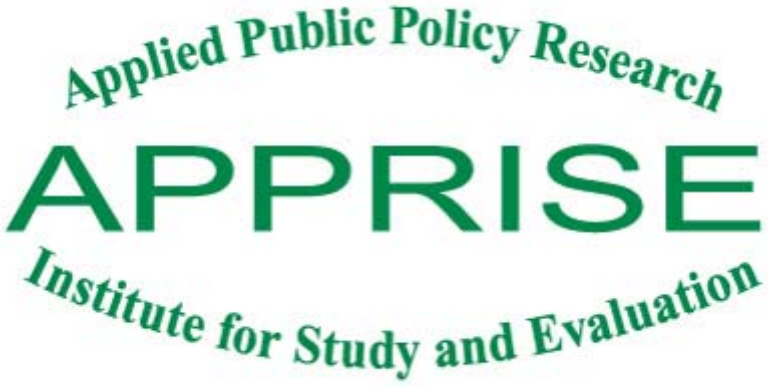

PECO LIURP Education Survey

Final Report

Prepared for PECO

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Executive Summary

APPRISE conducted PECO's 2005 Low Income Usage Reduction Program Impact Evaluation in 2007. One of the highlighted findings in APPRISE's 2005 PECO LIURP Evaluation was that customers who only received CFLs (because no other conservation opportunities were found in the home or because other services were rejected by the customer) had very large electric usage reductions. The savings were much larger than what would have been expected from only the CFL energy savings. Therefore, we concluded that a significant part of those savings were attributable to energy education provided by the LIURP service delivery professionals, and resulting changes in behavior from that energy education. In this report, we review those findings, and discuss survey research results that shed additional light on how customers were able to achieve large electric savings.

LIURP Usage Reduction Findings

The average weather-normalized usage for the pre and post-treatment periods and the average energy savings were as follows.

- Baseload jobs had average savings of approximately 1,100 kWh, or ten percent of pre-treatment usage.
- Electric heat jobs had average savings of approximately 1,600 kWh, or 7.4 percent of pre-treatment usage.
- Gas heat jobs had average savings of approximately 168 ccf, or 13.9 percent of pre-treatment usage.

For the most part, measure-specific savings estimates were developed through regression analysis. However, CFL savings could not be predicted through regression analysis, as there was almost no variation in the distribution of CFLs – almost all participants received four CFLs, and no data were available on the type of CFLs provided. Therefore, we estimated the savings due to CFL installation by examining savings for the 843 Electric Baseload jobs that only received CFLs.

Savings for households that only received four CFLs averaged 953 kWh, much higher than the 274 kWh that might be expected to be saved if each of the four CFLs replaced 60 watt incandescents that were used an average of four hours per day.[1] Therefore, we expect that a significant part of these savings is due to education and resulting changes in behavior.

Energy Education Research Methodology

APPRISE conducted a survey with a sample of 2005 LIURP participants in May 2007 to develop additional information about how changes in energy use behavior translated into large reductions

[1] (60 watts-13 watts)*0.001*365 days*4 hours/day* 4 bulbs=274 kWh

in electric usage. The sample was stratified to ensure that surveys were completed with customers with an adequate variation in savings to allow analysis of the relationship between electric savings and various survey responses.

The following characteristics were used to select the sample:

- Job Type: Two different types of jobs were eligible for sample selection – electric baseload job customers who only received CFLs, and gas heating job customers who only received CFLs on the electric side.

- Electric Supplemental Heat: Each customer type was divided into those who used electric supplemental heat at the time of service delivery and those who did not use electric supplemental heat at the time of service delivery.

- Energy Savings: We removed the top and bottom five percent of savers in each of the four groups, and then divided each group into top, middle, and bottom savers.

Surveys were completed with 234 LIURP participants.

Findings

Both the univariate and multivariate analyses showed expected relationships between energy education reports, changes in electric use behavior, energy education satisfaction, and electric savings. Some of the key findings are described below.

- *Energy education provided*: Respondents who said that the provider reviewed energy bills and estimated dollar savings for each recommended action had higher electric savings than those who did not. While the univariate analysis showed that respondents who reported that the provider did not recommend actions to save energy had higher savings than those who did (opposite of what was expected), the multivariate analysis did find greater savings for respondents who reported that the provider recommended actions to save energy. This may be due to the small sample size that reported the provided did not recommend actions, and other characteristics of this group that are associated with higher savings. The multivariate analysis shows that when these characteristics are controlled for, the households who report that the provider did recommend actions have higher savings.

- *Attention to follow-up materials*: Respondents who reported that they read more monthly energy education letters had higher electric savings. This suggests that these letters are an important component of PECO's energy education program and can result in increased savings.

- *Reports of behavior changes - unprompted*: Respondents who reported that they made changes in electric use behavior that are expected to have the greatest impact on electric savings did have the highest electric savings. These unprompted reports include avoiding use of space heaters, disconnecting unused refrigerators and freezers, and

reducing use of the electric clothes dryer. Respondents who reported that they took no action to reduce their energy usage had the lowest electric savings. This suggests that unprompted respondent reports of changes in energy use behavior are predictive of energy savings, and that customers were able to reduce their electric use due to changes in energy use behavior.

- *Reports of behavior changes – prompted:* Respondents who affirmed that they reduced use of specific electric appliances and lights had higher electric savings than those who did not. Differences are greater for those appliances that are expected to be associated with higher electric use, including space heaters, dehumidifiers, and lights left on all night. This provides evidence that prompted questioning about changes in energy use behavior are also predictive of energy savings and that customers were able to reduce their electric use due to changes in energy use behavior.

- *Hours of CFL usage:* Respondents who reported higher average hours of use for the CFLs that were provided by the program had higher electric savings. This suggests that respondent reports on hours of light use are predictive of energy savings.

- *Energy education ratings:* Respondents who reported greater satisfaction with energy education had greater electric savings. The relationship was stronger for the electric baseload jobs. The same finding was not true of satisfaction with the program as a whole. This suggests that respondent reports on the quality of energy education are predictive of resulting energy savings.

- *Usage and bill reduction:* Respondents who reported that their usage declined and their bills declined had greater electric savings than those who did not. This suggests that respondents can provide information about the success of the program in achieving usage reduction.

The majority of the differences that are discussed are not statistically significant. Therefore, we report that the findings in this analysis are suggestive, but are not definitive. Further research with a larger sample size or an additional group of customers would provide more information on the validity of these results. However, the study provides new evidence on the ability of energy education to reduce energy usage and on the ability of customers to report accurately on both the quality of energy education provided and their resulting changes in energy use behavior.

I. Introduction

APPRISE conducted PECO's 2005 Low Income Usage Reduction Program Impact Evaluation in 2007. Pennsylvania utilities are required to conduct these evaluations annually and to submit their findings to the Pennsylvania Public Utilities Commission. One of the highlighted findings in APPRISE's 2005 PECO LIURP Evaluation was that customers who only received CFLs (because no other conservation opportunities were found in the home or because other services were rejected by the customer) had very large electric usage reductions. The savings were much larger than what would have been expected from only the CFL energy savings. Therefore, we concluded that a significant part of those savings were attributable to energy education provided by the LIURP service delivery professionals, and resulting changes in behavior from that energy education. In this report, we review those findings, and discuss survey research results that shed additional light on how customers were able to achieve large electric savings.

II. LIURP Usage Reduction Findings

Below we summarize the average weather-normalized usage for the pre and post-treatment periods and the average energy savings. Table II-1 displays these results by job type. The table shows the following degree-day normalized savings.

- Baseload jobs had average savings of approximately 1,100 kWh, or ten percent of pre-treatment usage.
- Electric heat jobs had average savings of approximately 1,600 kWh, or 7.4 percent of pre-treatment usage.
- Gas heat jobs had average savings of approximately 168 ccf, or 13.9 percent of pre-treatment usage.

Table II-1
Average Usage and Savings

	#	Pre-Use	Post-Use	Savings	% Savings
Electric Baseload (kWh)					
Non Normalized	4,551	10,602	9,537	1,065	10.0%
Degree Day Normalized	4,551	11,188	10,073	1,115	10.0%
Electric Heat (kWh)					
Non Normalized	197	21,106	18,448	2,658	12.6%
Degree Day Normalized	197	21,956	20,326	1,629	7.4%
Prism Normalized	161	21,943	20,291	1,652	7.5%
Gas Heat (ccf)					
Non Normalized	1,164	1,145	895	250	21.8%
Degree Day Normalized	1,164	1,206	1,039	168	13.9%
Prism Normalized	621	1,153	993	159	13.8%

Next we display the findings on savings for compact fluorescent light bulbs (CFLs). For the most part, measure-specific savings estimates were developed through regression analysis. However, CFL savings could not be predicted through regression analysis, as there was almost no variation in the distribution of CFLs – almost all participants received four CFLs, and no data were available on the type of CFLs provided. Therefore, we estimated the savings due to CFL installation by examining savings for the 843 Electric Baseload jobs that only received CFLs.

Table II-2 shows that savings for households that only received four CFLs averaged 953 kWh, much higher than the 274 kWh that might be expected to be saved if each of the four CFLs

replaced 60 watt incandescents that were used an average of four hours per day.[2] Therefore, we expect that a significant part of these savings is due to education and resulting changes in behavior.

In the cost and cost-effectiveness columns in Table II-2 we provide estimates using only the CFL costs and estimates that include both the CFL costs and the audit/education costs. Even when including the entire education and audit cost, the cost per kWh saved is only $0.29. This indicates that there may be potential to cost-effectively increase savings by providing more CFLs to LIURP participants, and that the education process is very effective.

Table II-2
Measure Savings Estimates

	Savings	Cost/Home	$/Unit Saved	Measure Life	$/Unit Saved Over Lifetime
Electric Baseload					
CFL Only	953 (±173)	$68/$274	$0.07/$0.29	5	$0.02/$0.07

[2] (60 watts-13 watts)*0.001*365 days*4 hours/day* 4 bulbs=274 kWh

III. Energy Education Research Methodology

APPRISE conducted a survey with 2005 LIURP participants in May 2007 to develop additional information about how changes in energy use behavior translated into large reductions in electric usage. This section describes how the sample was selected and how the survey was implemented. Survey response rate statistics are also presented in this section.

A. Sample Selection

The sample was stratified to ensure that surveys were completed with customers with an adequate variation in savings to allow analysis of the relationship between electric savings and various survey responses.

The following characteristics were used to select the sample:

- Job Type: Two different types of jobs were eligible for sample selection – electric baseload job customers who only received CFLs, and gas heating job customers who only received CFLs on the electric side. While the gas heating customers received only CFLs as baseload measures, their electric use may have also decreased due to shell measures that result in reduced use of the electric fan for households with forced hot air. These households may also have lowered their electric use if air sealing and insulation resulted in reduced need for air conditioning usage.

- Electric Supplemental Heat: Each customer type was divided into those who used electric supplemental heat at the time of service delivery and those who did not use electric supplemental heat at the time of service delivery. Use of electric supplemental heat was recorded by the service provider at the time of service delivery.

- Energy Savings: We removed the top and bottom five percent of savers in each of the four groups, and then divided each group into top, middle, and bottom savers. Originally, fifty households were selected from each of the twelve groups.

Because survey response rates were lower than expected, we attempted to select another 15 customers from each of the 12 groups. There were fewer customers available for selection in the gas heat, supplemental heat groups, so an additional eleven to twelve customers were selected in these groups. Table III-1 displays the sample stratification method that was used and the total number of customers selected in each group.

Table III-1
Sample Stratification Variables

Customer Type	Electric Supplemental Heat	Energy Savings	Number Selected
Electric Baseload	Yes	Top Third	65
		Middle Third	65
		Bottom Third	65
	No	Top Third	65
		Middle Third	65
		Bottom Third	65
Gas Heat	Yes	Top Third	61
		Middle Third	62
		Bottom Third	61
	No	Top Third	65
		Middle Third	65
		Bottom Third	65
TOTAL SAMPLE			**769**

B. Survey Implementation

APPRISE sent an advance letter to all customers who were selected for the survey. This letter notified customers that they would be called to participate in the survey, explained the purpose of the survey, and provided the option to call into the phone center to complete the survey at their convenience.

APPRISE retained Braun Research to conduct the survey through its phone center. Researchers from APPRISE trained Braun's employees on the survey instrument and monitored survey implementation. Braun's manager in charge of the survey instructed interviewers how to use the computerized version of the survey to record responses.

APPRISE staff trained Braun employees on the 15-minute survey in two-hour training sessions for the day and evening interviewers. Training included an explanation of LIURP, an introduction to the Program's population, an explanation of field codes included in the survey instrument, an overview of each question, and in-depth discussion of survey questions that required special attention.

Interviewer monitoring allowed APPRISE researchers to both listen to the interviewers conduct surveys and see the answers they chose on the computerized data entry form. Braun's manager facilitated open communication between the monitors and interviewers, which allowed the monitors to instruct interviewers on how to implement the survey and accurately record responses.

C. Response Rates

This research involved contacting low-income customers who had received conservation services between 1.3 and 2.3 years ago. Because of the length of time since service delivery and the demographics of the population studied, this was a difficult group of customers to contact. Table III-2 shows that we were able to complete surveys with 30 percent of the selected sample. A large percentage of the customers had phone numbers that were no longer working (24 percent), or wrong telephone numbers (9 percent). An additional 28 percent refused to complete the survey.

Table III-2
Survey Response

	Electric Baseload		Gas Heat		All Customers	
	Number	**Percent**	**Number**	**Percent**	**Number**	**Percent**
Not Working #	102	26%	79	21%	181	24%
Wrong #	33	8%	34	9%	67	9%
No Answer/Busy	19	5%	32	9%	51	7%
Refusal	114	29%	102	27%	216	28%
Language Barrier	8	2%	5	1%	13	2%
Deceased	3	1%	4	1%	7	1%
Complete	**111**	**28%**	**123**	**32%**	**234**	**30%**
Selected	390	100%	379	100%	769	100%

Table III-3 displays the number of surveys completed and response rate by sample group. The table shows that the number completed per group ranged from 15 to 24 and the response rate ranged from 23 percent to 37 percent.

Table III-3
Percent of Surveys Completed, By Group

Customer Type	Electric Supplemental Heat	Energy Savings	Surveys Completed	Percent Complete
Electric Baseload	Yes	Top Third	18	28%
		Middle Third	22	34%
		Bottom Third	18	28%
	No	Top Third	20	31%
		Middle Third	18	28%
		Bottom Third	15	23%
Gas Heat	Yes	Top Third	18	30%
		Middle Third	23	37%
		Bottom Third	20	33%
	No	Top Third	20	31%

Customer Type	Electric Supplemental Heat	Energy Savings	Surveys Completed	Percent Complete
		Middle Third	24	37%
		Bottom Third	18	28%
TOTAL RESPONDENTS			**234**	**30%**

IV. Univariate Analysis Results

This section provides an analysis of the relationship between respondent characteristics, survey responses, and the change in weather normalized electric usage. All analyses include 233 survey respondents, as one respondent was eliminated due to the use of electricity for the main source of heat. Table IV-1 shows that the mean savings for the 233 survey respondents was 854 kWh. We divided the respondents into those with large savings, medium savings, low savings, a small change in usage, and an increase in usage. Approximately 20 percent had savings of 1,500 kWh or more, 25 percent had savings between 500 and 1,500 kWh, 10 percent had savings between 250 and 500 kWh, 12 percent had a change between an increase and decrease of 250 kWh, and 22 percent had an increase of more than 250 kWh.

Baseload customers had higher electric savings than gas heat customers. While baseload customers' electric savings averaged 1,131 kWh, gas heat customers' electric savings averaged 602 kWh.

Customers with electric supplemental heat had larger savings than those who did not, suggesting that some of the electric savings resulted from reduced use of electric space heaters. As expected, the difference in electric savings between those with and without electric space heaters is greater for gas heat jobs than for baseload jobs, as some of the reduction in electric space heat use is likely due to the shell measures that were installed by the program. The difference in savings between electric space heaters and those without electric space heat is 301 for baseload jobs and 562 for gas heat jobs.

Table IV-1 also shows that savings for customers without air conditioning is greater than for those who do use air conditioning, although only a small group falls into this category.

Table IV-1
Electric Savings
By Job Type and Household Characteristics

	Obs.	Mean Change	Electric Savings Group				
			Large Savings	Medium Savings	Low Savings	Small Change	Usage Increase
			<=- 1,500 kWh	-500-1,500 kWh	-250-500 kWh	-250- +250 kWh	>250 kWh
All Customers	233	-854	31%	25%	10%	12%	22%
Baseload	111	-1,131	38%	24%	10%	10%	18%
Gas Heat	122	-602	24%	26%	11%	13%	26%
Elec Supp. Heat							
Yes	118	-1,078	38%	23%	11%	8%	20%
No	115	-624	23%	28%	10%	16%	24%

	Obs.	Mean Change	Electric Savings Group				
			Large Savings	Medium Savings	Low Savings	Small Change	Usage Increase
Baseload, Elec Supp. Heat	58	-1,275	40%	26%	12%	5%	17%
Baseload, No Elec Supp. Heat	53	-974	36%	23%	8%	15%	19%
Gas Heat, Elec Supp. Heat	60	-888	37%	20%	10%	10%	23%
Gas Heat, No Elec Supp, Heat	62	-326	11%	32%	11%	16%	29%
Air Conditioning							
Central	76	-955	37%	24%	11%	7%	22%
Window/Wall	140	-765	26%	25%	11%	14%	24%
None	17	-1132	35%	35%	6%	12%	12%
Baseload, central AC	41	-1177	46%	20%	10%	5%	20%
Baseload, window/wall AC	61	-1071	33%	25%	11%	13%	18%
Baseload, no AC	9	-1325	33%	44%	0%	11%	11%
Gas heat, central AC	35	-695	26%	29%	11%	9%	26%
Gas heat, window/wall AC	79	-529	22%	25%	10%	15%	28%
Gas heat, no AC	8	-916	38%	25%	13%	13%	13%

Table IV-2 displays electric savings by respondent reports on the energy education that they received. The table shows that respondents who reported that the provider reviewed bills and estimated the dollar savings for each action recommended had higher electric savings than those who did not. However, respondents who reported that the provider did not recommend actions to save energy and did not estimate the total dollar savings from all actions had higher savings than those who reported that the provider did provide this education. Note that only a small number of households reported that the provider did not recommend actions to save energy.

Table IV-2
Electric Savings
By Energy Education Reported

	Mean Electric Savings (kWh)	
Did the provider…	**Obs.**	**Savings**
Review bills?		
Yes	142	872
No/Don't Know	91	826
Recommend actions to save energy?		

	Mean Electric Savings (kWh)	
Did the provider…	**Obs.**	**Savings**
Yes	206	825
No/Don't Know	27	1074
Estimate $ savings from each action recommended?		
Yes	142	901
No/Don't Know	91	780
Estimate total $ savings from all actions?		
Yes	110	837
No/Don't Know	123	869

PECO's LIURP emphasizes energy education and the customer's role in reducing energy usage. For one year after LIURP services are provided, PECO and their service delivery contractor monitor customers' monthly energy usage. The service delivery provider mails monthly progress letters to customers to highlight any changes in monthly usage. Each quarter the provider revises these letters to emphasize energy saving tips that are specific to the current season. The provider furnishes an additional telephone energy education session to customers who do not reduce energy usage after they receive LIURP services.

The customer survey asked respondents how many of the monthly letters they read. Respondents were asked whether they read all, most, some, one, or none of the letters they received. Table IV-3 shows that there is a correlation between the number of letters that respondents reported that they read and their electric savings. However, customers who reported that they did not remember receiving the letters had mean electric savings that were approximately the same as those who reported that they read most of the letters.

Table IV-3
Electric Savings
By Number of Letters Read

	Mean Electric Savings (kWh)	
How many of the LIURP monthly energy saving letters have you read?	**Obs.**	**Savings**
All	64	1038
Most	35	900
Some	44	627
One/None	17	552
Don't Remember Letters	73	877

Respondents were asked to report unprompted "what energy-saving actions have you been able to take since the provider came to your home"? The action that is expected to result in the

greatest energy savings was coded for each respondent. Table IV-4 displays the reported actions and the electric savings for respondents who reported these actions. The table shows that respondents who reported actions that are expected to have the greatest electric savings have higher savings. Respondents who reported that they avoid space heaters, disconnect unused refrigerators/freezers, and reduce use of their dryer had average savings of 2253, 1395, and 1250 kWh respectively. Many respondents only reported that they use the CFLs that the program provided. Despite not reporting other actions, these respondents also had high energy savings, averaging 1148 kWh. Respondents who reported that they took no actions had the lowest savings, averaging only 13 kWh.

Table IV-4
Electric Savings
By Reported Changes in Behavior

	Mean Electric Savings (kWh)	
	Obs.	**Savings**
What energy-saving actions have you been able to take since the provider came to your home?		
Avoid space heaters	7	2253
Disconnect unused refrigerators/freezers	8	1395
Reduce use of electric dryer	4	1250
Use CFLs	69	1148
Accept LIURP services	15	1148
Turn off unused lighting	29	1021
Turn off unused television/computer	17	777
Other/don't know	15	518
Alter thermostat settings	15	369
Weatherization measures	37	365
New appliances	4	203
None	13	13

Following the unprompted question about actions taken to reduce energy use, respondents were asked specifically about whether they have reduced the use of several types of electric equipment in the home. Table IV-5 shows that respondents who reported that the reduced the use of each type of appliance and lights had higher mean electric savings than those who did not. Furthermore, differences in savings are greater for equipment that uses greater amounts of electricity. For example, while respondents who reported that they reduced the use of their electric space heater saved an average of 1150 kWh, respondents who reported that they did not reduce the use of a space heater or did not have a space heater saved an average of 611 kWh, a difference that is statistically significant at the 99 percent level. The other largest and statistically significant difference is for those who reduced the number of lights that are left on all night. Respondents who reported that they reduced the number of lights left on all night after receiving program services saved an average of 1174 kWh, compared to average savings of 781 kWh for those who did not reduce the number of lights left on all night.

Table IV-5
Electric Savings
By Reduced Use of Appliances

	Mean Electric Savings (kWh)	
Reduced use of _____ as a result of participating in the program?	**Obs.**	**Savings**
Electric Space Heater**		
Yes	105	1150
No/Don't Know	128	611
Air Conditioner		
Yes	136	947
No/Don't Know	97	723
Electric Dryer		
Yes	71	995
No/Don't Know	162	792
Dishwasher		
Yes	64	641
No/Don't Know	169	935
Dehumidifier		
Yes	18	1058
No/Don't Know	215	837
Number of Lights Left On All Night*		
Yes	43	1174
No/Don't Know	190	781
Lights		
Yes	161	879
No/Don't Know	72	797

**Statistically significant at the 99 percent level. *Statistically sig at the 90% level.

Respondents were asked to report that average number of hours that their CFLs are used. Table IV-6 displays the relationship between hours that they reported of CFL use and mean electric savings. The expected relationship is seen in this table. While those who reported average use of only one to two hours per day had mean electric savings of 649 kWh, those who reported average use of seven hours or more had mean savings of 1012 kWh. However, those who reported that they did not know how many hours their lights are used also had high savings, averaging 1044 kWh.

Table IV-6
Electric Savings
By Number of Hours CFLs are Used

	Mean Electric Savings (kWh)	
Average number of hours CFLs are used?	**Obs.**	**Savings**
1-2	29	649
3-4	54	819
5-6	58	705
7-24	32	1012
Don't Know	60	1044

Respondents were asked to report what they felt was the most important benefit of the program. Table IV-7 shows that respondents were most likely to report that the most important benefit was lower energy bills, and that these respondents had high savings. The next largest group, also with high savings was those who reported that the most important benefit was energy education. A few respondents reported a complaint or that they did not know what the most important benefit was, and these households had the greatest electric savings.

Table IV-7
Electric Savings
By Most Important Program Benefit

	Mean Electric Savings (kWh)	
What do you feel is the most important benefit of the program?	**Obs.**	**Savings**
Lower Energy Bills	72	1015
Energy Education	69	796
Safer/More Comfortable Home	17	769
Specific Services	23	671
Lower Energy Use	24	523
New Appliances	6	433
Compliant	3	1318
Don't Know	19	1227

Customers were asked how helpful the program was in teaching about energy use and ways to save energy. Most of the customers said that the program was very or somewhat helpful. Table IV-8 shows that customers who reported that the program was very helpful had higher savings than those who reported that the program was somewhat helpful. However, the small number of customers who reported that the energy education was of little help had the highest savings.

Table IV-8
Electric Savings
By Rating of Energy Education

	Mean Electric Savings (kWh)	
How helpful was LIURP in teaching about energy use and ways to save energy	**Obs.**	**Savings**
Very Helpful	135	925
Somewhat Helpful	69	645
Of Little Help	23	1055
Don't Know	6	881

Respondents were asked whether they felt that the household reduced its energy usage as a result of the program. Table IV-9 shows that respondents who reported that they household did reduce its energy usage had higher electric savings than those who reported that the household did not reduce its energy usage. The table also shows that the customers who reported that their bills declined had larger reductions in energy use than those who reported that the bill was unchanged or lower.

Table IV-9
Electric Savings
By Report of Energy Savings

	Mean Electric Savings (kWh)	
Has your household reduced its overall energy usage as a result of the program?	**Obs.**	**Savings**
Yes	189	897
No/Don't Know	44	667
Is your PECO bill higher, lower, or unchanged since receipt of energy services?		
Lower	138	920
Unchanged	56	706
Higher	29	660
Don't Know	10	1337

Respondents were asked how satisfied they were with the energy education provided by the program and how satisfied they were with the program as a whole. Table IV-10 shows that respondents who reported that they were very satisfied with the energy education had higher savings than those who reported that they were somewhat satisfied. When broken down by baseload and gas heat, the table shows that baseload customers who were very satisfied had much higher savings than those who were somewhat satisfied with the energy education.3 This

[3] This difference is statistically significant at the 95 percent level.

relationship is expected, as a large part of the baseload electric savings are inferred to result from energy education. However, for gas heat customers, this relationship is reversed.

While Table IV-10 shows that satisfaction with energy education is related to electric savings, the table shows that the same relationship does not hold for satisfaction with the program overall. The table shows that respondents who reported that they were very satisfied with the program had average electric savings of 742 kWh, but respondents who reported that they were somewhat satisfied with the program had average electric savings of 1021 kWh.

Table IV-10
Electric Savings
By Satisfaction with Energy Education and LIURP

	Mean Electric Savings (kWh)					
	All		Baseload		Gas Heat	
How satisfied were you with the energy education?	**Obs.**	**Savings**	**Obs.**	**Savings**	**Obs.**	**Savings**
Very Satisfied	140	885	69	1335	71	448
Somewhat Satisfied	79	696	39	683	40	708
Dissatisfied	10	1439	2	2417	8	1195
Don't Know	4	1414	1	1923	3	1245
	All		**Baseload**		**Gas Heat**	
How satisfied were you with LIURP?	**Obs.**	**Savings**	**Obs.**	**Savings**	**Obs.**	**Savings**
Very Satisfied	141	742	71	1153	70	325
Somewhat Satisfied	78	1021	37	1103	41	947
Dissatisfied	9	1044	1	273	8	1140
Don't Know	5	1054	2	1270	3	910

V. Multivariate Analysis Results

The analysis in the previous section examined the relationship between electric savings and individual respondent characteristics and/or survey responses. In this section, we conduct a multivariate analysis where we examine the relationship between electric savings and several respondent characteristics and survey responses simultaneously. This analysis allows us to examine the relationship between electric savings and survey responses, while controlling for many other factors.

The results from the regression analyses are shown in Table V-1. The first column shows results from a regression that focused on respondent reports of energy education that was provided by the service delivery contractor. This regression also includes controls for type of job and whether the respondent used electric space heat at the time of service delivery. A negative coefficient indicates that the factor is associated with higher electric savings. For example, the coefficient on "Baseload Job" is -524. This indicates that baseload jobs have electric savings that are 524 kWh higher than gas heat jobs. The coefficient on electric space heat is also large, negative, and statistically significant. All of the education report variables except estimated savings for each action are negative, as expected. For example, customers who report that the provider reviewed the energy bills have savings that are 121 kWh higher than those who did not report that the provider reviewed the bills. However, these coefficients are not statistically significant.

The second column of the table examines results for behavior changes. In this regression we remove the control for electric space heat, as we control for whether the respondent reported that he/she reduced the use of electric space heat. If the respondent did not use electric space heat at the time of service delivery, then the reduced use of electric space heat would be coded as no. These results show that respondents who reported that they reduced the use of their electric space heat had savings that were 502 kWh higher than those who reported that they did not reduce this use and those who did not have an electric space heater at the time of service delivery. The coefficients on all of the other variables in this regression are also negative, as expected, but are not statistically significant.

The third column presents the results of a regression that includes indicators of how satisfied respondents were with the energy education that they received. These factors have negative coefficients, as expected, but again are not statistically significant.

The last column includes all of the factors, education reports, behavior changes, and education satisfaction, in the regression. Again, almost all of the variables have negative coefficients, but are not statistically significant.

These results indicate that respondent reports of education and changed behavior are associated with reduced electric use. However, these coefficients are not statistically different from zero. This may be due to the relatively small sample size or it may be due to a lack of a real relationship between the factors examined and electric savings. However, the fact that the coefficients are consistently negative provides some support for the hypothesis that customer

reports on energy education provided, energy education quality, and behavior changes are predictive of reductions in electric use.

Table V-1
Electric Savings
Multivariate Analysis Results

Variable	Education Reports	Behavior Changes	Education Satisfaction	All Factors
Baseload Job	-524*	-508*	-493*	-542*
Electric Space Heat	-424*		-451*	
Provider Reviewed Bills	-121			-169
Provider Recommended Actions to Save Energy	-390			-455
Provider Estimated Savings from Each Action	204			202
Provider Estimated Savings from Actions Overall	-176			-228
Respondent Read All Letters	-142			-88
Respondent Read Most Letters	-123			53
Reduced Electric Space Heater Use		-502*		-472*
Reduced AC Use		-92		-139
Reduced Electric Dryer Use		-98		-89
Reduced Number of Lights Left on All Night		-265		-361
Reduced Use of Dehumidifier		-212		-144
Uses CFLs 7 or More Hours Per Day on Average		-155		-146
LIURP Very Helpful Teach How Reduce Use			-75	-73
Reduced Use as a Result of LIURP			-82	-80
Very Satisfied with Energy Education			-64	-20

*Statistically significant at the 95 percent level.

VI. Summary of Findings

APPRISE's 2005 PECO LIURP Evaluation found that customers who only received CFLs had much larger electric usage reductions than what would have been expected from only the CFL energy savings. Therefore, we concluded that a significant part of the program savings were attributable to energy education provided by the LIURP service delivery professionals, and resulting changes in behavior from that energy education. We conducted a survey with a sample of these households to investigate the relationship between energy education, reductions in appliance and light usage, and electric savings.

Both the univariate and multivariate analyses showed expected relationships between energy education reports, changes in electric use behavior, energy education satisfaction, and electric savings. Some of the key findings include:

- *Energy education provided*: Respondents who said that the provider reviewed energy bills and estimated dollar savings for each recommended action had higher electric savings than those who did not. While the univariate analysis showed that respondents who reported that the provider did not recommend actions to save energy had higher savings than those who did, the multivariate analysis did find greater savings for respondents who reported that the provider recommended actions to save energy. This may be due to the small sample size that reported the provided did not recommend actions, and other characteristics of this group that are associated with higher savings. The multivariate analysis shows that when these characteristics are controlled for, the households who report that the provider did recommend actions have higher savings.

- *Attention to follow-up materials*: Respondents who reported that they read more monthly energy education letters had higher electric savings. This suggests that these letters are an important component of PECO's energy education program and can result in increased savings.

- *Reports of behavior changes - unprompted*: Respondents who reported that they made changes in electric use behavior that are expected to have the greatest impact on electric savings did have the highest electric savings. These unprompted reports include avoiding use of space heaters, disconnecting unused refrigerators and freezers, and reducing use of the electric clothes dryer. Respondents who reported that they took no action to reduce their energy usage had the lowest electric savings. This suggests that unprompted respondent reports of changes in energy use behavior are predictive of energy savings, and that customers were able to reduce their electric use due to changes in energy use behavior.

- *Reports of behavior changes – prompted:* Respondents who affirmed that they reduced use of specific electric appliances and lights had higher electric savings than those who did not. Differences are greater for those appliances that are expected to be associated with higher electric use, including space heaters, dehumidifiers, and lights left on all

night. This provides evidence that prompted questioning about changes in energy use behavior are also predictive of energy savings and that customers were able to reduce their electric use due to changes in energy use behavior.

- *Hours of CFL usage:* Respondents who reported higher average hours of use for the CFLs that were provided by the program had higher electric savings. This suggests that respondent reports on hours of light use are predictive of energy savings.

- *Energy education ratings:* Respondents who reported greater satisfaction with energy education had greater electric savings. The relationship was stronger for the electric baseload jobs. The same finding was not true of satisfaction with the program as a whole. This suggests that respondent reports on the quality of energy education are predictive of resulting energy savings.

- *Usage and bill reduction:* Respondents who reported that their usage declined and their bills declined had greater electric savings than those who did not. This suggests that respondents can provide information about the success of the program in achieving usage reduction.

As noted in this report, the majority of the differences that are discussed are not statistically significant. Therefore, we report that the findings in this analysis are suggestive, but are not definitive. Further research with a larger sample size or an additional group of customers would provide more information on the validity of these results. However, the study provides new evidence on the ability of energy education to reduce energy usage and on the ability of customers to report accurately on both the quality of energy education provided and their resulting changes in energy use behavior.