$136***	-8.0%
Assistance Payments		\$20	\$22	\$2	10.3%
Other Credits		\$6	\$12	\$6**	92.9%
Total Credits		\$1,715	\$1,587	-\$128***	-7.5%

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

*Denotes significance at the 90 percent level.

Table V-6 displays a more detailed analysis of the types of assistance payments received in the pre- and the post-treatment periods by the 2016 LIURP participants. The table shows that the assistance remained approximately the same.

Table V-6
Assistance Payments
Pre and Post-LIURP Treatment

	#	Pre	Post	Change	% Change
Electric Baseload					
LIHEAP Cash	3,666	\$41	\$41	0	0.6%
LIHEAP Crisis		\$13	\$7	-\$5***	-42.5%
MEAF		<\$1	<\$1	\$0	-15.1%
Total Assistance		\$54	\$48	-\$5**	-9.8%
Electric Heat					
LIHEAP Cash	274	\$116	\$121	\$4	3.9%
LIHEAP Crisis		\$19	\$11	-\$8	-40.6%
MEAF		<\$1	\$0	<-\$1	-100.0%
Total Assistance		\$136	\$132	-\$4	-3.1%

	#	Pre	Post	Change	% Change
Gas Heat					
LIHEAP Cash	502	\$112	\$123	\$11	9.5%
LIHEAP Crisis		\$18	\$8	-\$10**	-54.4%
MEAF		\$4	\$2	-\$2	-58.9%
Total Assistance		\$133	\$132	-\$1	-0.7%
Education Only					
LIHEAP Cash	532	\$43	\$53	\$10**	23.9%
LIHEAP Crisis		\$3	\$4	\$1	35.9%
MEAF		\$0	\$0	\$0	-
Total Assistance		\$46	\$58	\$11**	24.7%
All Job Types					
LIHEAP Cash	4,974	\$52	\$55	\$3	5.0%
LIHEAP Crisis		\$13	\$7	-\$5***	-41.9%
MEAF		<\$1	<\$1	<-\$1	-49.2%
Total Assistance		\$65	\$62	-\$3	-4.5%

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

Table V-7 displays changes in cash and total bill coverage¹⁴ rates between the pre- and the post-treatment periods. These rates remained at approximately the same level following LIURP services.

**Table V-7
Coverage Rates
Pre and Post-LIURP Treatment**

	#	Pre	Post	Change	Percent Change
Electric Baseload					
Cash Coverage Rate	3,666	95.5%	94.8%	-0.7%	-0.8%
Total Coverage Rate		102.4%	103.7%	1.3%*	1.3%
Electric Heat					
Cash Coverage Rate	274	89.2%	87.0%	-2.2%	-2.4%
Total Coverage Rate		100.8%	100.9%	0.2%	0.2%
Gas Heat					
Cash Coverage Rate	502	89.8%	85.9%	-3.9%***	-4.3%
Total Coverage Rate		103.4%	99.1%	-4.3%***	-4.2%
Education Only					

¹⁴ The cash coverage rate is the amount of cash payments made divided by the bill. The total coverage rate is the total of all customer payments, customer assistance, and other credits divided by the bill.

	#	Pre	Post	Change	Percent Change
Cash Coverage Rate	532	94.1%	91.1%	-3.0%**	-3.2%
Total Coverage Rate		100.1%	98.6%	-1.5%	-1.5%
All Job Types					
Cash Coverage Rate	4,974	94.4%	93.1%	-1.4%**	-1.4%
Total Coverage Rate		102.1%	102.5%	0.4%	0.4%

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

*Denotes significance at the 90 percent level.

Table V-8 displays changes in customer balances. The table shows that balances remained at approximately the same level.

**Table V-8
Change in Customer Balance**

	#	Start	End	Change	Percent Change
Electric Baseload					
Pre Balance	3,666	\$137	\$141	\$5	3.5%
Post Balance		\$131	\$136	\$5	4.1%
Electric Heat					
Pre Balance	274	\$267	\$271	\$4	1.6%
Post Balance		\$216	\$193	-\$23	-10.6%
Gas Heat					
Pre Balance	502	\$188	\$157	-\$31*	-16.2%
Post Balance		\$158	\$174	\$16	10.0%
Education Only					
Pre Balance	532	\$127	\$121	-\$6	-4.7%
Post Balance		\$116	\$145	\$29**	25.4%
All Job Types					
Pre Balance	4,974	\$148	\$148	\$0	0.1%
Post Balance		\$137	\$144	\$7*	5.4%

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

*Denotes significance at the 90 percent level.

VI. Summary of Findings and Recommendations

PECO's LIURP delivered usage reduction services and energy education to over eight thousand customers in 2016, many of whom had vulnerable household members. Savings from electric baseload jobs, electric heating jobs, and gas heating jobs all declined as compared to the historical average and declined as compared to 2015 for electric baseload and electric heating jobs.

PECO and CMC made many improvements to LIURP in 2015 and 2016 to improve savings and to improve participants' satisfaction. Improvements included new and additional subcontractors; use of CMC in-house staff for installations on smaller jobs; improved training, oversight, and quality control for both CMC in-house staff and for their subcontractors; and use of tablets to collect data in the field which allowed for additional verification and more accurate job data. However, these changes did not result in higher savings in 2016.

We have the following recommendations to improve energy savings.

- *Outreach* – CMC is not able to reach 47 percent of targeted customers because these customers make no response to contact attempts. CMC's current procedure is to make at least three phone calls and send a follow-up letter.¹⁵ They should increase the number of calls to potential customers and pilot additional methods including outreach to targeted neighbors when they are in the field and leaving door hangers when they are in the neighborhood where additional customers are targeted.
- *Previously Treated Customers* – PECO allows customers who were treated more than two years ago to be re-treated by LIURP. Customers in the same home who were treated within the past five years are unlikely to have significant energy-saving opportunities. PECO should consider expanding the length of time before CMC can return to the home to deliver LIURP again.
- *Service Delivery* – APPRISE completed a technical evaluation of PECO's LIURP in 2014 that included on-site observation of service delivery and inspections of completed jobs. The research found that refining current procedures and improved implementation with additional contractor training could have significant positive impacts on the energy savings achieved by LIURP. Key aspects of service delivery that could be improved to increase energy savings include increased use of the blower door with pressure pan testing and zonal pressure testing, air sealing, duct sealing, and refrigerator replacement. PECO should continue to observe and inspect LIURP jobs to ensure that higher standards for service delivery are met.
- *CMC Process* – CMC has made improvements to their process over the past few years. It is possible that these changes will result in higher energy savings over time, but such savings have not yet been seen. Additionally, changes in the management at CMC could

¹⁵ This is PECO's minimum standard for the number of contact attempts.

potentially have a negative impact on the program. Evaluation results should be assessed next year to determine whether additional process changes are needed.

- *CMC Inspections:* CMC aims to inspect all comprehensive jobs and five percent of other jobs. The comprehensive inspections are expected to include blower door testing, zonal pressure diagnostics, combustion appliance zone testing, combustion testing on all appliances in the home, visual inspections for health and safety issues, and infrared cameras to look at moisture levels and if there were missed thermal opportunities, and also may include the use of gas sniffers and moisture meters. Inspections also include customer communication and education. Inspectors reported that these inspections take 30 to 60 minutes to complete, and that these tests are not always conducted. PECO should re-assess whether the time allocated for CMC inspections is adequate and consider utilizing a third-party for these reviews, especially given the trend toward more measure installations being done by CMC staff instead of subcontractors. Additionally, two subcontractors noted that the quality of the audit work could be improved, and installations made during the audits should be inspected by a third-party inspector.
- *Measure Opportunities:* Installation of major measures increased in electric heating jobs but remained at the same level in gas heating jobs. While 23 percent of electric heating jobs received insulation in 2015, 32 percent received insulation in 2016, and 30 percent received a blower door test in 2016 compared to 20 percent in 2015. Only 26 percent of gas heating jobs received insulation, compared to 35 percent in 2014, 30 percent in 2013, 46 percent in 2012, and 54 percent in 2011. Only 35 percent of gas heating jobs received a blower door test in 2016, compared to 40 percent in 2014, 41 percent in 2013, and 60 percent in 2011 and 2012. PECO should ensure that CMC is pursuing all cost-effective energy-saving opportunities on all job types.
- *Health and Safety Measures:* PECO should investigate whether a small amount spent on additional health and safety measures could lead to additional cost-effective energy efficiency measure installations.
- *Additional Measures:* The 2014 technical evaluation¹⁶ recommended the replacement of old dehumidifiers, and potentially use of LED bulb replacement (for incandescent bulbs) as their cost continues to decline and the cost-effectiveness is positively evaluated. Smart thermostats have been found to provide significant heating and cooling savings, and PECO should consider piloting this measure. PECO is considering the implementation of mini-split systems. CMC has several other recommendations for potential additional measures that PECO should evaluate.

¹⁶LIURP On-Site Research Final Report, February 2015.