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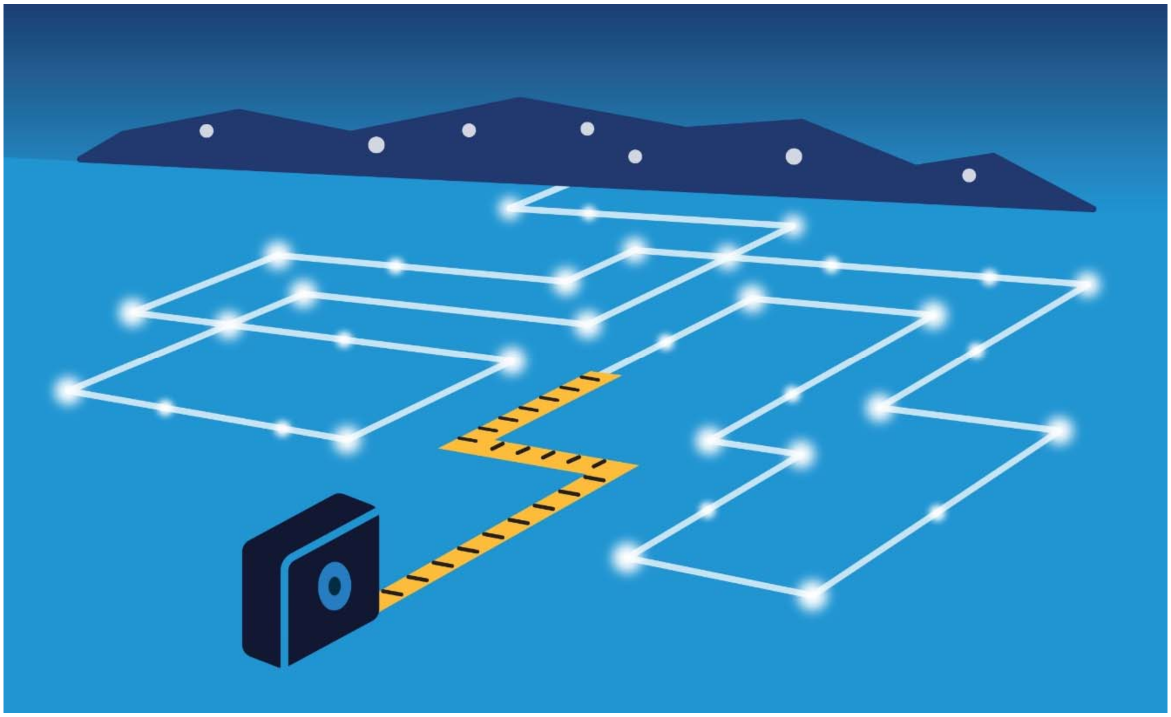

Long Island Power Authority Efficiency Long Island and Renewable Energy Portfolio

2013 Program Guidance Document

FINAL

Prepared for:

LIPA
Long Island Power Authority

PSEG LONG ISLAND
We make things work for you.

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June 2014

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1. INTRODUCTION

The 2013 Program Guidance Document provides a program-by-program review of gross and net impacts of the Efficiency Long Island and Renewable Energy Portfolios, as well as a description of the methods employed in our analyses to obtain the impacts. Opinion Dynamics created this document for use by PSEG Long Island program staff to provide data-driven planning actions moving forward and full transparency for the methods used to calculate savings. The Efficiency Long Island and Renewable Energy Portfolios were administered by the Long Island Power Authority through 2013, but are now administered by PSEG Long Island (PSEG-LI). As this evaluation covers PY2013, we refer to the Long Island Power Authority in our discussion of program activities and results covering that period. In consideration of the recent staffing and organizational changes affecting the Efficiency Long Island and Renewable Energy Portfolios, this document also presents updates to the program-specific implementation models and quality assurance/quality control procedures developed by Opinion Dynamics as part of our prior year evaluations.

This introduction includes a comparison of the estimated demand and energy impacts determined through our evaluation (ex post impacts) to the expected impacts used for program tracking (ex ante impacts). The Evaluation Team used the most detailed measure-level data available from program-tracking systems as the basis for our estimation of ex post impacts and measure-level ex ante estimates. Herein, we provide two specific comparisons with the first between the 1) ex ante net savings calculated by the Evaluation Team using detailed measure-level tracking information, and 2) evaluated savings, the ratio of which is defined as the realization rate (this information matches the data shown in Volume I and compared for the goal attainment purposes). The second comparison is between 1) the same ex ante net savings and 2) ex post savings, the ratio of which is defined as the cost-effectiveness realization rate.

We have organized the remainder of this document as follows:

- Sections 2 through 11 provide a program-by-program review of energy and demand savings. For each program, a section outlines the energy and demand savings accrued from 2013 programs, and provides any measure-specific recommendations for updating the gross energy and demand savings calculations.
- Section 12 presents updated implementation models and data flow figures for each program with a discussion of key data quality and control steps.
- Section 13 provides a summary of the study methodology, including information on the primary and secondary data collection, as well as the analytical methods used to derive savings estimates.
- Appendix A presents the ex ante and ex post net-to-gross values by program and measure.
- Appendix B provides the results of research conducted in 2013 on the ENERGY STAR® Labelled Homes program.

1.1 KEY DEFINITIONS

Below we provide definitions for key terms used throughout the document:

- Gross Impacts: The change in energy consumption and/or demand at the generator that results directly from program-related actions taken by participants, regardless of why they participated. These impacts include line losses, coincident factors for demand, waste-heat factors, and installation rate for lighting. Gross impacts are the demand and energy that the Long Island Power Authority's power plants do not generate due to program-related actions taken by participants.

- Net Impacts: The change in energy consumption and/or demand at the generator that results directly from program-related actions taken by participants, and would not have occurred absent the program. The only difference between the gross and net impacts is the application of the net-to-gross ratio.

- Net-to-Gross Ratio (NTGR): The factor that, when multiplied by the gross impact, provides the net impacts for a program. NTGR consists of two concepts: free ridership and spillover. Free ridership reduces the factor to account for those customers who would have installed an energy-efficient measure without the program. Spillover increases the factor to account for those customers who install energy-efficient measures outside of the program (i.e., without an incentive), but due to the actions of the program.

- Ex Ante Net Impacts: The energy and demand savings expected by the program as found in the program-tracking database. The ex ante net impacts include program-planning NTGR values.

- Evaluated Net Savings: The savings realized by the program after independent evaluation determined gross impacts and applied the program-planning NTGR values. The Evaluation Team uses the evaluated net savings to compare to the Long Island Power Authority's goals.

- Ex Post Net Savings: The savings realized by the program after independent evaluation determined gross impacts and applied ex post NTGR values. Ex post NTGR values have been determined through primary research by Opinion Dynamics. The Evaluation Team uses the ex post net impacts in the cost-effectiveness calculation to reflect the current best industry practices.

- Line Loss Factors: Line losses of 6.0% on energy consumption (resulting in a multiple of 1.0638 = (1/(1-0.06)) and a line loss of 9.1% on peak demand, (resulting in a multiple of 1.1001 = (1/(1-0.091)) have been applied to the reported numbers,

Within the Economic Analysis, three terms are used.

- Direct Impacts: These impacts are equal to the localized portion of direct spending of the Long Island Power Authority programs. For example, direct impacts would include money (and associated increases in employment) supplied to contractors to install energy efficiency measures in homes and businesses, such as the HVAC contractor installing energy-efficient central A/C systems on a project incented by the Cool Homes program.

- **Indirect Impacts:** These impacts are determined by the amount of the direct impacts spent within Long Island on supplies, services, labor, and taxes. For example, indirect impacts would include money (and associated employment) transferred to local businesses by contractors for supplies needed to install energy efficiency measures, such as if a local wholesaler of HVAC equipment had increased sales and added additional workers to help meet the growing demand for the company's products.

- **Induced Impacts:** These impacts are associated with the effects of the direct and indirect impacts on household and business proprietors' income. For example, money expended on Long Island by households or business proprietors benefitting from energy efficiency savings and direct and indirect program spending, such as if the employee of an HVAC contractor used his or her income (increased by work through the Cool Homes program) to purchase a car, which stimulates business at the local car dealership.

1.2 Summary of Gross and Net Impact Methods

Below we provide a summary of the methods used to determine evaluated and ex post net savings. A more detailed discussion of methods is presented in Appendix A.

Gross Impact Methods

We conducted multiple analyses to assess the evaluated gross energy and demand savings associated with the Long Island Power Authority's programs. The majority of our evaluated gross impacts are based on engineering analysis of savings using algorithms and inputs derived from the program-tracking database. We also performed a billing analysis for the Home Performance with ENERGY STAR® (HPwES) program, Home Performance Direct (HPD) program, and Residential Energy Affordability Partnership (REAP) program. For the Commercial Efficiency program (CEP), we had performed onsite M&V in the summer of 2012 on custom projects that resulted in a gross realization rate applied to the custom projects within 2013 as well.

Net Impact Methods

The Evaluation Team used net impact estimates as inputs to three separate analyses required by Long Island Power Authority management: 1) the determination of annual demand and energy savings goal attainment; 2) the benefit-cost assessment; and 3) the economic impact assessment. Based on the specific requirements of each assessment, we developed two separate net savings estimates as described below.

Evaluated Net Savings

An important catalyst in the Long Island Power Authority's decision to invest in the Efficiency Long Island and Renewable Energy Portfolios was the desire to offset the need to develop approximately 520 MW of generating capacity on Long Island required to satisfy forecasted energy demand. As such, performance relative to the annual capacity savings goals is a critically important performance metric for the Long Island Power Authority's programs. The Long Island Power Authority derived its annual savings goals from planning assumptions regarding key inputs to the estimation of expected gross and net savings. To allow for consistency and direct comparison between evaluated program performance and established savings goals, the Evaluation Team developed "evaluated net savings" estimates for each Efficiency Long Island and Renewable Energy program for purposes of assessing goal attainment. This approach is consistent with the approach applied by utilities in nearly half of all states with energy efficiency program offerings. We calculated evaluated net savings by applying the Long Island Power Authority's planning assumptions for NTGR to the gross demand and energy savings estimates determined through our evaluation.

Ex Post Net Savings

Among other inputs, the benefit-cost and economic impact assessments require an estimate of net program savings. The best practice approach for both assessments dictates that the net savings used to develop the benefit-cost ratio or to quantify economic benefits reflect current levels of free ridership, and spillover to provide an accurate estimate of the benefits associated with the current year's investment in the programs. As such, the Evaluation Team used ex post net savings in both assessments. We calculated ex post net savings by applying ex post NTGRs to evaluated gross impact estimates. For 2013, we had no new primary data collection or activities to update previous NTGR values. As such, all ex post NTGR are identical to 2012 values. Both the planning NTGR values (applied within the evaluated savings) and ex post NTGR values (applied within the cost-effectiveness savings) are provided in Appendix 13.

1.3 Summary of Evaluated Demand and Energy Gross and Net Impacts

Overall, our evaluation found that evaluated net savings were closely aligned with program-tracking estimates. The realization rates in Table 1-1 below provide a comparison of evaluated net savings to ex ante savings. We discuss reasons why the evaluated values differ from the ex ante values within Sections 2 through 11.

Table 1-1. Portfolio Evaluated Impacts (Used for Comparison to Goals)

Program	Ex Ante		Evaluated		Realization Rate	
	MW	MWh	MW	MWh	MW	MWh
CEP Mid-Market	7.6	28,975	6.90	25,074	91%	87%
Solution Provider	18.09	81,872	16.27	73,719	90%	90%
Direct Install	5.51	21,684	5.49	17,466	100%	81%
Total Commercial	31.20	132,530	28.67	116,260	92%	88%
Energy-Efficient Products	18.88	128,538	21.49	150,522	114%	117%
Cool Homes	5.14	4,442	5.00	4,361	97%	98%
Residential Energy Affordability Partnership	0.72	4,654	0.30	2,234	42%	48%
Home Performance with ENERGY STAR®	0.5	430	0.46	348	92%	81%
Home Performance Direct	1.27	3,029	1.10	1,051	87%	35%
Residential New Homes	0.31	779	0.31	779	100%	100%
Total Residential	26.82	141,871	28.67	159,295	107%	112%
Efficiency Long Island Total	**58.02**	**274,402**	**57.34**	**275,555**	**99%**	**100%**
Solar Pioneer	6.34	20,804	7.84	18,715	124%	90%
Solar Thermal	<0.01	28	<0.01	28	100%	100%
Backyard Wind	<0.01	89	<0.01	75	25%	84%
Renewable Energy Total	**6.35**	**20,922**	**7.84**	**18,818**	**123%**	**90%**
Total Portfolio	**64.38**	**295,324**	**65.19**	**294,373**	**101%**	**100%**

1.4 SUMMARY OF COST-EFFECTIVENESS RESULTS

Based on an analysis of program- and portfolio-level impacts and costs, the savings generated by the Efficiency Long Island Portfolio are cost-effective. The Evaluation Team used two separate tests to establish a Benefit/Cost ratio for each program: the Program Administrator (PA) test and the Total Resource Cost (TRC) test. The tests are similar in most respects but consider slightly different benefits and costs in determining a Benefit/Cost ratio. The PA test measures the net costs of an energy efficiency program as a resource option based on the costs incurred by the Program Administrator, including all program costs and any rebate and incentive costs, but excludes costs incurred by the participant. The TRC test considers costs to the participant but excludes rebate and incentive costs, as these are viewed as transfers at the societal level. The TRC test also includes the benefits of non-electric energy savings where applicable, resulting in different benefit totals than the PA test. To allow for direct comparison with the Long Island Power Authority's assessment of all supply-side options, we apply the PA test as the primary method of determining cost-effectiveness and used assumptions similar to those used by the Long Island Power Authority's resource planning team.

Table 1-2 below presents the benefit/cost ratios for both PA and TRC tests for each program and for each portfolio separately. The PA test benefit/cost ratio is 3.1 for the Efficiency Long Island Portfolio and 2.1 for the Renewable Energy Portfolio, indicating that portfolio benefits exceed Program Administrator costs in both cases (a Benefit/Cost ratio greater than 1 indicates that portfolio benefits outweigh costs). The portfolio-level TRC values are 1.8 and 0.7 for the Efficiency Long Island and Renewable Energy portfolios, respectively.

Table 1-2. Cost-Effectiveness for the Efficiency Long Island and Renewable Energy Portfolios

Program	Total Resource Cost			Program Administrator		
	NPV Benefits	Costs	Benefit /Cost Ratio	NPV Benefits	Costs	Benefit /Cost Ratio
Subtotal Commercial Efficiency Program	**$140,203,141**	**$63,616,631**	**2.2**	**$140,203,141**	**$47,486,296**	**3.0**
Energy-Efficient Products	$79,358,692	$40,207,388	2.0	$79,358,692	$15,340,288	5.2
Cool Homes	$17,317,931	$22,436,415	0.8	$17,317,931	$7,855,090	2.2
REAP	$1,294,548	$3,305,568	0.4	$1,271,201	$3,269,952	0.4
Home Performance with ENERGY STAR®	$4,782,317	$3,244,692	1.5	$1,662,132	$1,627,448	1.0
Home Performance Direct	$3,002,335	$2,509,241	1.2	$2,262,488	$2,478,028	1.1
Existing Homes Subtotal	*$26,397,130*	*$31,495,916*	*0.8*	*$22,903,751*	*$15,230,518*	*1.5*
Residential New Homes	$2,707,966	$1,953,231	1.4	$1,469,274	$948,535	1.5
Subtotal Residential	**$108,463,788**	**$73,656,535**	**1.5**	**$103,731,717**	**$31,519,341**	**3.3**
Subtotal Efficiency Long Island	**$248,666,929**	**$137,273,165**	**1.8**	**$243,934,859**	**$79,005,636**	**3.1**
Solar PV	$51,014,348	$73,493,512	0.7	$51,014,348	$24,214,105	2.1
Solar Hot Water	$33,757	$373,818	0.1	$33,757	$324,766	0.1
Backyard Wind	$68,501	$199,310	0.3	$68,501	$227,179	0.3
Subtotal Renewable Energy	**$51,116,606**	**$74,066,640**	**0.7**	**$51,116,606**	**$24,766,050**	**2.1**
Total	**$299,783,535**	**$211,339,806**	**1.4**	**$295,051,465**	**$103,771,686**	**2.8**

A levelized cost analysis is a way to quickly compare the cost of energy efficiency programs with the energy or demand saved from the programs. Levelized costs are expressed as $/kW or $/kWh, meaning that the result can readily be compared to the cost of alternative supply additions or the cost of generating electricity. However, this is different from how power is typically purchased—where capacity is purchased first and then the additional cost of energy is added—the levelized costs here are either/or values. That is, the total costs are included in the calculation for levelized costs for kWh, and then the same costs are included in the kW value. Regardless, if the cost of the efficiency investment is less than the cost of capacity additions or generated electricity, efficiency is considered a wise investment.

Table 1-3 below provides the levelized costs for each program and for each portfolio separately. The levelized costs of capacity and energy for the Efficiency Long Island portfolio savings is $194.07 per kW-yr and $0.043 per kWh—less than the comparable costs of alternative supply-side resources and less than the cost of generating the displaced energy.[1] Using these as benchmark values, the Renewable Energy portfolio is below the cost of alternative supply options for demand, but exceeds this level for energy. However, when taking both portfolios together, the Long Island Power Authority's efficiency and renewable options compare favorably to the cost of alternative supply.

Table 1-3. Levelized Costs for the Efficiency Long Island and Renewable Energy Portfolios

Program	Total Program Costs	Levelized Costs	
		$/kWh	$/kW-yr
Commercial Efficiency Program	**$47,841,002**	**0.049**	**200.93**
Energy-Efficient Products	$15,727,157	0.019	132.87
Cool Homes	$8,417,104	0.255	200.90
REAP	$3,305,568	0.235	1,735.05
Home Performance with ENERGY STAR®	$1,665,726	0.217	456.75
Home Performance Direct	$2,509,241	0.412	356.51
Existing Homes Subtotal	*$15,897,639*	*0.236*	*288.69*
Residential New Homes	$997,863	0.129	323.86
Subtotal Residential	**$32,622,659**	**0.036**	**184.81**
Subtotal Efficiency Long Island	**$80,463,660**	**0.043**	**194.07**
Solar PV	$24,244,155	0.098	233.90
Solar Hot Water	$327,190	0.983	7,513.91
Backyard Wind	$238,8685	0.242	7,270.38
Subtotal Renewable Energy	**$24,810,030**	**0.100**	**239.18**
Total	**$105,273,690**	**0.049**	**203.10**

The Long Island Power Authority's expenditures varied for each program. Figure 1-1 and Figure 1-2 below show the respective breakouts of the Long Island Power Authority's spending related to the Efficiency Long Island and Renewable Energy Portfolios by type of expenditure.[2]

[1] Typical supply-side capacity costs are in the range of $350/kW-yr, while energy costs are around $0.08/kWh.

[2] Rebates consist of payments made to participating Long Island Power Authority customers. Incentives consist of payments made to participating contractors (e.g., HVAC installers). Customer Services consist of payments made to program implementers involved with direct installation (e.g., Lime Energy for SBDI).

Figure 1-1. 2013 Long Island Power Authority Expenditures for the Efficiency Long Island Portfolio

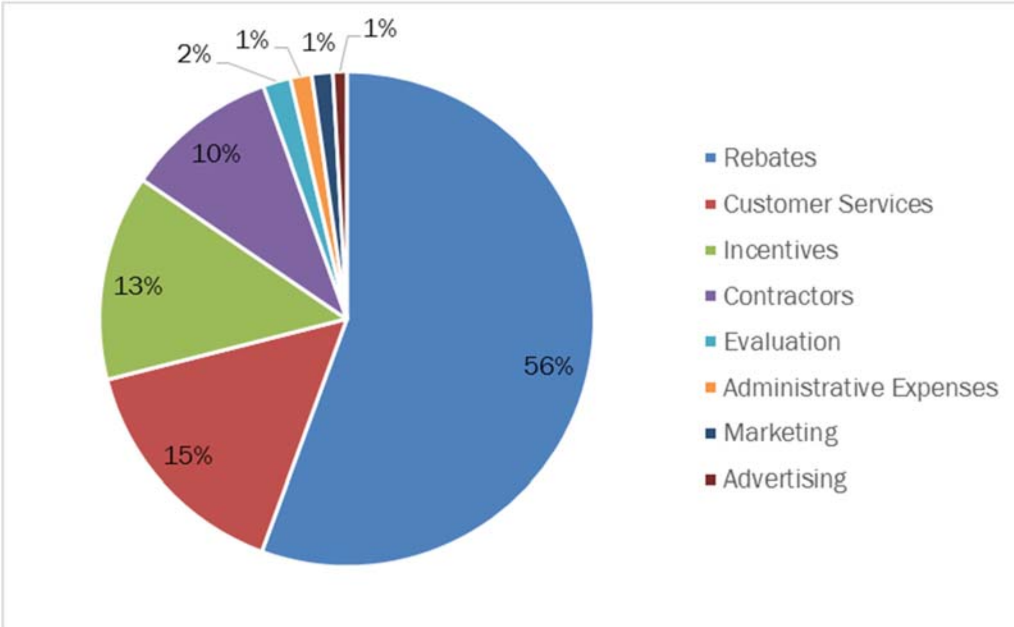
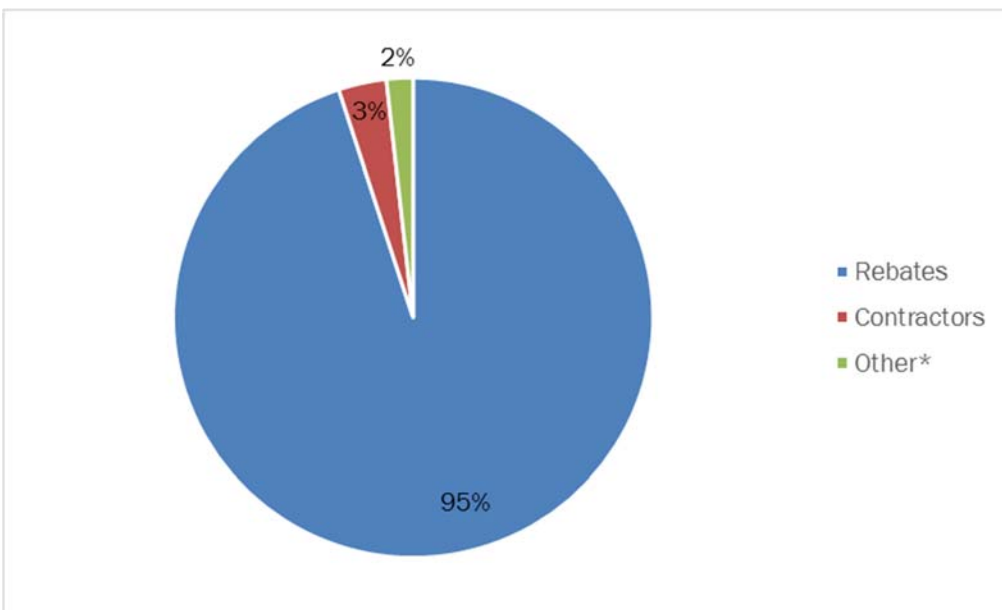


Figure 1-2. 2013 Long Island Power Authority Expenditures for the Renewable Energy Portfolio



*Other includes marketing, advertising, evaluation, and administrative expenses.

1.5 Summary of Economic Benefits Results

The Evaluation Team estimated the expected changes to Long Island's overall economic output and employment resulting from the Long Island Power Authority's 2013 Efficiency Long Island and Renewable Energy Portfolios over the next 10 years. Table 1-4 and Table 1-5 below present the direct impacts and the combined indirect and induced impacts for 2013 and for the 10-year period of 2013 to 2022. To account for expected inflation and the assumed increasing cost of electricity, the tables show the results as net present value using the discount rate used in the Long Island Power Authority's supply-side planning and the cost-effectiveness analysis.

Over 10 years, the 2013 investments in the Efficiency Long Island program are expected to return $153 million in total economic benefits to the regional economy (in 2013 dollars), with an employment benefit of 1,096 new full-time equivalent employees (FTEs)[3] over that time period.

Table 1-4. Economic Impact of PY2013 Efficiency Long Island Program Investments

PY2014 Efficiency Long Island Program Investments	2013 Economic Impact	2013-2022 Economic Impact (NPV[4])
Economic Impact		
Total Economic Output (millions)	$85.0	$153.3
Direct Effect	$84.3	$84.3
Indirect & Induced Effect	$0.7	$68.7
Employment (FTE)	542	1,096
Impact per $1M Investment		
2013 Program Investment (millions)	$80.5	$80.5
Total Economic Output in M per $1M Investment	$1.1	$1.9
Employment (FTE) per $1M Investment	6.7	13.6

Over 10 years, the 2013 investments in the Renewable Energy program are expected to return $49.2 million in total economic benefits to the regional economy (in 2013 dollars), with an employment benefit of 339 new FTEs over that time period.

[3] Full-time equivalents represent the number of total hours worked divided by the number of compensable hours in a full-time schedule. This unit allows for comparison of workloads across various contexts. An FTE of 1.0 means that the workload is equivalent to a full-time employee for one year, but could be done by one person working full-time for a year, two people working part-time for the year, or two people working full-time each for six months.

[4] Using nominal discount rate of 5.643%, based on Long Island Power Authority energy-supply cost assumptions.

Table 1-5. Economic Impact of PY2013 Renewable Energy Program Investments

PY2013 Renewable Energy Program Investments	2013 Economic Impact	2013-2022 Economic Impact (NPV[5])
Economic Impact		
Total Economic Output (millions)	$35.9	$49.2
Direct Effect	$44.9	$44.9
Indirect & Induced Effect	($9.0)	$4.3
Employment (FTE)	229	339
Impact per $1M Investment		
2013 Program Investment (millions)	$24.8	$24.8
Total Economic Output in M per $1M Investment	$1.4	$2.0
Employment (FTE) per $1M Investment	9.2	13.7

The Long Island Power Authority's investments in the Efficiency Long Island Portfolio resulted in a larger total economic output in 2013 ($85.0 million) than in 2012 ($81.6 million). This increase is directly in line with the Long Island Power Authority's increased expenditures – the total economic output created per $1 million of investment in 2013 matched results from 2012. However, employment created per $1 million of investment declined as compared to 2012. Several factors contribute to the difference in employment benefits, including:

- Decreased expenditures on advertising, marketing, salaries, and professional services, all of which provide direct employment benefits to the local economy
- Increased nominal and relative expenditures on rebates, which are used to purchase equipment manufactured outside of Long Island but may not contribute as significantly to employment as direct expenditures on advertising, marketing, salaries, and professional services
- Changes to the implementation of programs in the Efficiency Long Island Portfolio, including rebate and incentive levels
- Changes to the Long Island economy and how economic impacts diffuse through different sectors

Spending on the Long Island Power Authority's Renewable Energy Portfolio resulted in much greater benefits to the Long Island economy in the 2013 program year than in 2012. This difference is driven by the falling price of PV modules as well as the increased number of systems installed through the Solar Pioneer program. We updated our assumptions of the component costs (e.g., hardware and installation labor) of solar PV systems and, as a result, the estimated labor costs increased in 2013 as a share of the total system cost.[6] Because the economic benefit of labor costs remains mostly on Long Island while the spending on PV modules benefits firms outside Long Island,

[5] Using nominal discount rate of 5.643%, based on Long Island Power Authority energy-supply cost assumptions.

[6] National Renewable Energy Laboratory. *Benchmarking of Non-Hardware Balance-of-System (Soft) Costs for U.S. Photovoltaic Systems, Using a Bottom-Up Approach and Installer Survey – Second Edition.*

the increased share of labor costs results in relatively more economic benefit in the Long Island Power Authority's territory.

2. Commercial Efficiency Program

The Long Island Power Authority's Commercial Efficiency Program (CEP) is multi-faceted and comprehensive in how it provides incentives to commercial customers with facilities in the Long Island Power Authority's service territory. The Commercial Efficiency Program caters to all business customers in the Long Island Power Authority's service territory, including small business customers and not-for-profit entities. It offers incentives for a variety of energy-efficient equipment options, and provides other types of support, such as energy audits and technical assistance studies. In 2013, the Commercial Efficiency Program continued delivering their program through the following four avenues:

- Prescriptive: Offers predefined new construction, as well as replacement and retrofit measures that are rebated at set incentive amounts.
- Existing Retrofit: Offers retrofit measures using the predefined menu of measures installed in the existing site as the determination of savings. These measures are rebated at set incentive amounts.
- Direct Install: Offers lighting measures to small business customers in load constrained pockets in Long Island. Features turnkey delivery approach.
- Custom/Whole Building Design: Offers incentives for more complex and less common energy-efficient equipment and for new construction projects that integrate energy-efficient building shell and operating systems that result in a building that exceeds standard practice. Custom projects offer a certain degree of flexibility in terms of equipment choices and incentive amounts, thus allowing the Long Island Power Authority to better meet customers' needs and engage customers with the program.

In addition to these core components, the Long Island Power Authority's Commercial Efficiency Program also offered no-cost energy audits, cost-shared technical assistance studies, building commissioning co-funding, and Leadership in Energy and Environmental Design (LEED) certification incentives in 2013.

Commercial customers were serviced by one of the three implementation entities: CEP Mid-Market (implemented by National Grid), Solutions Provider (implemented by TRC), and Small Business Direct Install (SBDI, implemented by Lime Energy). Both CEP Mid-Market and Solutions Provider work with customers to obtain savings through the Prescriptive, Existing Retrofit, or Custom components. Customers must work with Lime Energy to participate in the Direct Install component. However, customers involved with SBDI can also work with CEP Mid-Market or Solutions Provider if they prefer.

In 2013, the program reached its overall demand goal on an ex ante basis, with the CEP Mid-Market and Solutions Provider components exceeding their ex ante demand goals by 8% and 11%, respectively. The SBDI program component came in under its goal. A key reason for this shortfall in savings was interruptions in program delivery due to turnover of key staff on the part of the implementation contractor.

Table 2-1. Ex Ante Program Performance against Goals

Program Component	Goal		Ex Ante Net Savings		% of Goal	
	MW	MWh	MW	MWh	MW	MWh
Mid-Market	7.0	29,809	7.6	28,975	108%	97%
Solutions Provider	16.3	71,040	18.1	81,872	111%	115%
SBDI	7.7	32,741	5.5	21,684	71%	66%
Total	**31.0**	**133,590**	**31.2**	**132,530**	**101%**	**99%**

Note: Program goals do not include 770 MWh for BOC. This program was not implemented in 2013 and, therefore, not evaluated.

The Commercial Efficiency Program continued to rely primarily on lighting measures. As can be seen in Table 2-2 below, close to 90% of the 2013 ex ante net demand savings came from the lighting installations.

Table 2-2. Commercial Efficiency Program Savings from Lighting and Non-lighting Measures

Program Component	Ex Ante Net Savings	
	% MW	% MWH
Lighting	88%	81%
Non-Lighting	12%	19%

In 2013, the Commercial Efficiency Program built upon a proven implementation structure and solid foundation of rigorous data capture, transfer, and tracking, as well as a procedure-driven delivery process with thorough QA/QC processes. Siebel continued to be the core data entry and tracking system for the Commercial Efficiency Program. Despite multiple QA/QC steps undertaken throughout the project implementation (as further detailed in the implementation and QA/QC models included in this report), our impact evaluation found that the program does not always gather all the data required to support evaluation for some prescriptive measures, and for Existing Retrofit HVAC we found some data inaccuracies in four out of ten applications. The impact section of this report contains greater detail on the missing and inaccurate data.

Core programmatic changes in 2013 included the redesign of the Technical Assistance program to incentivize customers to implement energy savings initiatives in the study and capping the incentives that customers are able to receive through the Prescriptive, Existing Retrofit, and Custom components of the program to 70% of the project cost.

According to the program staff interviews, program promotion through trade ally outreach continued to be the main vehicle for marketing the Mid-Market and the Solutions Provider program components in 2013. The program had two dedicated staff members to market its offerings to trade allies. In addition, the program continued to offer trade ally open house meetings every Friday to answer any program related questions from trade allies.

The Commercial Efficiency Program also relied on a dedicated team of Senior Territory Managers (STMs) reaching out to customers directly and engaging them with the program. For large accounts, the Commercial Efficiency Program continued to engage Account Executives in marketing the program. Marketing to customers also included the annual Energy Efficiency Conference for Long Island Businesses held in April 2013, which was well attended, and radio advertising, which promoted the HVAC stimulus.

To increase the installation of the HVAC measures through the program, between May and October of 2013, the Commercial Efficiency Program offered enhanced incentives for certain HVAC retrofits. This stimulus doubled the rebate amounts, up to $800 per ton, for qualified projects in which new air conditioning equipment replaced existing equipment rated 9 EER or less. According to interviews with the program staff, the offer was very successful, more than doubling participation in the HVAC component of the program from 2012.

Based on the interviews with the program staff, the program generally ran smoothly in 2013 with few bottlenecks or issues. One challenge identified by the program staff was continuing bottlenecks associated with channeling potential customers to the proper implementation entity, be it the Solutions Provider or SBDI. Customers would often be channeled to the wrong entity by Infoline representatives, which caused delays and could have potentially led to customer dissatisfaction. Based on the follow-up conversations with the program staff, it appears that this issue has been addressed through additional training for Infoline representatives to ensure smooth customer channeling in the future.

In January 2014, similar to the other programs in the Long Island Power Authority's energy efficiency portfolio, PSEG Long Island took over from National Grid the implementation of the Commercial Efficiency Program. Moving forward, PSEG Long Island will be responsible for the development of the overall design, budget, marketing and implementation of the annual commercial programs budget approved by the Long Island Power Authority.

Planned changes for 2014 are minimal. One change that took place in early 2014 is the waiver of the mandatory post-inspection requirement for smaller prescriptive and existing retrofit projects (incentives under $5,000). Instead, 10% of these projects will be inspected at random moving forward. No other changes to the program design, delivery structure, measure, or incentive offerings are planned for 2014. Program staff, however, acknowledged that the program is flexible and changes are possible over the course of the year where participation levels to require them.

Overall Impacts for Commercial Efficiency Program

Table 2-3 provides a comparison of evaluated net savings to ex ante savings for the Commercial Efficiency Program impacts by implementation entity.

Table 2-3. Commercial Efficiency Program Impacts for Goal Comparison

Program Component	Category	Ex Ante		Evaluated		Realization Rate	
		kW	kWh	kW	kWh	kW	kWh
CEP Mid-Market	Prescriptive	407	1,624,585	360	2,000,475	88%	123%
	Custom	41	205,995	32	195,695	80%	95%
	Existing Retrofit	7,153	27,143,945	6,513	22,878,040	91%	84%
	CEP Mid-Market Subtotal	*7,601*	*28,974,525*	*6,905*	*25,074,210*	*91%*	*87%*
Solutions Provider	Prescriptive	1,172	9,792,730	1,143	10,805,079	97%	110%
	Custom	2,509	20,106,440	2,007	19,101,118	80%	95%
	Existing Retrofit	14,406	51,972,799	13,124	43,813,083	91%	84%
	Solutions Provider Subtotal	*18,088*	*81,871,969*	*16,274*	*73,719,280*	*90%*	*90%*
Small Business Direct Install		5,509	21,683,874	5,494	17,466,015	100%	81%
Commercial Program Total		**31,197**	**132,530,368**	**28,674**	**116,259,505**	**92%**	**88%**

Ex post net savings differ from evaluated net savings in that ex post savings are developed using ex post NTGRs, while evaluated net savings are based on program planning NTGR values. Program-planning NTGRs differed from evaluated values by program component. The Evaluation Team did not perform new research this year and, therefore, used NTGR established through previous evaluations. The derivation of ex post NTGRs is described in detail below and in Section 13 of this report.

Table 2-4 provides a comparison of ex ante and ex post savings by the Commercial Efficiency Program implementation entity and project category. The Evaluation Team developed ex post net impact estimates for use in the benefit-cost and economic impact assessments.

Table 2-4. Commercial Efficiency Program Impacts for Cost-Effectiveness

Program Component	Category	Ex Ante		Ex Post		Cost-Effectiveness Realization Rate	
		kW	kWh	kW	kWh	kW	kWh
CEP Mid-Market	Prescriptive	407	1,624,585	286	1,651,224	70%	102%
	Custom	41	205,995	26	156,556	64%	76%
	Existing Retrofit	7,153	27,143,945	5,098	17,807,266	71%	65%
	CEP Mid-Market Subtotal	7,601	28,974,525	5,409	19,615,046	71%	68%
Solutions Provider	Prescriptive	1,172	9,792,730	925	9,216,475	70%	102%
	Custom	2,509	20,106,440	1,606	15,280,894	64%	76%
	Existing Retrofit	14,406	51,972,799	10,271	34,099,460	71%	66%
	Solutions Provider Subtotal	18,088	81,871,969	12,802	58,596,830	71%	72%
Small Business Direct Install		5,509	21,683,874	4,781	15,242,591	87%	70%
Commercial Program Total		**31,197**	**132,530,368**	**22,992**	**93,454,467**	**74%**	**71%**

Next, we provide the measure-level information by program component.

Prescriptive Component of Commercial Efficiency Program

This section provides the results of the Evaluation Team's analysis of energy and demand savings associated with prescriptive measures installed through the Commercial Efficiency Program by the CEP Mid-Market and Solutions Provider implementation entities. We performed our analysis by program component (Prescriptive, Custom, and Existing Retrofit) and not by implementation entity. As such, we aggregated our results for prescriptive measures across implementation entities within our analysis and used the same realization rate for both. For the purposes of engineering analysis, we grouped prescriptive measures into seven end-use categories: HVAC, compressed air, refrigeration, motors and variable-frequency drives (VFDs), building envelope (i.e., Cool Roofs), kitchen equipment, and vending machines. We analyzed the lighting and performance lighting together through a separate realization rate analysis, and then included it back into the prescriptive savings totals.

The evaluation of the seven prescriptive measures noted above consisted of several phases. First, analysts obtained the program's savings database, which contained ex ante savings estimates for each individual measure incentivized through the program in 2013. The database also contained information regarding measure characteristics, allowing the Evaluation Team to tailor the analysis of energy savings to reflect the efficiency standards set by the program over the past year. For example, for HVAC measures, equipment size (in tons) and efficiency (in SEER/EER) were available, and we applied these characteristics to evaluation savings calculations to ensure an "apples-to-apples" comparison with ex ante estimates presented in the program-tracking database. The Evaluation Team used the measure type and characteristic information from the database to derive the impacts as defined in Section 13.3. Similar to last year's analysis, we selected a sample of projects within the lighting and performance lighting measure groups for a separate analysis that allowed the team to look closely at the details within projects (as the program-tracking data did not contain the detailed information required for review).

Table 2-5 presents evaluated net energy and demand savings associated with the Prescriptive program component by end-use category. As both ex ante and evaluated net savings values are calculated using program-planning NTGRs, the differences expressed through the realization rates represent differences in the ex ante and evaluated gross savings. See the definitions in Section 1.1 for a discussion of the difference between the ex ante and evaluated values.

Table 2-5. Prescriptive Component of CEP: Net Savings for Goal Comparison

Category	Number of Units	Ex Ante		Evaluated		Realization Rate	
		kW	kWh	kW	kWh	kW	kWh
Lighting	11,567	621	2,683,868	660	3,088,252	106%	115%
HVAC	310	380	876,428	386	905,425	101%	103%
Compressed Air	67	273	1,709,832	86	1,264,884	31%	74%
Refrigeration	3,493	153	4,138,692	153	4,138,692	100%	100%
Motors and VFD	103	73	1,863,550	138	3,256,083	189%	175%
Building Envelope	25	78	134,542	78	134,542	100%	100%
Kitchen Equipment	4	1	5,242	2	10,484	199%	200%
Vending Machines	4	0	5,161	0	7,192	100%	139%
Total	**15,573**	**1,579**	**11,417,315**	**1,502**	**12,805,554**	**95%**	**112%**

The Evaluation Team identified a number of reasons for discrepancy in gross savings by category as described below.

Reasons for Differences in Impacts

- For ***Lighting*** measures (both prescriptive and performance lighting), the analysis we completed allowed a thorough project-specific information on installed lighting systems. This allowed evaluators to calculate energy and demand savings for a sample of projects based on the project parameters such as fixture type, occupancy sensor type, and installed number of components, resulting in evaluated savings 15% and 6% higher than ex ante. From our sample of 10 projects, we found only a few issues as described below.
  - The evaluators used deemed savings per measure type to calculate evaluated demand and energy savings. After discussions with the Long Island Power Authority, deemed savings from 2012 were updated for three types of fixtures and three types of occupancy sensors.
  - Following the updates to the deemed values for several light fixtures, evaluators still had to estimate savings for one fixture type because a deemed savings value was not available. This resulted in a realization rate of more than 200% for this project.
  - For one project, we found two additional types of lighting fixtures installed beyond the rebated fixtures. We assumed the user installed these fixtures because of the program, even though they were not rebated, which resulted in a realization rate of more than 300% for this project.

  - Three projects had slight discrepancies in the number of fixtures and/or sensors installed per the program documentation with the actual number installed per the post-inspection. In two of the three cases this resulted in less savings compared with the ex ante, while the third case resulted in additional savings.

  - Two projects achieved fairly high realization rates with no known explanation for the differences in the data.

- For *HVAC* measures, evaluators applied a similar analysis strategy as in the past evaluations. Measure-specific characteristics such as cooling capacity and efficiency were available for most projects in the program database and were used to characterize the efficient operation of installed equipment. The database did not contain cooling capacity information for some measures, which we then estimated based on measure type and tracking data from previous evaluations. We determined evaluated savings by comparing the installed equipment to a code-standard baseline. Our analysis used normalized savings values (i.e., kW/ton or kWh/ton) and similar algorithms and assumptions as used by the Commercial Efficiency Program. We multiplied these normalized values by the installed tons for each measure provided by the Long Island Power Authority to arrive at our estimated savings. The Evaluation Team did not know the specifics around the Commercial Efficiency Program calculated program savings, so we cannot explain the differences in values.

- For *Motor and Variable-Frequency Drive (VFD)* measures, the database featured extensive per-install information. With this useful information, evaluators conducted an analysis by facility and motor type, leading to realization rates of 189% for demand savings and 175% for energy savings. Our analysis used the normalized savings values (i.e., kW/hp or kWh/hp) that the NYTM recommends based on different building types and application. We multiplied these values by the installed horsepower for each measure provided by the Long Island Power Authority to arrive at our estimated savings. Since the program assumptions utilized for motors and variable-frequency drives do not differentiate between building types, evaluators believe that the NYTM recommended values are therefore more appropriate for analyzing specific 2013 projects.

- *Refrigeration* measures featured lack of installed kW information and have thus been assigned a realization rate of 100% for this year. Previous evaluation review of program algorithms and assumptions has given evaluators confidence that the program is characterizing this measure category's savings appropriately. The Evaluation Team recommends the program update its data collection and tracking procedures for this measure to ensure that all data required for evaluation are accurately recorded and available to evaluators. As the program’s tracking system evolves for these measures, evaluators can perform a more thorough engineering analysis in the future.

- The database contained install-specific information for *Compressed Air* measures, leading to lower ex post savings as compared to ex ante, by 69% on the demand side and 26% on the energy side. The air receiver measures are the major contributors to the lower ex post savings. This measure category accounted for about two-thirds of the demand savings and one-third of energy savings from the compressed air projects. The Evaluation Team’s analysis for compressed air applied savings estimates that are used consistently throughout the Northeast. However, the Commercial Efficiency Program assumes a saving percentage. We do not know the specifics around how the Commercial Efficiency Program calculated the savings percentage, so we therefore cannot pinpoint why our values are different. Going forward, we recommend using savings algorithms for these measures based on TRMs provided by the Evaluation Team and that PSEG Long Island collect and track all data required for these calculations to allow a thorough evaluation.

- For ***Vending Machine*** measures, the evaluators used install-specific information when available to most accurately characterize the incentivized equipment.
- For ***Building Envelope*** measures, there was insufficient information to complete a thorough analysis. The 25 building envelope measures in the database account for 0.3% of the Commercial demand savings and have therefore been assigned a realization rate of 100% for this year's analysis due to the lack of program data. The Evaluation Team recommends the program update its data collection and tracking procedures for this measure to ensure that all data required for evaluation are accurately recorded and available to evaluators. As the program's tracking system evolves for these measures, evaluators will perform a more thorough engineering analysis in the future.
- ***Kitchen Equipment*** measures feature realization rates of 199% for demand savings and 200% for energy savings. The Evaluation Team did not know the specifics around how the Commercial Efficiency Program calculated program savings, but believe that the differences in savings may be due to a factor of 0.5 applied by the program for "insulated folding cabinets - half size", which was the only measure installed in the Kitchen Equipment category.

Net impacts indicate the savings off the grid due to program intervention. The ex ante NTGR values varied from the ex post NTGR by end-use as shown in Table 2-6.

Table 2-6. NTGR for Prescriptive Component of Commercial Efficiency Program

End-Use	Ex Ante NTGR[a]	Ex Post NTGR[b]
Lighting	0.92	0.72
Performance Lighting	0.92	0.72
Motors and VFDs	0.64 or 0.92	0.72
Compressed Air	0.91	0.72
HVAC	0.64 to 0.92	0.72
HVAC Controls	0.60 or 1.00	0.72
Kitchen Equipment	0.75 to 1.10	0.72
Building Envelope	1.00	0.72
Vending Machines	0.99	0.72

[a]Ex ante NTGR values are from measures specific information received from PSEG Long Island staff.

[b]Ex post free ridership is 0.3 for both kW and kWh. The specific spillover value varies between demand and energy. The demand spillover is 1.87% while the energy spillover is 1.55%.

Table 2-7 shows a comparison of ex ante to ex post net energy and demand savings associated with the Prescriptive program component by end-use category. See the definitions in Section 1.1 for a discussion of the difference between the ex ante and ex post values. As noted previously, the Evaluation Team developed ex post net impact estimates for use in the benefit-cost and economic impact assessments.

Table 2-7. Prescriptive Component of Commercial Efficiency Program for Cost-Effectiveness

Category	Number of Units	Ex Ante		Ex Post		Cost-Effectiveness Realization Rate	
		kW	kWh	kW	kWh	kW	kWh
Lighting	11,567	621	2,683,868	515	2,401,788	83%	89%
HVAC	310	380	876,428	307	723,032	81%	82%
Compressed Air	67	273	1,709,832	68	998,980	25%	58%
Refrigeration	3,493	153	4,138,692	110	2,975,461	72%	72%
Motors and VFD	103	73	1,863,550	154	3,656,480	211%	196%
Building Envelope	25	78	134,542	56	96,691	72%	72%
Kitchen Equipment	4	1	5,242	2	10,046	190%	192%
Vending Machines	4	0	5,161	0	5,221	100%	101%
Total	**15,573**	**1,579**	**11,417,315**	**1,211**	**10,867,699**	**77%**	**95%**

Reasons for Differences in Net Impacts

We applied the same ex post NTGR as last year's evaluation. The Evaluation Team developed an updated NTG factor for the Commercial Efficiency Program and Solutions Provider program elements in 2011 and performed primary research in 2012 to specifically look for participant spillover. Spillover added approximately 0.02[7] to the previous NTG factor of 0.70. We calculated ex post net savings by applying the NTGR of 0.72 to the evaluated gross savings. In contrast, the program calculates ex ante net savings by assigning multiple deemed net-to-gross ratios based on measure type. These deemed NTGRs vary from 0.60 to 1.10.

Existing Retrofit Component of Commercial Efficiency Program

Table 2-8 presents evaluated net energy and demand savings associated with the Existing Retrofit program component by end-use category. As both net savings values were calculated using program-planning NTGRs, the differences expressed through the realization rates represent differences in the ex ante and evaluated gross savings. See the definitions in Section 1.1 for a discussion of the difference between the ex ante and evaluated values.

[7] The specific spillover value varies between demand and energy. The demand spillover is 1.87% while the energy spillover is 1.55%. When considered at the single level, both are 2%. We applied the specific values shown here in our analysis.

Table 2-8. Existing Retrofit Component of Commercial Efficiency Program for Goal Comparison

Program Component	Category	End Use	Ex Ante			Evaluated		Realization Rate	
			Units	kW	kWh	kW	kWh	kW	kWh
Existing Retrofit	CEP	Lighting	1,470	6,476	26,089,991	5,930	22,032,341	92%	84%
		HVAC	143	677	1,053,954	583	845,699	86%	80%
	Solution Provider	Lighting	788	13,180	50,151,066	12,069	42,351,314	92%	84%
		HVAC	110	1,226	1,821,733	1,055	1,461,769	86%	80%
	Total		**2,511**	**21,559**	**79,116,744**	**19,637**	**66,691,123**	**91%**	**84%**

Reasons for Differences in Impacts

We performed two analyses for this program component—one for the lighting end-use and one for the HVAC end-use and found realization rates of 92% and 84% for lighting demand and energy savings, respectively, and 86% and 80% for HVAC end-use demand and energy savings respectively. The realization rates for HVAC end-use include a revised analysis that increased the sample size from 10 to 25 projects.

For the ***Lighting*** analysis, two primary reasons for differences in the realization rates were:

- Out of 15 sampled projects, nine had slight differences in fixture counts per the post-inspection than what was in the program-tracking data. The differences ranged from minor (i.e., one fixture) to fairly large (multiple fixture types and quantities not matching).
- The assumed hours of use on two of the projects were adjusted after reviewing the project documentation. One project (a Food Store) was using 6,570 hours, but this value was adjusted down to 4,055 hours per factor table (NYTM) to be consistent with the other food stores. Note the 6,570 value did not match any building type. Another project had different hours of use between Siebel and the project documentation. Our analysis confirmed the values in the project documentation. For both projects, the adjustment to operating hours reduced the ex post savings.

For the ***HVAC*** analysis, 11 out of the 25 sampled projects revealed the discrepancies described below.

- Seven projects appeared to have a data entry issue within Siebel or data missing from the tracking database. These included one project that calculated savings using a SEER of 3 rather than 13 resulting in a significantly higher ex ante value than appropriate. Additionally, six projects did not include baseline efficiencies in tracking data so we could not replicate the ex ante calculations or had to assume baseline efficiencies based on the NYTM.
- Two projects contained discrepancies between the tracking database and the project worksheets. It appeared that the project worksheets had been updated following the post-installation inspection, while the tracking database did not get updated.
- Two projects contained gross per unit savings in the project worksheet that did not match per unit savings seen for the same measure in other projects. Since the worksheets are protected, we were not able to determine the exact reason for this discrepancy, but it resulted in significantly lower realization rates for these projects.

Table 2-9 shows a comparison of ex ante to ex post net energy and demand savings associated with the Existing Retrofit program component by end-use category. See the definitions in Section 1.1 for a discussion of the difference between the ex ante and ex post values. As noted in Section 1, the Evaluation Team developed ex post net impact estimates for use in the benefit-cost and economic impact assessments.

Table 2-9. Existing Retrofit Component of Commercial Efficiency Program for Cost-Effectiveness

Program Component	Category	End Use	Ex Ante			Ex-Post		Realization Rate	
			Units	kW	kWh	kW	kWh	kW	Units
Existing Retrofit	CEP	Lighting	1,470	6,476	26,089,991	4,633	17,134,935	72%	66%
		HVAC	143	677	1,053,954	465	672,330	69%	64%
	Solution Provider	Lighting	788	13,180	50,151,066	9,428	32,937,354	72%	66%
		HVAC	110	1,226	1,821,733	842	1,162,106	69%	64%
	Total		**2,511**	**21,559**	**79,116,744**	**15,369**	**51,906,725**	**71%**	**66%**

Reasons for Differences in Net Impacts

Similar to the Prescriptive program component, we did not perform any new NTG analysis this year. The Evaluation Team developed an updated NTG factor for the Commercial Efficiency Program and Solutions Provider program elements in 2011 and performed primary research in 2012 to specifically look for participant spillover. Spillover added approximately 0.02[8] to the previous NTG factor of 0.70. The planning NTGRs are 0.92 for lighting and 0.90 for HVAC. The evaluated NTGR is 0.72 reduced ex post net savings values.

Small Business Direct Install (SBDI) Component of Commercial Efficiency Program

Table 2-10 shows net energy and demand savings associated with the Small Business Direct Install (SBDI) program component by end-use category. As both net savings values are calculated using program-planning NTGRs, the differences expressed through the realization rates represent differences in the ex ante and evaluated gross savings. See the definitions in Section 1.1 for a discussion of the difference between the ex ante and evaluated values.

Table 2-10. SBDI Component of Commercial Efficiency Program Impacts for Goal Comparison

CEP	Ex Ante		Evaluated		Realization Rate	
	kW	kWh	kW	kWh	kW	kWh
All Measures	5,509	21,683,874	5,494	17,466,015	100%	81%

[8] The specific spillover value varies between demand and energy. The demand spillover is 1.87% while the energy spillover is 1.55%. When considered at the single level, both are 2%. We applied the specific values shown here in our analysis.

Reasons for Differences in Impacts

Our analysis resulted in a near 100% realization rate for demand savings, but a realization rate of 81% for energy savings. The reason for this discrepancy is that four out of the 20 sampled projects required modifications to hours of use based on the TRM hours of use by building type. Two of the four projects required a reduction in hours of use, while the remaining two required an increase in the hours of use. One of the projects that required a reduction was by far the largest project in the sample, which is the primary reason driving down the low energy realization rate. One additional project achieved a lower realization rate because the ex ante savings factored in a large demand savings for occupancy sensors, but the ex post does not account for occupancy sensors in demand savings. We do not include demand savings from occupancy sensors as we expect commercial buildings to be occupied during peak demand times. Note this project was small and had little effect on the overall realization rates.

Table 2-11 presents net ex post energy and demand savings associated with the small business direct install program component by end-use category. The Evaluation Team estimated a single NTGR for the SBDI component of the Commercial Program last year and applied the same value this year with the addition of a negligible level of spillover.[9] This NTGR value, 0.87, was lower than the program planning value of 1.0, reducing all values in Table 2-11. See the definitions in Section 1.1 for the difference between the ex ante and ex post values. As noted in Section 1, the Evaluation Team developed ex post net impact estimates for use in the benefit cost and economic impact assessments.

Table 2-11. SBDI Component of Commercial Efficiency Program Impacts for Cost-Effectiveness

Category	Ex Ante		Ex Post		Realization Rate	
	kW	kWh	kW	kWh	kW	kWh
All Measures	5,509	21,683,874	4,781	15,242,591	87%	70%

Custom Program

We based energy impacts from the Custom program on the evaluation of 29 sites via engineering measurement and verification (M&V) during the 2012 impact evaluation. We applied the same realization rates (0.8 for demand and 0.95 for energy) from this past analysis to the 2013 Custom projects.

[9] Our analysis of participant spillover for the SBDI set of customers indicated very little spillover. We found spillover of 0.27% for energy and 0.01% for demand. These were included in the total savings in our analysis.

Table 2-12. Custom Program Component for Goal Comparison

Program Component	Category	Ex Ante		Evaluated		Realization Rate	
		kW	kWh	kW	kWh	kW	kWh
Custom	CEP Mid-Market	41	205,995	32	195,695	0.80	0.95
	Solutions Provider	2,509	20,106,440	2,007	19,101,118	0.80	0.95
	Total	2,550	20,312,435	2,040	19,296,813	0.80	0.95

Table 2-13 presents net ex post energy and demand savings associated with the Custom program component. See the definitions in Section 1.1 for the difference between the ex ante and ex post values. As noted in Section 13, the Evaluation Team developed ex post net impact estimates for use in the benefit-cost and economic impact assessments.

Table 2-13. Custom Program Component for Cost-Effectiveness

Program Component	Category	Ex Ante		Ex Post		Realization Rate	
		kW	kWh	kW	kWh	kW	kWh
Custom	CEP Mid-Market	41	205,995	26	156,556	0.64	0.76
	Solutions Provider	2,509	20,106,440	1,606	15,280,894	0.64	0.76
	Total	2,550	20,312,435	1,632	15,437,451	0.64	0.76

Reasons for Differences in Net Impacts

Similar to the Prescriptive Program component, we performed no NTG research this year. The Evaluation Team developed an updated NTG factor for the Commercial Efficiency Program and Solutions Provider program elements in 2011 and performed primary research in 2012 to specifically look for participant spillover. Spillover added approximately 0.02[10] to the previous NTG factor of 0.70. We calculated ex post net savings by applying the updated NTGR, 0.72, to evaluated gross savings. In contrast, the program calculates ex ante net savings using a deemed value that varied by end-use, but averaged 0.965 overall for the Commercial Efficiency Program.

Net-to-Gross Ratio Estimation

Free Ridership and Participant Spillover

The net-to-gross ratio (NTGR) is defined as the savings that can be attributed to programmatic activity. The NTGR accounts for naturally occurring efficiency that would have happened even if the program did not exist (free ridership) as well as projects that were influenced by the program but did not receive direct assistance (spillover). The NTGR is generally expressed as a decimal and quantified through the following algorithm:

$$NTGR = 1 - Free\ Ridership + Spillover$$

[10] The specific spillover value varies between demand and energy. The demand spillover is 1.87% while the energy spillover is 1.55%. When considered at the single level, both are 2%. We applied the specific values shown here in our analysis.

The Long Island Power Authority uses deemed NTGRs for the Commercial Efficiency Program that vary from 0.41 to 0.95 depending on the measure for the Commercial Efficiency Program and uses an NTGR of 1 for the SBDI program. The 2011 program evaluation found a 0.70 NTGR for the Commercial Efficiency Program and a 0.87 for SBDI.

In 2012, the Evaluation Team performed primary research to estimate participant spillover. The resulting spillover adds another approximately 0.02[11] to the previous NTGR of 0.70 and a negligible amount to the previous 0.87 NTGR for SBDI. The resulting total NTG for SBDI, consequently remained at 0.87 and the remaining program components increased to 0.72.

We did not revisit NTG assessment as part of the 2013 evaluation, but rather relied on the free ridership estimate developed during the 2011 evaluation and spillover estimate developed as part of the 2012 evaluation.

[11] Ibid.

3. Energy-Efficient Products (EEP) Program

The objective of the Energy-Efficient Products (EEP) program is to increase the purchase and use of energy-efficient appliances and lighting among Long Island Power Authority residential customers. In 2013, the program provided rebates or discounts on ENERGY STAR® compact fluorescent lamps (CFLs) including fixtures, solid state lighting (LEDs), advanced power strips, dehumidifiers, refrigerators, room air conditioners, and super-efficient dryers. The program also provided rebates on variable- and two-speed pool pumps, and included an appliance-recycling component in which the program paid residents to recycle older working refrigerators, freezers, room air conditioners, and dehumidifiers.

The overall goal of the EEP program is market transformation so consumers regularly choose energy-efficient appliances and lighting over less-efficient alternatives. In addition to offering financial incentives, the program educates customers about the benefits of using energy-efficient products in their homes through the Long Island Power Authority website and program marketing materials. The EEP program coordinates its requirements with ENERGY STAR®, the Environmental Protection Agency (EPA), and the U.S. Department of Energy (DOE), and updates efficiency requirements whenever any of these organizations make a change.

The majority of the EEP program's design and implementation remained the same in 2013, though some specific program areas were modified. The program discontinued their television mid-stream program. Additionally, participants in the appliance recycling component of the program were given a $20 gift certificate for EFI's online efficient lighting catalog.

Impacts for Goal Comparison

Table 3-1 provides a program-level comparison of evaluated net savings to ex ante savings by measure category. See the definitions in Section 1.1 for a discussion of the difference between the ex ante and evaluated values.

Table 3-1. EEP Impacts for Goal Comparison

Category	N[a]	Ex Ante		Evaluated			Realization Rate	
		kW	kWh	N	kW	kWh	kW	kWh
Lighting	2,445,649	12,452	111,873,473	2,448,896	14,836	133,354,294	119%	119%
Dehumidifiers	10,475	778	1,308,866	10,476	1,287	2,163,473	165%	165%
Refrigerators	23,313	556	2,691,521	23,316	555	2,683,526	100%	100%
Room AC	31,894	1,994	964,203	31,894	1,973	953,863	99%	99%
Televisions	5,833	108	949,414	5,833	108	949,387	100%	100%
Appliance recycling	9,471	1,341	7,672,829	9,455	1,310	7,647,029	98%	100%
Pool pumps	3,038	1,400	2,739,401	3,037	1,399	2,738,403	100%	100%
Super-efficient dryers[b]	2	226	306,000	2	0.23	306	0%	0%
Advanced power strips	402	27	32,074	402	27	32,074	100%	100%
Totals	**2,530,077**	**18,882**	**128,537,781**	**2,533,311**	**21,494**	**150,522,355**	**114%**	**117%**

[a] Ex post impacts reflect 3,247 additional lighting units, one additional dehumidifier, three additional refrigerators, 16 fewer appliance recycling, and one less pool pumps than ex ante.
[b] Ex ante impacts for super-efficient dryers were too high by a factor of 1,000 which resulted in a realization rate of 0.1% for both demand and energy.

Reasons for Differences in Impacts

Lighting: We determined a realization rate of 119% for both energy and demand for lighting sold through the program in 2013. The higher realization rates are due to differences in program assumed delta watts and in-service rates assumed by the evaluators, described in more detail below:

- **Delta watts.** We used the program-tracking database to categorize each of the program bulbs by wattage category and to assign an assumption regarding the pre-program wattage for each category. In total, the average incentivized bulb was 15.61, and the assumed pre-program wattage was 66.60 watts, for a per-unit weighted savings of 50.99 watts. The program assumed a delta watts of 49.1 watts, contributing to the higher energy and peak demand realization rate.

- **In-service rates.** Many light bulbs are sold in multi-packs, and customers typically install a portion of the bulbs shortly after purchase and place the rest in storage. Results from the in-home study we conducted found that 83% of all CFLs in homes are installed, with 17% in storage. This number is unchanged from the residential baseline study we conducted in 2010.[12] Based on this research, we used a first-year installation rate of 83%. A study in California estimated a trajectory of future installation for stored program bulbs, and found that 98% of bulbs are installed within two years of purchase. The study further concluded that 60% of the remaining bulbs are installed two years after purchase while 40% are installed three years after purchase. Therefore, the program can claim savings of bulbs sold in 2011 and 2012 but not installed until 2013. We added 9% of CFL savings from 2012 and 6% of CFL savings from 2011 to the 2013 totals for kWh and peak kW. The ex ante savings

[12] *2010 LIPA Residential Baseline Study*. Opinion Dynamics Corporation. June 2011.

do not account for bulbs installed a year or more after program participation; this is the primary reason for higher evaluated kWh and peak kW savings as compared with ex ante.

Dehumidifiers: We were unable to determine specific algorithms within ex ante estimates for gross impacts of dehumidifiers. We used 2013 dehumidifier tracking information on sizes (pints/day) to calculate the gross savings and compared this with ex ante values. We referenced the pre and post dehumidifier energy use for each size category from values recommended by ENERGY STAR®.

Televisions: Per ENERGY STAR® recommendations, evaluators revised the program’s gross savings estimates to 137 kWh/unit for energy and 0.07 kW/unit for demand. The program had assumed gross savings estimates of 170 kWh/unit and 0.093 kW/unit for energy and demand, respectively. This led to a reduction in evaluated energy and demand savings of 19% for televisions.

Appliance Recycling: Evaluators agree with the program's gross savings estimates for dehumidifier and refrigerator recycling but the minor discrepancy in realization rate is due to differences in the ex ante net-to-gross calculations compared to evaluators. For RAC recycle measure, the *ex ante* energy savings value used was found to be low compared to evaluated savings. Moving forward, we recommend that the deemed savings values for RAC recycling be increased to match the energy savings values recommended by ENERGY STAR® (where applicable).

Super-Efficient Dryer Pilots. The ex ante reported savings for this new measure were too high by a factor of 1000. The program claimed MW and MWh savings when the measure actually resulted in kW and kWh savings. This error led to a realization rate of 0.1% for both peak demand and energy savings.

Impacts for Cost-Effectiveness

The ex post net-to-gross ratio (NTGR) differed from the ex ante NTGR assumption to varying degrees across program measures. Table 3-2 below shows the ex ante and ex post NTGRs by measure.

Table 3-2. NTGR for EEP

Program Measures	Ex Ante			Ex Post		
	Free rider	Spillover	NTGR	Free rider	Spillover	NTGR
Refrigerators	20.0%	10.0%	90.0%	20.0%	10.0%	90.0%
Dehumidifier	30.0%	15.0%	85.0%	67.0%	0.0%	33.0%
Room AC ≤6kBtuh	30.0%	25.0%	95.0%	30.0%	25.0%	95.0%
Room AC >6k ≤ 8k Btuh	30.0%	25.0%	95.0%	30.0%	25.0%	95.0%
Room AC ≥8kBtuh	30.0%	25.0%	95.0%	30.0%	25.0%	95.0%
CFLs – common	30.0%	4.0%	74.0%	30.0%	4.0%	74.0%
CFLs – specialty	25.0%	20.0%	95.0%	25.0%	20.0%	95.0%
ENERGY STAR SSL	5.0%	25.0%	120.0%	5.0%	25.0%	120.0%
Fixtures	1.7%	3.2%	101.5%	1.7%	3.2%	101.5%
Smart strips	0.0%	0.0%	100.0%	0.0%	0.0%	100.0%
Ceiling fans	30.0%	0.0%	70.0%	30.0%	0.0%	70.0%
Appliance recycle	43.0%	0.0%	57.0%	52.0%	0.0%	48.0%
Pool pumps – two speed	20.0%	10.0%	90.0%	20.0%	10.0%	90.0%
Pool pumps – variable speed	20.0%	10.0%	90.0%	20.0%	10.0%	90.0%
Super-Efficient Dryer – Electric	0.0%	0.0%	100.0%	0.0%	0.0%	100.0%

Applying the NTGRs in Table 3-2 to evaluated gross savings provides ex post net savings. Table 3-3 below provides a category-by-category comparison of ex ante to ex post net savings. See the definitions in Section 1.1 for a discussion of the difference between the ex ante and ex post values. As noted in Section 1, the Evaluation Team developed ex post net impact estimates for use in the benefit cost and economic impact assessments.

Table 3-3. EEP Net Impacts for Cost-Effectiveness

Category	N[a]	Ex Ante		Ex Post			Realization Rate	
		kW	kWh	N	kW	kWh	kW	kWh
Lighting	2,445,649	12,452	111,873,473	2,448,896	14,836	133,354,294	119%	119%
Dehumidifiers	10,475	778	1,308,866	10,476	500	839,937	64%	64%
Refrigerators	23,313	556	2,691,521	23,316	555	2,683,526	100%	100%
Room AC	31,894	1,994	964,203	31,894	1,973	953,863	99%	99%
Televisions	5,833	108	949,414	5,833	108	949,387	100%	100%
Appliance Recycling	9,471	1,341	7,672,829	9,455	1,103	6,439,603	82%	84%
Pool Pumps	3,038	1,400	2,739,401	3,037	1,399	2,738,403	100%	100%
Super Efficient Dryers[b]	2	226	306,000	2	0.23	306	0%	0%
Advanced Power Strips	402	27	32,074	402	27	32,074	100%	100%
Totals	**2,530,077**	**18,882**	**128,537,781**	**2,533,311**	**20,500**	**147,991,393**	109%	115%

[a] Ex post impacts reflect 3,247 additional lighting units, one additional dehumidifier, three additional refrigerators, 16 fewer appliance recycling, and one less pool pumps than ex ante.
[b] Ex ante impacts for super-efficient dryers were too high by a factor of 1,000 which resulted in a realization rate of 0.1% for both demand and energy.

4. Cool Homes Program

The Cool Homes program seeks to improve the energy efficiency of residential heating, ventilation, and air conditioning (HVAC) systems throughout Long Island. Through the assistance of a Long Island Power Authority-approved contractor, residential account holders can apply for incentives associated with the quality installation of higher-efficiency HVAC equipment including central air conditioners (CACs), furnace fans, geothermal and air source heat pumps, and ductless mini-split systems. Further, the program offers larger rebate incentives for the early retirement of central air conditioning systems for these measures. In addition, the 2013 program tested the market by offering customers an additional rebate to encourage the replacement of existing ductwork. The Cool Homes program plans to continue the ductwork replacement measure in 2014. There are no plans to continue the upstream program.

The Cool Homes program met its demand goals in 2013, after falling short of these goals in the previous two years. In 2013, Cool Homes provided incentives for 6,164 measures. The majority of these measures were traditional CACs (72%). The remaining measures were ductless mini-splits (12%), furnace fans (6%), air source heat pumps (5%), geothermal heat pumps (3%) and ductwork (3%), as seen in Table 4-1.

Table 4-1. Number of Systems by Measure

Measure	Quantity	Percent
Traditional CAC	4,421	72%
Ductless Mini-Split	716	12%
Furnace Fan	375	6%
Air Source Heat Pump (ASHP)	279	5%
Geothermal Heat Pump (GTHP)	195	3%
Ductwork	178	3%
Total	**6,164**	**100%**

Source: 2013 Cool Homes program-tracking data.

The program grew in 2013, providing 19% more rebates in 2013 than in 2012 (as seen in Table 4-2 below). The greatest growth was seen in ASHP (19%) and traditional CACs (17%). A decline was seen in the number of geothermal heat pumps (12%).

Table 4-2. Difference in Number of Measures Installed, 2012 to 2013

Measure	2012	2013	Percent Difference
Traditional CAC	3,768	4,421	17%
Ductless Mini-Split	647	716	11%
Furnace Fan	324	375	16%
Air Source Heat Pump	235	279	19%
Geothermal Heat Pump	222	195	-12%
Ductwork[13]		178	
Total	**5,196**	**6,164**	**19%**

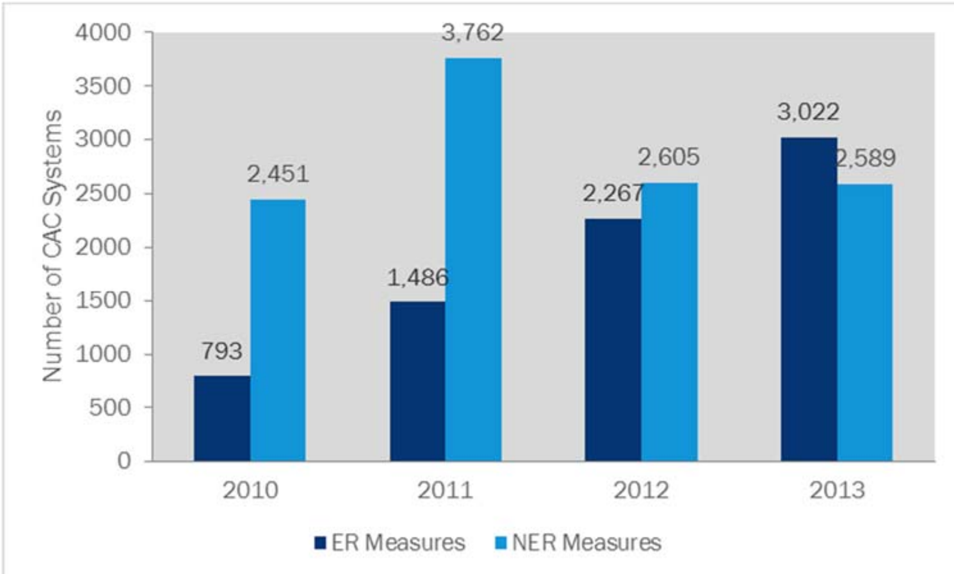
Source: Cool Homes program-tracking data, 2012 and 2013.

Most of the measures offered through the Cool Homes program have two incentive paths: Early Retirement (ER) and Non-early Retirement (NER)[14]. Both offerings aim to encourage the installation of more energy efficient CAC systems. The ER path, however, also seeks to accelerate the replacement of functional inefficient systems. The increase in savings in 2013 is primarily a result in an increase in the number of CAC systems processed through the Early Retirement (ER) program offering which offers higher ex ante savings per unit. Figure 4-1 shows that over the past four years, the number of systems that received rebates through the ER offering has grown from providing rebates for 793 measures in 2010 to 3,022 measures in 2013.

[13] Rebates for ductwork were not offered in 2012.

[14] Non-early retirement (NER) includes new CACs or replacement CACs that did not go through the Early Retirement program offering.

Figure 4-1. Number of CAC Systems Rebated through the ER and NER Program Offerings, 2010 to 2013*



Source: Cool Homes program-tracking data, 2010-2013.
*Analysis includes traditional CACs, ASHPs, and ductless mini-split systems. Geothermal heat pumps are not eligible for ER and are not included in this analysis.

Impacts for Goal Comparison

Table 4-3 provides a program-level comparison of evaluated net savings to ex ante savings by measure category. As both ex ante and evaluated net savings values are calculated using program-planning NTGRs, the differences expressed through the realization rates represent differences in the ex ante and evaluated gross savings. See the definitions in Section 1.1 for a discussion of the difference between the ex ante and evaluated values.

Table 4-3. Cool Homes Net Impacts for Goal Comparison

Category	Installs	Ex Ante		Evaluated		Realization Rate	
		kW	kWh	kW	kWh	kW	kWh
Central A/C	4,421	4,370	3,069,077	4,229	2,944,383	97%	96%
Furnace	375	75	183,692	57	141,935	75%	77%
Geothermal Heat Pump	195	234	499,230	273	551,948	117%	111%
Unitary Heat Pump	279	275	489,415	268	489,560	97%	100%
Ductless	716	189	200,551	176	232,888	93%	116%
Total	**5,986**	**5,143**	**4,441,965**	**5,003**	**4,360,713**	**97%**	**98%**

Source: 2013 Cool Homes program-tracking data.

Reasons for Differences in Impacts

The algorithms within the evaluation analysis incorporated average installed size and efficiency for each measure, as determined through examination of the program's 2013 install database. Normalized, ex post savings-per-ton values were multiplied with total installed capacity in 2013 to compare the total savings with ex ante values by measure. We believe most of the measure-specific discrepancies are due to differences in pre-existing efficiency data for early replacements used by the program compared to the values used by the Evaluation Team, since the program uses the same coincidence factors and effective full load cooling hours (EFLCH). Based on the measure-specific evaluations and the program savings outlined in Table 4-3, we have the following category-specific comments:

Central air conditioner: Central air conditioner (CAC) units featured slightly lower ex post savings, leading to realization rates of 96% and 97% for energy and peak demand, respectively. This small discrepancy may be due to slight differences in assumed baseline for early-replacement CACs. The Evaluation Team averaged the available baseline values and applied these averages to instances where the baseline efficiency was missing. In the case of new installs, we used baseline values documented in the TRM. We were unable to confirm the baseline values used to calculate the ex ante values.

Furnace fans: Furnace fans with ECM motors featured lower ex post savings for demand (75%) and energy (77%). We are unable to evaluate the assumptions for baseline efficiency and operating hours used in the ex ante calculations. To calculate ex post, we applied baseline values where available, and filled in missing data with averages across the other measures.

Geothermal heat pumps: Geothermal heat pumps featured 117% higher ex post savings for demand and for 111% for energy. These discrepancies can be attributed to differences in baseline efficiency assumptions between ex ante and ex post. Evaluators used average installed and preexisting efficiency data (when available) to most accurately calculate savings.

Ductless systems: Ductless systems featured demand and energy realization rates of 93% and 116%, respectively. The 2013 Cool Homes program efficiency requirement for ductless mini split systems is 18 SEER. However, there were two installs in the 2013 data that featured 17.5 SEER. Evaluators believe the slightly lower ex post demand savings are due to this discrepancy. Ex post energy savings are higher than ex ante due to differences in baseline efficiency values used by the evaluators and the program for early replacement projects. The Evaluation Team relied upon tracking data on preexisting equipment efficiency and size to characterize the baseline for early replacement projects. As consistent with the Cool Homes TRM, the Evaluation Team applied a code baseline efficiency for end-of-life replacements or new construction projects.

Air source heat pumps: Air source heat pumps (ASHP) featured slightly lower ex post energy savings, leading to a realization rate of 100% for energy and 97% for demand. Like CACs addressed above, these discrepancies are due to slight differences in baseline for early-replacement ASHPs.

Impacts for Cost-Effectiveness Calculations

The cost-effectiveness calculations are based on ex post net savings estimates. As discussed in Section 1, ex post net savings are calculated using NTGRs developed by the Evaluation Team. For this analysis the Evaluation Team developed an ex post NTGR value for traditional CAC measures only, and applied program assumptions for all other measures incented through the Cool Homes program. The ex post NTGR for CAC was derived from extensive research in 2011 with participating and non-participating customers as well as HVAC market actors, including contractors and equipment distributors (see the 2011 report for details). Table 4-4 shows a categorical breakdown of ex post savings compared with tracked program savings (ex ante) CAC measures rebated by the program. See the definitions in Section 1.1 for the difference between the ex ante and ex post values.

Table 4-4. Cool Homes Net Impacts for Cost-Effectiveness

Category	Installs	Ex Ante		Ex Post		Cost Effectiveness Realization Rate	
		kW	kWh	kW	kWh	kW	kWh
Central A/C	4,421	4,370	3,069,077	3,472	2,008,085	79%	65%
Furnace	375	75	183,692	57	141,935	75%	77%
Geothermal Heat Pump	195	234	499,230	291	551,911	125%	111%
Unitary Heat Pump	279	275	489,415	293	534,525	107%	109%
Ductless	716	189	200,551	192	253,589	102%	126%
Total	**5,986**	**5,143**	**4,441,965**	**4,305**	**3,490,044**	**84%**	**79%**

The program applies planning NTGR values of between 0.84 and 0.98 for each program measure category.[15] Additionally, the program NTGR differs for energy and demand for some measures. The Evaluation Team developed an updated NTGR for traditional CAC installations only in 2011, including separate factors for savings associated with Quality Installation practices and equipment efficiency, and used those same values this year. We applied the program-planning values for all other measures. The evaluated NTGR for CAC installations included participant free ridership and program spillover. Table 4-5 below shows the NTGR values for the Cool Homes program.

[15] Long Island Power Authority assigns different levels of free ridership based on the efficiency tier of the equipment. These FR values range from 0.20 for the lowest tier to 0.10 for the highest tier. The program measure category NTGRs are a weighted average of all tiers for each measure category.

Table 4-5. Cool Homes NTGRs

Measure	Ex Ante kW[a]	Ex Ante kWh[a]	Ex Post kW	Ex Post kWh
Central AC equipment	0.90	0.90	0.52	0.52
Central AC quality installation	0.90[b]	0.90[b]	1.48	1.41
Central AC total	*0.90*	*0.90*	*0.73*	*0.61*
Air source heat pump equipment	0.86	0.86	0.98	0.98
Air source heat pump quality installation	0.90[b]	0.90[b]	1.00	1.00
Air source heat pump total	*0.90*	*0.90*	*0.98*	*0.98*
Ductless mini-split	0.90	0.90	0.98	0.98
Geothermal heat pump	0.92	0.98	0.98	0.98
Furnace fan	0.84	0.90	0.90	0.90
Program level	0.90	0.90	0.77	0.73

a=The Evaluation Team calculated the effective NTGR based on the information included in the program tracking data. These values are different than the program-planning assumptions for some measures.

b=Ex ante savings for quality installation are included in the overall ex ante savings for central AC and air source heat pump systems and the program applies the NTGR to the overall measure level savings. Ex post savings were calculated using a separate NTRG for equipment and quality installation.

Cool Homes program savings can be separated into three components – ER savings, NER savings, and quality installation (QI) spillover savings. Early retirement savings comprise savings from increasing efficiency, reducing capacity, and accelerating the replacement of inefficient CAC equipment for all units receiving rebates through ER program offering. Non-early retirement includes savings attributed to increasing efficiency, and lowering capacity for all units receiving rebates through the non- ER program offering. Savings attributed to the quality installation spillover component of the program include savings from quality installation practices contractors perform outside the program that can be attributed to that contractor’s participation in the program.

Table 4-6 provides a comparison of savings from each of these three components. Forty-two percent (42%) of savings in the Cool Homes program are attributable to the ER component of the program, while 38% of Cool Homes’ savings are attributable to the quality installation spillover component of the program, and approximately 20% come directly from the NER program offering.

Table 4-6. Savings Attribution

Savings Attribution	Quantity	Ex Post Savings		Percent of Cool Homes Ex Post Savings	
		kW	kWh	kW	kWh
Early Retirement[16]	3,354	1,801	1,791,536	42%	52%
Non-Early Retirement	2,632	863	1,143,496	20%	32%
Quality Installation Spillover	-	1,641	555,012	38%	16%
Total	5,986	4,305	3,490,044	100%	100%

Results from ongoing market characterization research suggests that while the Early Retirement (ER) program offering does increase overall efficiency and lower capacity compared to non-participating units, counter to the underlying program theory for the ER program component, it does not appear to accelerate the replacement of operational, older, less efficient CAC equipment. Specifically, the research indicates that the majority of CAC units on Long Island that are replaced outside of the Cool Homes program are operational at the time of replacement and of the same average age as the units replaced through the program.

Opinion Dynamics will conduct additional research in the spring of 2014 to assess the influence of the ER component of the Cool Homes program on the CAC market. We will collect information on the age and operating condition of CAC spit systems being replaced in comparable regions outside of Long Island Power Authority territory where early retirement programs are not offered (e.g., New Jersey and Connecticut). Upon completion, we will combine the findings from this research with the results of our prior CAC market characterization efforts and discuss the program design and planning implications with PSEG Long Island. We note that shifting program focus to pursue strategies designed to increase overall participation and market share as opposed to those targeting early retirement may yield higher net savings at the program level. As described below, Opinion Dynamics conducted additional market research in 2013 aimed at better understanding the motivations and barriers to program participation.

Ongoing Market Research

As part of the ongoing market characterization research, the Evaluation Team conducted telephone surveys with 345 homeowners who participated in Cool Homes in 2012 as well as 107 homeowners who had installed a traditional split-system CAC between 2010 and 2013 (non-participants).[17] This section is organized by subjects relevant to marketing, including program awareness, reasons for non-participation, and reasons for CAC replacement equipment, efficiency selection, contractor selection, and contractor influence. A summary of findings is provided at the end of this section.

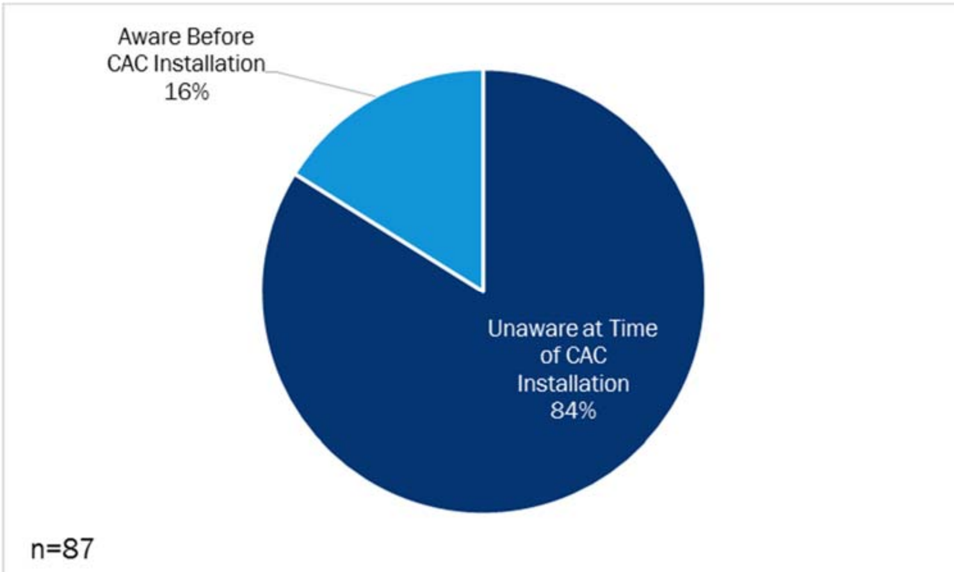
[16] Early retirement includes savings from increasing efficiency, lowering capacity, and accelerating the replacement of inefficient CAC equipment. Non-early retirement includes savings from increasing efficiency and lowering capacity.

[17] This equipment was verified by the Evaluation Team through on-site visits to the homes.

Program Awareness

Of the 87 non-participating homeowners we spoke with, 16% reported that they were aware of the Cool Homes program at the time they installed their CAC, as can be seen in Figure 4-2.

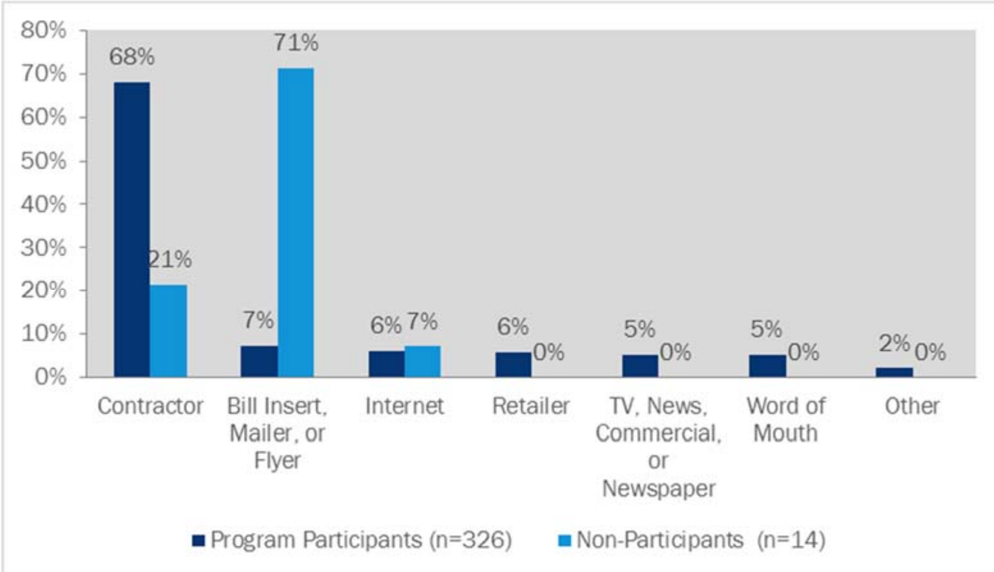
Figure 4-2. Non-Participant Awareness of Cool Homes



Source: 2013 non-participant telephone survey

We asked both participants and non-participants how they first became aware of the Cool Homes program. As shown in Figure 4-3 below, 68% of participants became aware of the program through their contractor, while 7% found out from a bill insert, mailer, or flyer. Non-participants who were aware of the program were most likely to find out from a bill insert, mailer, or flyer (71%), while 21% became aware of the program from their contractor. These results suggest that while bill inserts, mailers, and flyers may be helpful in increasing awareness, interaction with a participating contractor appears to play a key role in moving from awareness to participation.

Figure 4-3. Methods of Program Awareness*

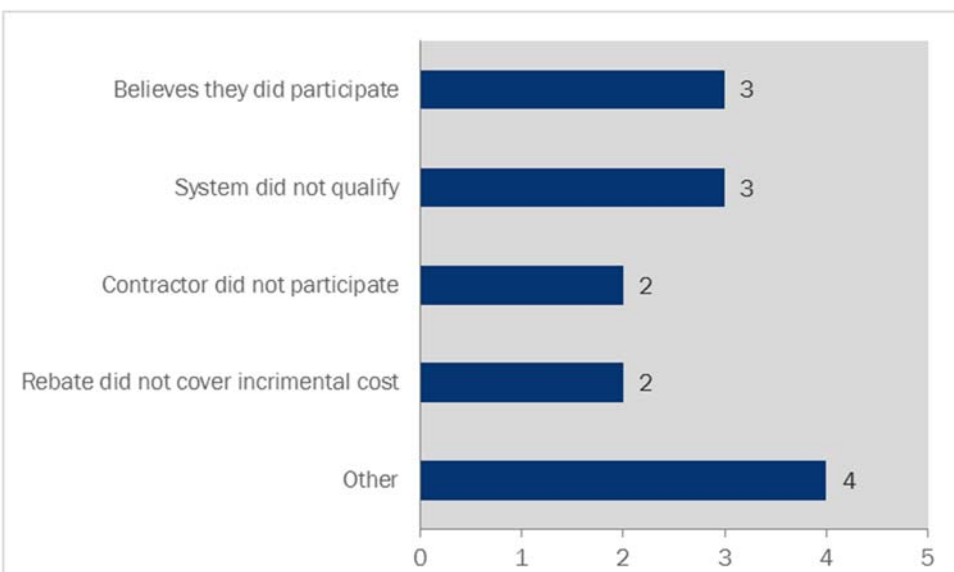


Source: 2013 participant and non-participant telephone surveys.
*Only non-participants who were aware of the program prior to CAC installation are included in this figure.

Reasons for Non-Participation

We asked non-participating homeowners who were aware of the program at the time they installed their CAC why they did not participate. Of the 14 non-participants who were aware of the program before installing their CAC, three believed they participated in the program, three noted that their system did not qualify, two chose contractors that did not participate in the program, and two noted that the rebate was not high enough, as reflected in Figure 4-4 below. The remaining four homeowners noted complicated paperwork, general feelings about the Long Island Power Authority's Sandy response, inability to go through the program because they needed a new system immediately, and misinformation about lack of program funds as a reason for not participating.

Figure 4-4. Reasons for Non-Participation among Aware Homeowners



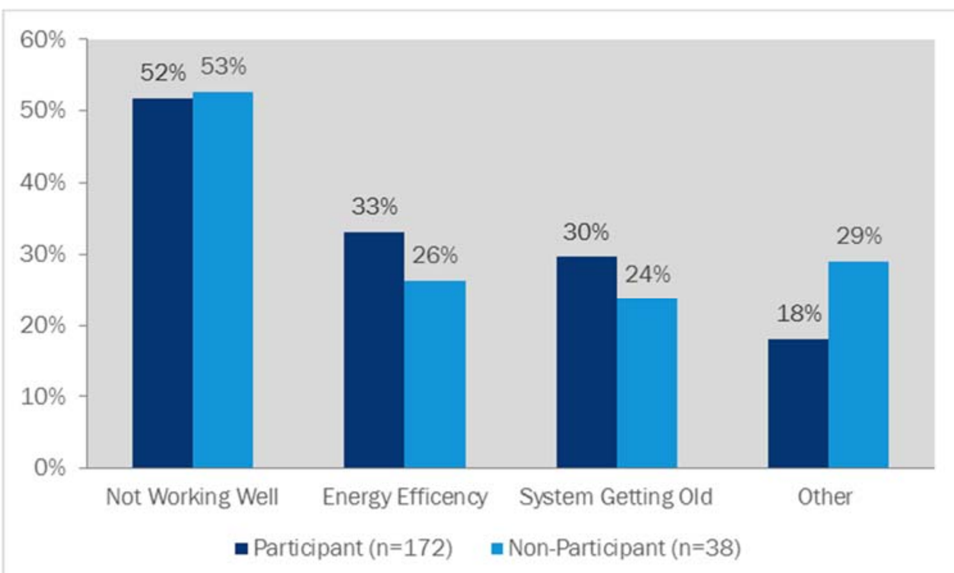
Source: 2013 non-participant telephone survey.

In prior Cool Homes research, a small number of contractors reported that non-participating contractors may reduce the price of their installation to compete with program-participating contractors. We asked non-participating customers who were aware of the program if their contractor offered them a discount in place of the Long Island Power Authority rebate. Of the eight respondents who were able to answer this question, none reported their contractor offering such a discount. However, five[18] non-participants reported that they participated in Cool Homes, though we found no record of their participation in the program tracking data for recent years. This finding may suggest that some non-participating contractors might leverage program benefits in their marketing to customers or that participating contractors indicate to customers that they will submit the application for rebate and ultimately never do so.

Why Replace a Working CAC

The majority of non-participants (78%) reported that their CAC was operational at the time it was replaced. The Evaluation Team investigated why homeowners tend to replace their CAC before failure. Figure 4-5 shows that both participants and non-participants tend to replace their CACs for similar reasons. Over half of both groups noted that their CAC was not working well at the time they retired it. Homeowners noted that the previous system was not cooling adequately, was drafty, rusty, or noisy, among other reasons. A third of participants and 26% of non-participants replaced their old system because they wanted a more energy efficient one. Another common reason was that the previous system was getting old (30% of participants and 24% of non-participants). Twenty-nine percent (29%) of non-participants and 18% of participants give other reasons for CAC replacement, including concerns about Freon, increasing system size, and home renovation.

Figure 4-5. Reasons for Replacing an Operational System*



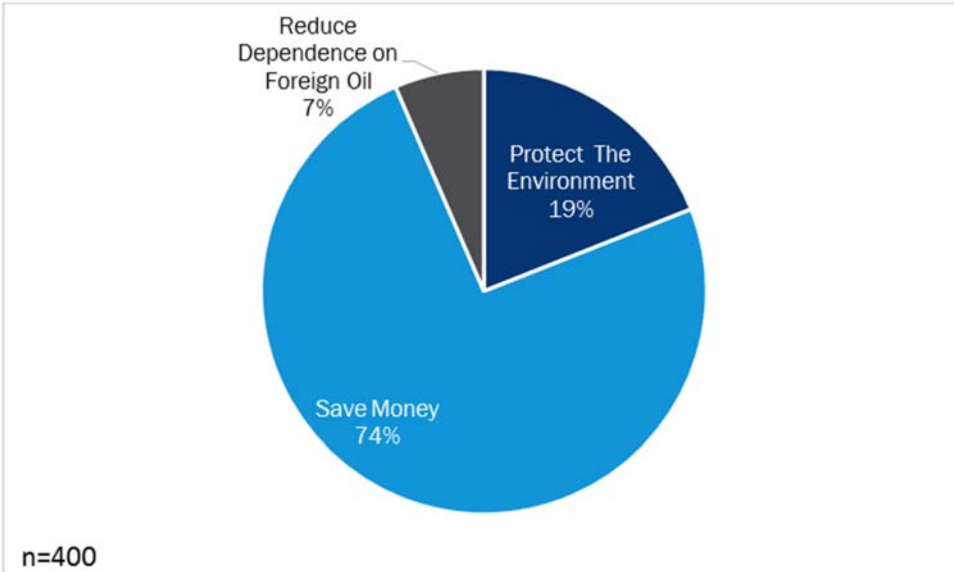
Source: 2013 participant and non-participant telephone surveys.
*Numbers sum to more than 100% because of multiple response.

[18] This includes the three homeowners reported in Figure 4-4 and two additional.

Selecting Efficiency Levels

Ninety-five percent (95%) of homeowners reported that saving energy is important to them.[19] When asked why, 74% of these respondents reported that they strive to be energy-efficient because of the impact it has on their bills, 19% noted the environmental impact of saving energy, and 7% would like to reduce demand on foreign oil, as seen in Figure 4-6 below.

Figure 4-6. Reasons Why Saving Energy Is Important

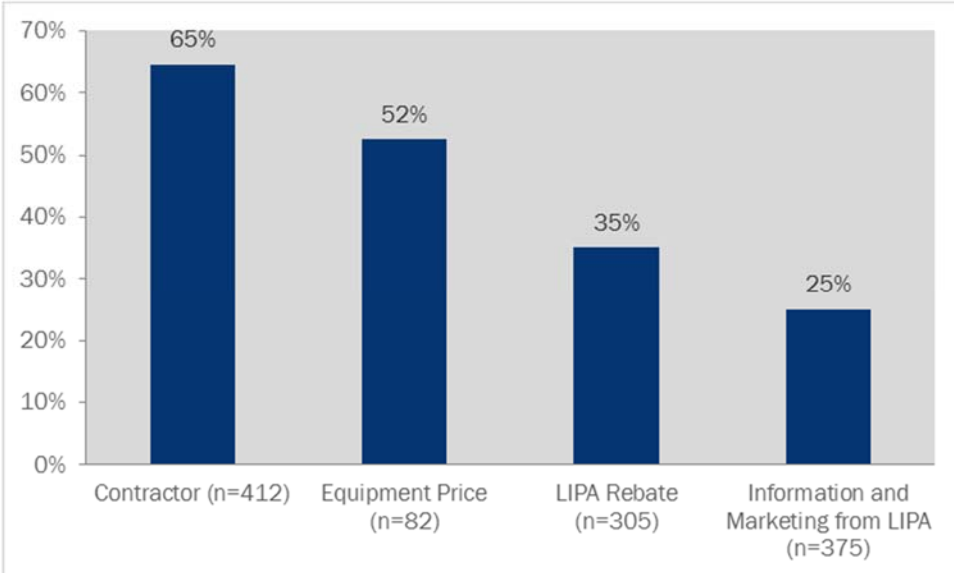


Source: 2013 participant and non-participant telephone surveys.

Figure 4-7 examines which market forces have the strongest influence in determining CAC efficiency level. Sixty-five percent (65%) of respondents reported that their contractor had a strong influence on the efficiency level they chose. Fifty-two percent (52%) reported that the cost of the equipment has a strong influence on determining CAC efficiency level, and 35% reported that the Long Island Power Authority rebate had a strong influence on efficiency level. A quarter of respondents reported that Long Island Power Authority marketing had a strong influence on efficiency level. There was little difference in influencing factors between participants and non-participants.

[19] Ninety-five percent (95%) of the 463 homeowners in our survey who were asked to rank the important of energy savings on a scale of 1 to 7, where 1 is “not at all important” and 7 is “very important,” gave a ranking of 5 or above.

Figure 4-7. Percent of Respondents Reporting High Level of Influence on CAC Efficiency Level of Select Market Forces *

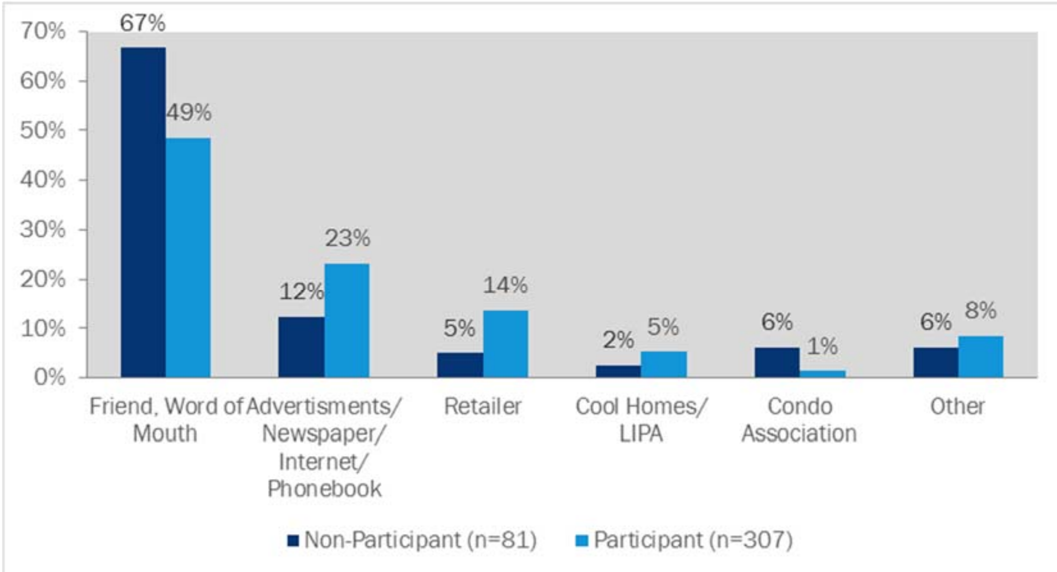


Source: 2013 participant and non-participant telephone surveys.
*Survey respondents were asked to rate the influence level on a 1-to-7 scale where 1 is "not at all influential" and 7 is "very influential." High levels of influence were ratings of 6 or 7. Participants were asked about the influence of the Long Island Power Authority rebate and non-participants were asked about price of equipment. All participants and non-participants who had seen Long Island Power Authority marketing were asked about its influence.

Contractor Selection

As noted in Figure 4-7, contractors have a high level of influence on HVAC efficiency levels. Understanding how homeowners select contractors can provide PSEG Long Island with insights into the market. Most customers find their contractors through a referral from someone they know, especially among non-participating homeowners, as shown in Figure 4-8 below. Participants are more likely to find their contractor through advertisements, newspapers, the Internet, or the phone book.

Figure 4-8. Methods Employed to Find Contractor



Source: 2013 participant and non-participant telephone surveys.

Participants are more likely than non-participants to find their contractor through retailers, which is likely a result of many of the large retailers on Long Island being affiliated with the Cool Homes program. Certain retailers were noted more than others. Sears was mentioned most frequently, along with some local retailers. Home Depot, Costco, and Lowe's were also noted.

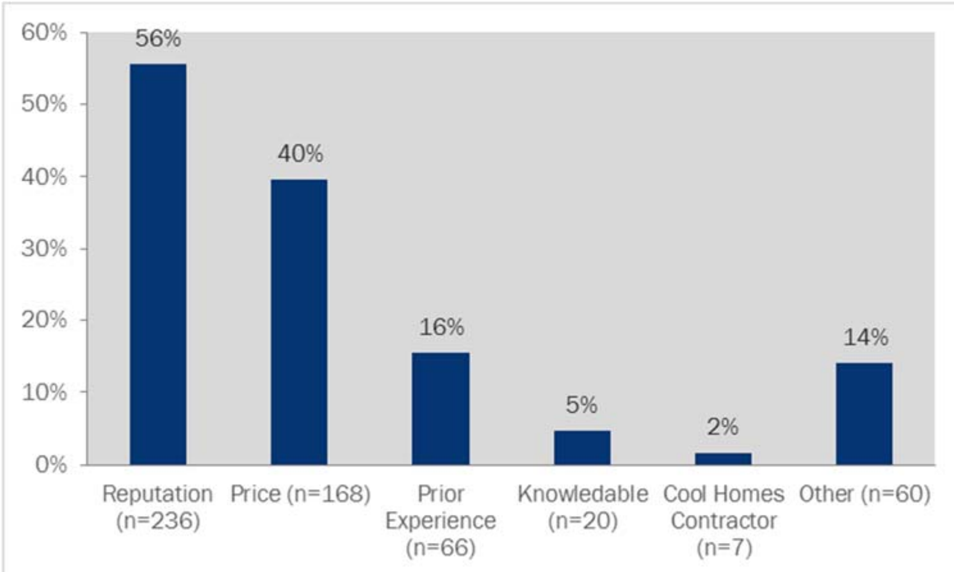
Table 4-7. Number of Respondents Mentioning Retailer

Retailer	Number of Mentions
Sears	7
Local Retailers	5
Home Depot	3
Costco	1
Lowe's	1
Total	17

Source: 2013 participant and non-participant telephone surveys.

Because of the important role that contractors play in equipment selection, we also explored how customers select contractors. Figure 4-9 shows that 65% of homeowners spoke with more than one contractor. When asked what factors were most important in their final selection of contractor, over half (56%) cited contractor reputation and 40% mentioned price.

Figure 4-9 Reasons for Contractor Selection



Source: 2013 participant and non-participant telephone surveys.
Adds up to more than 100% because of multiple mention.

Summary of Findings and Next Steps

Based on ongoing market characterization research , the Evaluation Team makes the following recommendations.

- Explore models for increasing contractor participation and market share. The results of previous and ongoing market characterization studies suggest that there remain significant opportunities for the Cool Homes program to expand market share. In early 2013, interviews with contractors revealed that many find aspects of program participation to be burdensome and, therefore, some chose not to participate in the program or did not include every program eligible unit in the program. The Evaluation Team recommends researching several existing residential HVAC program designs with high levels of contractor and customer participation and in comparable jurisdictions. Research would include collecting information from Program Managers about overall program success, contractor requirements for participation, methods used to engage contractors, the relative successes of these methods, and other relevant information about program structure and design.

- Continue to stress the financial benefits of high efficiency CACs to customers. Ninety-five percent of homeowners report that saving energy is important to them.[20] When asked why, 74 percent of these respondents report they strive to be energy efficient because of the impact it has on their bills. PSEG Long Island should continue to highlight the financial benefits of their program in their homeowner-targeted marketing. In addition,

[20] Ninety-five percent of the 463 homeowners in our survey who were asked to rank the important of energy savings on a scale of one to seven, where one is "not at all important" and seven is "very important" gave a ranking of 5 or above.

participating contractors can be provided with marketing materials stressing the financial benefits of high efficiency in combination with rebates.

- Conduct further research into the effectiveness of the Early Retirement component of the Cool Homes program. Ongoing market characterization research suggests that while the Early Retirement (ER) program offering does increase overall efficiency and lower capacity compared to non-participating units, it does not appear to accelerate the replacement of inefficient CAC equipment. Opinion Dynamics will conduct additional research in the spring of 2014 to assess the influence of the ER component of the Cool Homes program on the CAC market. We will collect information on the age and operating condition of CAC spit systems being replaced in comparable regions outside of Long Island Power Authority territory where early retirement programs are not offered (e.g., New Jersey and Connecticut). Upon completion, we will combine the findings from this research with the results of our prior CAC market characterization efforts and discuss the program design and planning implications with PSEG Long Island. We note that shifting program focus to pursue strategies designed to increase overall participation and market share as opposed to those targeting early retirement may yield higher net savings at the program level. We propose research to evaluate the cost savings and effectiveness of a Cool Homes program without an Early Retirement offering using the standard baseline method of savings. As part of this work, we recommend calculating the participation levels necessary for meeting program savings goals without the ER program offering.

5. Home Performance with ENERGY STAR® (HPwES) Program

The Home Performance with ENERGY STAR® (HPwES) and Home Performance Direct (HPD) programs work in concert to provide homeowners with free and low-cost energy-efficient measures, and information to encourage greater energy savings. Together the programs consist of a full-home audit, home energy rating score, and possible incentives for new efficient equipment. HPwES encourages installation of weatherization, insulation, and other building shell measures through incentives for residential account holders. Incentives have varied over time based on the heating type and cooling systems of participating customers.

Though there were some minor changes in 2012 and 2013, program implementation largely remained consistent in both years. Decreases in incentive levels were accompanied by slightly lower participation; however, the mix of measures and eligibility requirements remained the same in 2013. Table 5-1 outlines the changes to the program from 2012 to 2013.

Table 5-1. HPwES Program Changes in 2012 and 2013 Affecting Comparisons Between Years

Type of Program Change	Description	Date of Change
Changes related to savings	For consistency in reporting, all HPwES jobs should model duct sealing in RHA as "Long Island Power Authority Duct Sealing."	1/22/13
	Contractors can voluntarily submit their install for QC so they do not have to undergo a QA inspection after the job is completed.	5/24/13
	HPD measures and savings are included in pro-forma calculations to help project meet cost effectiveness requirements.	6/14/13
Changes related to eligibility or incentives	Incentive rate to 40% (from 50%) and cap at $2,000. Ventilation is also at a rate of 40%, up to $300 (also falls under the $2,000 cap). Approvals are valid for 90 days.	5/4/12
	Incentive rate to 25% and incentive cap to $1,500. Ventilation rate to 25% and ventilation cap to $250. Approvals valid for 90 days.	5/11/12 – ongoing
	Incentive for homes with Through-Wall and Mini Split ACs drops from $1500 to $500	1/3/13

Impacts for Goal Comparison

Table 5-2 provides a review of impacts for the program in 2013 by category. See the definitions in Section 1.1 for the difference between the ex ante and evaluated values. To support the 2013 evaluation, the team conducted both an engineering analysis and billing analysis. As described below, due to program changes, billing analysis results are only applied to lighting measures.

Table 5-2. HPwES Net Impacts for Goal Comparison

HPwES Measure Category	N	Ex Ante		Evaluated		Evaluated RR	
		kW	kWh	kW	kWh	kW	kWh
Envelope	1,322,601	284	207,535	284	207,535	100%	100%
HVAC	744	161	86,622	143	81,240	89%	94%
Air Sealing	6,200	29	37,474	29	37,474	100%	100%
Hot water	192	16	31,673	1	7,953	8%	25%
Lighting	1,324	9	63,930	2	10,868	16%	17%
Refrigerator	4	1	2,274	>1	3,348	35%	147%
Total	**1,331,064**	**501**	**429,510**	**459**	**348,419**	**92%**	**81%**

Note: May not sum to total due to rounding

Reasons for Differences in Impacts

The Evaluation Team conducted a billing analysis to estimate program savings for lighting measures. The analysis found that the Home Performance programs realized 17% of their expected net energy savings and 15% of their expected peak demand savings for lighting. We believe that differences between the program's annual operating hour estimates and the actual use of the measures are the primary drivers for the low realization rate. A detailed description of the billing analysis appears later in this section.

For non-lighting measures, the Evaluation Team performed an engineering review of the savings algorithms and deemed savings values. The team saw wide fluctuations in realization rates among measure categories. We have highlighted the primary reasons for measure-level discrepancies below:

For HVAC measures, the evaluated demand and energy savings were 11% and 6% lower than ex ante, respectively. No reference information on program algorithms or assumptions is available for the Evaluation Team to pinpoint specific reasons for the discrepancy in savings. Because no information on tonnage was available, the Evaluation Team estimated savings by using the average per-install savings for the Cool Homes program. We determined that the average Home Performance square footage and the Cool Homes square footage are similar, so the assumption of identical system size is valid.

For Building Envelope measures, the engineering analysis resulted in evaluated energy savings much greater than ex ante savings estimates[21]. As was the case in prior years, we cannot determine specific reasons for the difference due to lack of program algorithms and assumptions associated with the ex ante calculations. Additionally, we performed an analysis of participant billing data which showed that at the whole house level, the observed reduction in usage between the pre and post participation periods was much smaller than the overall expected ex ante savings. As such, we did not deem it prudent to report an increase in ex ante savings for building envelope measures that could not be supported by actual bill reductions. Therefore, the Evaluation Team assigned a 100% realization rate for energy and peak demand savings for building envelope measures. We

[21] We attribute evaluated savings to the reduction in heating losses and gains between the baseline and installed condition. The evaluated savings algorithm uses thermal circuit logic to determine the heating and cooling savings. Savings for these measures are calculated on a per square foot basis.

recommend that going forward, the program develop and use transparent algorithms for determining ex ante savings values for building envelope measures.

For Air Sealing measures, no information was available on algorithm inputs used to develop ex ante savings estimates. We examined the program savings algorithm in prior years and determined that it was reasonable based on engineering judgment. To remain consistent with last year, we assigned a 100% realization rate for these measures.

For Domestic Hot Water measures, including showerheads, faucet aerators, pipe insulation, ENERGY STAR® clothes washers, and ENERGY STAR® dishwashers, the program's tracking data lacked sufficient detail to identify specific differences between ex ante and evaluated savings. While these measures are a relatively small component of HPwES savings, the Long Island Power Authority may want to consider making additions to the program's tracking database to capture additional per-install details such as type of pipe insulation, type of tank wrap insulation, pre and post R value of tank wrap, and area (sf) of tank wrap. The evaluated savings calculation methodology for these measures is as follows:

- The preexisting showerhead and faucet aerator flow rates in gallons per minute (gpm) were used to estimate gpm and energy savings.
- We calculated the evaluated savings for pipe insulation using DOE 3E Plus software.
- We calculated the savings for clothes washer and dishwasher measures using the EPA savings estimator[22,23] and engineering approaches that incorporated standard assumptions.
- When estimating peak demand savings, we used a coincidence factor of 0.23 adopted from a study of electric hot water heaters.[24] Due to the low peak demand realization rates, we believe that the program used a higher value for the coincidence factor when calculating ex ante savings.

Ex ante Refrigerator savings are significantly higher than that of other residential programs such as EEP and REAP. Evaluators cannot determine specific reasons why, as detailed refrigerator characteristics are not available from HPwES tracking data. Evaluated savings for the four refrigerators installed in 2013 reflect the weighted average ENERGY STAR®-recommended savings based on 2013 installed refrigerators' sizes and configurations. The baseline refrigerators represent a weighted average energy consumption based on year of preexisting refrigerator, per ENERGY STAR®. Since the 2013 HPwES tracking spreadsheet did not contain information on the age of the preexisting refrigerator, 2013 REAP install data was referenced by the Evaluation Team when performing these weighted savings calculations. We believe that the program used a higher value than the Evaluation Team for coincidence factor when calculating ex ante peak demand savings.

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[22] EPA Savings Estimator for ENERGY STAR® Clothes Washer. http://www.energystar.gov/certified-products/detail/clothes_washers?fuseaction=find_a_product.showProductGroup&pgw_code=CW

[23] EPA Savings Estimator for ENERGY STAR® Dishwasher. http://www.energystar.gov/certified-products/detail/dishwashers?fuseaction=find_a_product.showProductGroup&pgw_code=DW

[24] "Water Heating Load Control." Minnesota Municipal Utilities. http://www.mmua.org/html/CIP/CIPdocs/pt_loadcontrol95.doc

Impacts for Cost-Effectiveness

The cost-effectiveness calculations are based on ex post net savings estimates. As discussed in Section 1, ex post net savings are calculated using NTGR values developed by the Evaluation Team. Table 5-3 provides a categorical breakdown of net impacts, using the NTGR developed by the Evaluation Team. See the definitions in Section 1.1 for the difference between the ex ante and ex post values.

Table 5-3. HPwES Net Impacts for Cost-Effectiveness

HPwES Measure Category	N	Ex Ante		Ex Post		Cost-Effectiveness Realization Rate	
		kW	kWh	kW	kWh	kW	kWh
Envelope	1,322,601	284	207,535	210	155,229	74%	75%
HVAC	744	161	86,622	106	60,674	65%	70%
Air Sealing	6,200	29	37,474	22	28,029	74%	75%
Hot water	192	16	31,673	1	5,949	6%	19%
Lighting	1,324	9	63,930	1	10,229	15%	16%
Refrigerator	4	1	2,274	>1	2,504	26%	110%
Total	**1,331,064**	**501**	**429,510**	**339**	**262,704**	**68%**	**61%**

Note: May not sum to total due to rounding

The program applies a planning NTGR of 1 for each program measure category to develop the ex ante savings estimates. The Evaluation Team developed an NTGR for the program in 2011, including free ridership and program spillover. We used the same evaluated NTGR for the 2013 evaluation for all measure categories except lighting, where we developed a net realization rate using a billing analysis. Table 5-4 shows the program-planning and evaluated NTGR for the HPwES program.

Table 5-4. HPwES NTGRs

Component	Ex Ante kW	Ex Ante kWh	Ex Post kW	Ex Post kWh
Lighting Measures	1.00	1.00	Net ex post savings calculated using billing analysis	
Non-Lighting Measures	1.00	1.00	0.74	0.75

Note: Ex post free ridership is 0.28 for both kW and kWh. The Evaluation Team calculated spillover of 0.019 for kW and 0.028 for kWh.

Impacts Using Billing Analysis

The Evaluation Team conducted a billing analysis with the goal of determining ex post net program savings for HPD and HPwES lighting installations. Given the overlap in programs, the two programs were analyzed within a single model. Energy consumption data from the 2012 HPD/HPwES participant group is used to estimate a lighting realization rate, which is the ratio of observed gross lighting savings from lighting to ex ante gross savings from lighting. Billing analysis covers 2012 participants, because the method requires post-installation electricity usage data for approximately one year after participation. Note that participants who initiated participation in 2012 and continued participating in 2013 (i.e., through HPwES) are considered 2012 participants for the purpose of this analysis and are included in the billing analysis.

We focused the billing analysis on the lighting realization rate due to differences in program protocols between 2012 and 2013 that primarily affected ex ante savings for duct sealing and other heating-dependent measures (Table 5-1). As shown in Table 5-5, though the maximum bulb quantities fluctuated over the course of 2012 through 2013, average ex ante gross savings per household from lighting remained relatively constant. We understand that the method of estimating savings from each bulb was also relatively consistent from year to year – starting in 2011, program guidelines stipulated that it is the HP contractor's responsibility to provide accurate estimation of the hours per day the CFL will be used. Therefore, it is likely that a combination of contractor questions and participant self-report were used in both years to assess hours of use. Because of similarities in average ex ante savings and methods of assigning savings, we have no reason to believe that the lighting realization rate would be different from year to year.

The billing analysis model is a linear fixed effects regression (LFER) conditional demand analysis (CDA) model, which utilizes individual "dummy" variables to indicate the presence of any major measure installation. Through this method, we can isolate the effect of weather-dependent and non-lighting measure installations such as duct sealing, air sealing and insulation, and thereby examine lighting savings separately from other measures. In other words, the fact that ex ante savings from weather-dependent measures like duct sealing increased from 2012 to 2013 does not impact our understanding of the lighting realization rate, as the model is able to separate expected savings from weather-dependent measures from other measures, including lighting.

Table 5-5. Comparison of Ex Ante Gross Savings between 2012-2013 Participants Included and Excluded from Billing Analysis Model

End-Use	Billing Analysis Included Group (2012 Only and 2012-2013 Participants)		Billing Analysis Excluded Group (2013 Only Participants)	
	Participant n	Average Ex Ante Gross kWh	Participant n	Average Ex Ante Gross kWh
Total	**2,406**	**1,188**	**2,205**	**1,465**
Lighting	1,575	1,333	1,730	1,331
Duct Sealing	1,730	257	1,750	373
Insulation	1,139	169	705	156
Air Sealing	2,144	43	2,035	40
DHW	15	1,191	62	942
HVAC Equipment	12	720	17	1,316
Refrigerator	1	2,800	3	713
Window/Door	28	48	35	32

Table 5-6 presents the net savings associated with lighting measures for 2012 participants in HPD and HPwES. As shown below, the 2012 Home Performance programs realized 16% of their expected net savings for lighting.

The billing analysis results for lighting are not surprising upon examination of the underlying billing data. Before conducting billing analysis, we examined average annual consumption among all participants that were eligible for the model (i.e., clean measure data, and installations in 2012 or 2012-2013) and found that electricity consumption decreased by about 4% between the pre- and post-periods, without adjusting for differences in weather.[25] The billing analysis is designed to determine net savings after adjusting for differences in weather in the pre-program and post-treatment periods. Based on our analysis of billing data, weather-adjusted reduction in pre-participation consumption was only 3-4% among all 2012 participants. However, the ex ante savings expected from Home Performance measure installations totaled 11% of pre-period savings – more savings than either the billing analysis or an unadjusted comparison of electricity consumption can support.

Table 5-6. Savings from Home Performance Billing Analysis Compared to Savings Expected from Program-Planning Estimates

EEnd-Use	N (Participants in Billing Analysis)	Observed KWH Savings		Program Planning KWH Savings		Realization Rate
		Household Daily Savings for those with Lighting	Household Annual Savings for those with Lighting	Household Daily Savings for those with Lighting	Household Annual Savings for those with Lighting	
Lighting	2,003	0.59	217	3.62	1,323	16%

[25] This is based on a direct comparison of average annual consumption in 2011 and average annual consumption in 2013 among 2012 participants. This comparison only includes participation with at least a 350-day span of billing data in both years (to ensure we are looking at a full year for each person).

6. Home Performance Direct (HPD) Program

The Home Performance Direct (HPD) and Home Performance with ENERGY STAR® (HPwES) programs work in concert to provide homeowners with free and low-cost measures, and information to encourage greater energy savings. Together, the programs consist of a full-home audit, home energy rating score, and possible incentives for new, efficient equipment. The HPD program conducts free, full-home audits with a Long Island Power Authority-certified home energy rater for homes with central air conditioning (CAC). The HPD program provides free air- and duct-sealing measures and compact fluorescent light bulbs (CFLs).[26]

The program underwent a number of changes between 2012 and 2013. As shown in Table 6-1, several of these changes had a potential impact on unit savings values. In addition, in conjunction with NYSERDA's Green Jobs-Green New York (GJGNY) Program, the HPD program expanded the length of a standard in-home audit. Finally, changes in program eligibility (and targeting) shifted the composition of the participant base to a lower proportion of electric space heat homes.

Table 6-1. Key HPD Program Changes in 2012 and 2013 Affecting Comparisons between Years

Type of Program Change	Description	Date of Change
Changes related to savings	Program institutes a 20 CFL bulb maximum per home (previous guideline was to install a CFL in every incandescent socket, though contractors still had to provide an accurate estimation of the hours per day the CFL will be used).	4/13/12 – 9/10/12
	Duct Sealing is considered an HPD Program requirement on all jobs where site conditions allow the measure to be completed and will take precedence over all other HPD install measures.	5/4/12 - ongoing
	All HPD services will be preceded by a GJGNY audit. Now consists of one 6-7 hour visit, of which approximately 2 hours will be devoted to a GJGNY audit and 4+ hours devoted to HPD installs. GJGNY also provide on-bill financing, which may affect the mix of larger measures.	8/23/12 – ongoing
	HPD contractors provided with a new GJGNY/HPD site procedure guide. Bulb install maximum increased to 40. CFLs only to be installed in high traffic areas and not unfinished	9/10/12 – 4/26/13

[26] The type and extent of HPD measure installation depends on which measures will have the greatest savings impact, as determined by household attributes and program software. Air- and duct-sealing work is limited by the amount of time contractors can spend installing measures during their HPD visit.

Type of Program Change	Description	Date of Change
	spaces or exterior lights.	
	Due to a CFL contract issue, the HPD CFL install cap was lowered to 15 until Long Island Power Authority arranged a new CFL ordering contract.	4/26/13 – 7/29/13
	HPD CFL bulb cap increased to 20 per household.	7/29/13
Changes related to eligibility or incentives	The targeted HPD housing stock will focus on single family detached homes. The program will no longer accept leads for attached housing units and apartments.	5/4/12 – ongoing
	HPD Follow Up work no longer needs to use the fixed pricing for insulation.	7/3/12 – ongoing
	HPD contractors may add a permanent Saturday slot to their weekly schedule if they choose.	3/18/13- Ongoing

Due to the collaboration with NYSERDA's GJGNY Program, HPD visits have, in practice, been extended from 4 hours to between 6 and 8 hours. Beginning in August of 2012, at least 2 hours of each HPD visit was devoted to a GJGNY audit. HPD contractors were then able to devote a minimum of 4 hours to the standard HPD comprehensive home assessment during the same visit. This has allowed contractors to spend considerably more time at each home to ensure that all savings opportunities related to the Long Island Power Authority's Home Performance programs are highlighted.

Impacts for Goal Comparison

Table 6-2 provides a review of impacts for the program in 2013 by measure category. See the definitions in Section 1.1 for the difference between the ex ante and evaluated values. To support the 2013 evaluation, the team conducted both an engineering analysis and billing analysis. The results of engineering analysis are presented and applied for the purposes of goal comparison and cost-effectiveness analysis for all measure categories except lighting, for which the billing analysis was used.

Table 6-2. HPD Net Impacts for Goal Comparison

Category	N	Ex Ante		Evaluated		Realization Rate	
		kW	kWh	kW	kWh	kW	kWh
HVAC	17,399	1,028	557,151	1,028	557,151	100%	100%
Lighting	28,203	189	2,387,853	28	405,935	15%	17%
Air sealing	6,541	38	51,208	38	51,208	100%	100%
Hot water	183	16	32,530	10	36,387	64%	112%
Totals	**48.390**	**1,271**	**3,028,741**	**1,104**	**1,050,680**	**87%**	**35%**

Reasons for Differences in Impacts for Goal Comparison

The Evaluation Team conducted a billing analysis to estimate program savings for lighting measures. The analysis found that the Home Performance programs realized 17% of their expected net energy savings and 15% of their expected peak demand savings for lighting. We believe that differences between the program's annual operating hour estimates and the actual use of the measures are the primary drivers for the low realization rate. A detailed description of the billing analysis appears later in this section.

For non-lighting measures, the Evaluation Team performed an engineering review of the savings algorithms and deemed savings values. We have highlighted the primary reasons for measure-level discrepancies below:

For Air Sealing and HVAC measures, no information was available regarding input values for the ex ante savings algorithm. We examined the program savings algorithm in prior years and determined that it was reasonable based on engineering judgment. To remain consistent with last year, we assigned a 100% realization rate for these measures.

For Domestic Hot Water measures, including showerheads, faucet aerators, pipe insulation, tank wrap, and temperature turndown, the program's tracking data lacked sufficient detail to identify specific differences between ex ante and evaluated savings. While these measures are a relatively small component of program savings, the Long Island Power Authority may want to consider making additions to the program's tracking database to capture additional per-install details such as type of pipe insulation, type of tank wrap insulation, pre and post R value of tank wrap, and area (sf) of tank wrap. The evaluated savings calculation methodology for these measures is as follows:

- The preexisting showerhead and faucet aerator flow rates in gallons per minute (gpm) were used to estimate gpm and energy savings.
- We calculated the evaluated savings for pipe insulation using DOE 3E Plus software, while the savings for temperature turndown and tank wrap measures were calculated using engineering assumptions on boiler surface losses.

- When estimating peak demand savings, we used a coincidence factor of 0.23 adopted from a study of electric hot water heaters.[27] Due to the low peak demand realization rates, we believe that the program used a higher value for the coincidence factor when calculating ex ante savings.

Impacts for Cost-Effectiveness Calculations

The cost-effectiveness calculations are based on ex post net savings estimates. As discussed in Section 1, ex post net savings are calculated using NTGR values developed by the Evaluation Team. Table 6-3 provides a categorical breakdown of net evaluated savings using the NTGR estimated by the Evaluation Team. See the definitions in Section 1.1 for the difference between the ex ante and ex post values.

Table 6-3. HPD Net Impacts for Cost-Effectiveness

Measure Category	N	Ex Ante		Ex Post		Cost-Effectiveness Realization Rate	
		kW	kWh	kW	kWh	kW	kWh
HVAC	17,399	1,028	557,151	1,048	572,730	102%	103%
Lighting	28,203	189	2,387,853	26	382,056	14%	16%
Air sealing	6,541	38	51,208	38	52,640	102%	103%
Hot water	183	16	32,530	11	37,404	65%	115%
Totals	**48.390**	**1,271**	**3,028,741**	**1,123**	**1,044,830**	**88%**	**34%**

Note: May not sum to total due to rounding.

The program applies a planning NTGR of 1 for each program measure category. For the 2013 evaluation, we applied the program-planning values for all non-lighting measures. The evaluated NTGR for lighting included participant free ridership and program spillover. Table 6-4 shows the NTGR values for the HPD program.

Table 6-4. HPD NTGRs

Measure	Ex Ante kW	Ex Ante kWh	Ex Post kW	Ex Post kWh
Air sealing	1.0	1.0	1.026	1.066
Hot water	1.0	1.0	1.026	1.066
HVAC	1.0	1.0	1.026	1.066

Note: Ex post NTGR values include 0.026 spillover for kW and 0.066 spillover for kWh

[27] "Water Heating Load Control." Minnesota Municipal Utilities. http://www.mmua.org/html/CIP/CIPdocs/pt_loadcontrol95.doc

Impacts Using Billing Analysis

The Evaluation Team conducted a billing analysis with the goal of determining ex post net program savings for HPD and HPwES lighting installations. Given the overlap in programs, the two programs were analyzed within a single model. Energy consumption data from the 2012 HPD/HPwES participant group is used to estimate a lighting realization rate, which is the ratio of observed gross lighting savings from lighting to ex ante gross savings from lighting. Billing analysis covers 2012 participants, because the method requires post-installation electricity usage data for approximately one year after participation. Note that participants who initiated participation in 2012 and continued participating in 2013 (i.e., through HPwES) are considered 2012 participants for the purpose of this analysis and are included in the billing analysis.

We focused the billing analysis on the lighting realization rate due to differences in program protocols between 2012 and 2013 that primarily affected ex ante savings for duct sealing and other heating-dependent measures (Table 6-1). As shown in

Table 6-5, though the maximum bulb quantities fluctuated over the course of 2012 through 2013, average ex ante gross savings per household from lighting remained relatively constant. We understand that the method of estimating savings from each bulb was also relatively consistent from year to year – starting in 2011, program guidelines stipulated that it is the HP contractor's responsibility to provide accurate estimation of the hours per day the CFL will be used. Therefore, it is likely that a combination of contractor questions and participant self-report were used in both years to assess hours of use. Because of similarities in average ex ante savings and methods of assigning savings, we have no reason to believe that the lighting realization rate would be different from year to year.

The billing analysis model is a linear fixed effects regression (LFER) conditional demand analysis (CDA) model, which utilizes individual "dummy" variables to indicate the presence of any major measure installation. Through this method, we can isolate the effect of weather-dependent and non-lighting measure installations such as duct sealing, air sealing and insulation, and thereby examine lighting savings separately from other measures. In other words, the fact that ex ante savings from weather-dependent measures like duct sealing increased from 2012 to 2013 does not impact our understanding of the lighting realization rate, as the model is able to separate expected savings from weather-dependent measures from other measures, including lighting.

Table 6-5. Comparison of Ex Ante Gross Savings between 2012-2013 Participants Included and Excluded from Billing Analysis Model

End-Use	Billing Analysis Included Group (2012 Only and 2012-2013 Participants)		Billing Analysis Excluded Group (2013 Only Participants)	
	Participant n	Average Ex Ante Gross kWh	Participant n	Average Ex Ante Gross kWh
Total	**2,406**	**1,188**	**2,205**	**1,465**
Lighting	1,575	1,333	1,730	1,331
Duct Sealing	1,730	257	1,750	373
Insulation	1,139	169	705	156
Air Sealing	2,144	43	2,035	40
DHW	15	1,191	62	942
HVAC Equipment	12	720	17	1,316
Refrigerator	1	2,800	3	713
Window/Door	28	48	35	32

Table 6-6 presents the net program savings associated with lighting for 2012 participants in HPD and HPwES. As shown below, the 2012 Home Performance programs realized 16% of their expected net savings for lighting.

The billing analysis results for lighting are not surprising upon examination of the underlying billing data. Before conducting billing analysis, we examined average annual consumption among all participants that were eligible for the model (i.e., clean measure data, and installations in 2012 or 2012-2013) and found that electricity consumption decreased by about 4% between the pre- and post-periods, without adjusting for differences in weather.[28] Our analysis of billing data, weather-adjusted reduction in pre-participation consumption was only 3-4%. However, the ex ante savings expected from Home Performance measure installations totaled 11% of pre-period savings – more savings than either the billing analysis or an unadjusted comparison of electricity consumption can support.

[28] This is based on a direct comparison of average annual consumption in 2011 and average annual consumption in 2013 among 2012 participants. This comparison only includes participation with at least a 350-day span of billing data in both years (to ensure we are looking at a full year for each person).

Table 6-6. Savings from Home Performance Billing Analysis Compared to Savings Expected from Program-Planning Estimates

End-Use	N (Participants in Billing Analysis)	Observed KWH Savings		Program Planning KWH Savings		Realization Rate*
		Household Daily Savings for those with Lighting	Household Annual Savings for those with Lighting	Household Daily Savings for those with Lighting	Household Annual Savings for those with Lighting	
Lighting	2,003	0.59	217	3.62	1,323	16%

*This is a net realization rate, estimated by billing analysis that incorporates a comparison group and monthly dummies. It is the rate used for cost effectiveness. A gross realization rate of 17% is used for comparison to program goals.

7. Residential Energy Affordability Partnership (REAP) Program

The objective of the Residential Energy Affordability Partnership (REAP) program is to assist low-income households with energy efficiency improvements. The logic behind this program is that a reduction in utility bills through energy efficiency would lower the Long Island Power Authority's financial risk with collection and bad debt while improving residential energy efficiency on Long Island. Households must meet specific income requirements to be eligible for the REAP program, and once enrolled, receive free home energy audits (a.k.a. home energy surveys) and energy efficiency measures.

In 2013 the mix of measures offered through the program remained the same as in 2012. The measures included refrigerators, CFL light bulbs, pipe insulation, attic insulation, duct sealing, air sealing, hot water tank wrap, and low-flow showerheads. The majority of energy and demand savings for this program came from lighting and refrigeration measures. The measure mix moving forward will not include the air and duct sealing measures. Based on the interview with the program manager, poor installation quality and a need for frequent follow-up remediation visits led to the decision to discontinue those measures as part of the REAP program.

The program is also considering discontinuing its refrigerator offering and replacing it with room air conditioners and/or dehumidifiers. Furthermore, moving forward, any REAP qualifying customer with central air conditioning may be channeled into and treated through the Home Performance Direct (HPD) program. The initial home energy audit will be covered through NYSERDA's Green Jobs Green New York statewide program, and the rest will be expensed to REAP. Measures will still be installed at no cost to qualified REAP customers and all savings will be attributed to the REAP program. These customers will be able to receive air and duct sealing improvements. Based on the interview with the program manager, these changes may take effect in May 2014 or later.

Program implementation processes remained consistent between 2012 and 2013; however, the program staff is considering program design changes which may take effect in 2014 for the REAP Program. Currently, these changes are being discussed with Program Management, Procurement and the Planning Team. Overall, based on the interview with the program manager, program goals and budgets were reduced for 2014. As a result, program marketing and outreach will be reduced as compared to the previous program years.

Impacts for Comparison to Goal and Cost-Effectiveness

As in the 2012 evaluation, the Evaluation Team used two approaches to estimate ex post savings for the REAP program in 2013: engineering review and billing analysis. Because the billing analysis uses actual customer usage to estimate savings, and is therefore more robust than engineering estimates, we based the savings from the program on the results of the billing analysis. We show the results in Table 7-1 below. The results of this year's billing analysis are very similar to the results of last year's billing analysis of 2011 participants (which were: cost-effectiveness realization rate of 45% for kW savings and 41% for kWh savings).

Table 7-1. REAP Net Impacts for Comparison to Goal and for Cost Effectiveness

Measure Category	N (Number of Homes)	Ex Ante		Ex Post		Realization Rate	
		kW	kWh	kW	kWh	kW	kWh
All	3,109[a]	719	4,654,125	302.5	2,233,980	42%	48%

a=Number of homes as of December 31, 2013.

Similar to last year, our analysis used a comparison group to reflect what would have occurred absent the program. As such, the results from a billing analysis are implicitly the net savings; that is, these results already incorporate the gross realization rate and NTGR adjustments. These results are applicable to both the comparison to goal and the cost-effectiveness calculation.

Billing Analysis

While the billing analysis is used to estimate program impacts in 2013, as noted in prior evaluations, we cannot use 2013 participants as we need 12 months of post installation billing data for evaluation. Instead, we used 2012 participants in the billing analysis. As such, the results of our billing analysis show savings from the 2012 participants as shown in Table 7-1.

Participants from 2013 were used as a comparison group in the analysis. This model allows us to compare the post-participation billing records of the treatment group (2012 participants) to both its own pre-participation records and to the pre-participation billing records of the comparison group (2013 participants). Those two periods (pre-participation for the treatment group and pre-participation for the comparison group) are contemporaneous.

In terms of the comparability of the program across program years, there were only slight differences in share of measures between the 2012 and 2013 program years (as shown in Table 7-2 below) and no substantive change in program design across the two years. In both years, lighting contributed around 70% of ex ante program savings, and refrigeration also contributed a significant share (24% in 2012 and 23% in 2013). Overall, the analysis of the measure composition shows that the two program years are comparable.

Table 7-2. REAP Installations by Program Year

Category	2012		2013	
	Number of Installs	Percentage of Ex Ante kWh	Number of Installs	Percentage of Ex Ante kWh
Lighting	51,927	72.5%	45,136	68.7%
Refrigerator	1,388	23.8%	1,224	23.4%
Hot water	469	2.7%	793	7.2%
Air sealing	1,523	0.2%	551	0.1%
HVAC	169	0.6%	123	0.6%
Envelope	30,787	0.2%	0	0.0%

Selecting a comparison group of later participants means that they are likely similar in terms of their orientation or inclination to participate in an energy efficiency program. Customer orientation (propensity to participate) is important for comparability, but is often difficult to measure or control for. This is mainly because most variables at our disposal that we might use to control statistically for differences between treatment and comparison groups might not capture the largely unobservable factors that drive people to participate or to be interested in energy efficiency—and in turn, influence their energy consumption after program intervention. Using a comparison group of future participants (i.e. 2013 participants) addresses this problem to a very large degree. To further assure comparability, we also examined the billing histories of the treatment and comparison groups during the pre-participation period (i.e. 2010 and 2011) to assess whether the two groups had similar patterns of electricity consumption in each month. Although we did find a statistically significant difference in usage patterns between the treatment and comparison groups, using a two-way fixed effects model allowed to control for this to a large extent.[29]

The two-way fixed-effects panel model allows all household factors that do not vary over time to be absorbed by (and therefore controlled for) the individual constant terms in the equation. This would include such things as square footage, appliance stock, habitual behaviors, household size, and many other factors. Of course, any of these factors could change during the evaluation period and, in that case, the effects of those changes would be confounded with the program effects, either artificially increasing or decreasing them. However, these effects are likely to be quite infrequent, relatively random, and would probably have no systematic effect on the results. The critical things to include in these models are other, more measurable, time-varying factors. As such, we included a second fixed effect of time (year-months), thus controlling for effects that are common to everyone during the evaluation period.

Please see Section 13 for a more detailed discussion of the billing analysis method and our model specification.

[29] We also tested interactions of baseline usage with measures installed to control for differential effects of baseline usage for different measures installed under the program.

Table 7-3 below presents the end-use and overall program savings and realization rates for the 2012 participants. As described above, we have applied the 2012 program realization rate to the 2013 program. The end-use specific realization rates in the table below are for descriptive purposes only. This is because (a) the relative variance around the variables used to calculate end-use specific realization rates is greater compared to the program overall, and (b) given that the end-use specific estimates for lighting and refrigeration are similar to the program overall, the overall program realization rate is preferable for estimating net savings for the 2013 program. Weighted savings are shown only for lighting and refrigeration because they are the only measures with large enough sample sizes to give a reasonable level of confidence in the measure-level savings results. Measure-level savings estimates for the other measures were unreliable since there were only 78 HVAC participants and 90 Domestic Hot Water (DHW) participants in the final analysis sample.

Table 7-3. Savings from Billing Analysis Compared to Savings Expected from Program-Planning Estimates

End-Use	N (Participants in Billing Analysis)**	Program Planning Savings*		Observed Savings		Realization Rate
		Weighted Average Household Daily Savings (kWh)***	Weighted Average Household Annual Savings (kWh)	Weighted Average Household Daily Savings (kWh)	Weighted Average Household Annual Savings (kWh)	
Overall Program	2,639	4.10	1,498	1.98	722	48%
Lighting	2,581	3.04	1,111	1.54	562	50%
Refrigerators	1,012	0.93	339	0.42	152	45%

*The line loss factor is not applied to the program-planning savings.
**There was a total of 3,714 unique accounts from PY 2012. Of that, 1,075 program participants were excluded from the billing analysis due to missing or incomplete measure data, or insufficient billing data in the pre- or post-participation periods.
***These averages include all households, even those that did not install measures (their "zero" savings values are part of the average).

Engineering Analysis

The Evaluation Team also performed a measure-level engineering review of ex ante savings to determine ex post gross savings. Specifically, the team used program tracking data and applied either deemed savings estimates or calculated savings based on various parameters described in additional detail below. Given that REAP is a direct installation program serving low-income customers, the Evaluation Team assumed that this customer segment would not invest in energy efficiency without assistance, as they have limited financial resources and many other competing needs. As a result, we used a NTGR of 1.0, which is typical for low-income programs.

Table 7-4 provides a review of impacts for the program in 2013 by category based on an engineering estimate of savings. See the definitions in Section 1.1 for the difference between the ex ante and ex post values.

Table 7-4. REAP Measure-Specific Net Impacts – Engineering Approach

REAP Measure Category	N	Net Ex Ante		Net Ex Post		RR	
		kW	kWh	kW	kWh	kW	kWh
Lighting	45,136	313.6	3,198,326.4	278.6	2,503,308.3	89%	78%
Refrigerator	1,224	186.5	1,089,096.1	86.4	726,697.6	46%	67%
Hot Water	793	169.1	337,183.2	59.0	239,991.7	35%	71%
Air Sealing	551	2.5	3,229.0	2.5	3,229.0	100%	100%
HVAC	123	47.3	26,290.2	47.3	26,290.2	100%	100%
Total	**47,827**	**719**	**4,654,125**	**474**	**3,499,517**	**66%**	**75%**

Reasons for Differences in Engineering Impacts

The following are measure-specific explanations for the differences in ex ante and ex post savings estimates from the engineering analysis:

In general, several of the measures feature discrepancies that cannot be pinpointed due to lack of tracking information. Evaluators suggested to the Long Island Power Authority in 2012 a number of parameters that should be recorded by contractors during REAP installs. These fields are now included in the tracking data; and although the data were gathered by the implementation team, all of the fields in the program tracking database are not populated.

For example, evaluators cannot determine the DHW system details (equipment size) or refrigerator characteristics (size, layout) associated with each install. This information is crucial to the evaluator's ability to identify the exact reasons for realization rate discrepancy. Currently, ex post values are calculated based on the limited information available from 2013 Home Performance and 2012 REAP tracking databases.

Lighting: The Evaluation Team believes that the program assumed a delta watts estimate of 57.6 whereas evaluated peak demand savings reflected a delta watts value of 51.0 watts as determined through extensive wattage analysis of EEP installs. The REAP recommendation is consistent with that of other residential lighting offerings in EEP and Home Performance programs. In terms of energy savings, based on 2013 tracking data, we believe the program assumed an annual operating hours estimate of 1,150; however, when calculating evaluated savings, we used an annual operating hours value of 1,022 to align with the EEP CFL recommendation.

Refrigerator: For refrigerator measures, the ex post savings reflect the weighted average Energy Star®-recommended savings based on 2013 installed refrigerators' sizes and configurations. The baseline refrigerator energy consumption represents a weighted average energy consumption based on year of preexisting refrigerator, per Energy Star. Since the 2013 REAP tracking spreadsheet did not contain information on the age of the baseline refrigerator, the Evaluation Team referenced 2012 REAP program-tracking data to obtain the age of the baseline refrigerators when performing these weighted savings calculations.

HVAC: Air-sealing and HVAC duct-sealing measures account for the HVAC energy and demand savings associated with the REAP program. Savings are associated with reduced energy use for space cooling and heating resulting from improving the tightness of the building shell and duct systems of participating homes. We concluded that the algorithms and values used to estimate ex ante demand and energy savings are consistent with industry standards, and we recommend no revisions. Given the deemed ex ante savings algorithms, however, it is not possible to fully evaluate savings-specific details of each project, as detailed project data are not included in the tracking data extract.

Air- and duct-sealing measures are quantified by the number of hours billed by a contractor in the program-tracking data, and values vary from 15 minutes to more than 14 hours among line items. Given that we have no basis to indicate that this is not an appropriate method, and we have no additional data to generate an alternative engineering estimate, we have not de-rated the ex ante savings values.

Domestic Hot Water (DHW): Showerheads, faucet aerators, pipe insulation, tank wrap and temperature turndown account for the domestic hot water savings attributable to the REAP program. The program-tracking data lacked several key assumptions to determine/validate impacts. These assumptions and the savings calculation methodology are described below:

- The preexisting showerhead and faucet aerator flow rates in gpm were not included in the program-tracking spreadsheet; therefore, evaluators used 2013 HPD program data to estimate this value.
- The evaluated savings for pipe insulation was calculated using DOE 3E Plus software, while the savings for temperature turndown and tank wrap measures were calculated using engineering assumptions on boiler surface losses. It is not clear how the program savings were determined.
- When estimating peak demand savings, evaluators used a coincidence factor of 0.23 adopted from a study of electric hot water heaters[30]. Due to the low peak demand realization rate, we believe that the program used a higher value for coincidence factor when calculating ex ante savings, but cannot determine what factor was used from the program-tracking data extract provided to us.

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[30] "Water Heating Load Control." Minnesota Municipal Utilities.
http://www.mmua.org/html/CIP/CIPdocs/pt_loadcontrol95.doc

8. ENERGY STAR® LABELED HOMES (ESLH) PROGRAM

The Long Island Power Authority's ENERGY STAR® Labeled Homes (ESLH) program works with local residential building contractors and the supporting contractor and architect infrastructure to encourage the construction of more energy-efficient, ENERGY STAR®-certified homes. The program draws on an established network of Home Energy Rating System (HERS) providers to work with builders during the design and construction of participating homes. The program also uses the HERS rating to verify that ENERGY STAR® standards have been met. Historically, the ESLH program also used marketing and outreach to educate both homeowners and builders about the program and the benefits of participating.

In 2012, the ESLH program transitioned its efficiency standard from ENERGY STAR® Version 2.0 to ENERGY STAR® Version 3.0. Program staff noted that many builders decided not to participate in the program due to the increased requirements associated with ENERGY STAR® Version 3.0. In response to the reduced demand for ENERGY STAR® 3.0, in 2013, the ESLH program revised its incentive structure to offer incentives on homes that are not ENERGY STAR®-qualified but have reached a HERS score below 70 (referred to as "HERS Index homes"), along with other program requirements. Program staff believes this change has increased overall program participation and allowed builders who do not wish to build to the ENERGY STAR® platform to take part in the program. Nevertheless, participation in 2013 decreased. In 2013 the program completed 305 HERS rated homes – about the same as in 2012, but only 61 ENERGY STAR® homes – compared to 429 in 2012.

Impacts for Comparison to Goal and Cost-Effectiveness

Table 8-1 shows the net evaluated savings compared with net tracked (ex ante) program savings. (See Section 1.1 for the definitions of ex ante and evaluated impacts.) Savings are broken out by homes that met all program requirements (ENERGY STAR® homes) and homes the Evaluation Team has categorized as program spillover (HERS Index homes).

Table 8-1. ESLH Net Impacts for Comparison to Goal and Cost-Effectiveness

Home Type	Ex Ante Impacts			Evaluated Impacts			Realization Rate	
	N	kW	kWh	N	kW	kWh	kW	kWh
ENERGY STAR® homes	61	58.73	213,246	61	58.73	213,246	100%	100%
HERS Index homes	305	251.15	565,917	305	251.15	565,917	100%	100%
Total Savings	**366**	**310**	**779,163**	**366**	**310**	**779,163**	**100%**	**100%**

The ESLH program uses a "true-up" calculation using REM/Rate software to estimate ex ante savings for participating homes. The Evaluation Team reviewed program documents, savings algorithms, and inputs associated with the whole-home energy rating. The parameters of the user-defined reference home (UDRH) align well with REM/Rate software standards and other equivalent incentive programs. The Evaluation Team deems this an appropriate method and finds no major discrepancies in algorithms or assumptions associated with the ESLH program.

The program's current method of calculating home energy performance is based on an older score rating system from ENERGY STAR® with the addition of an updated reference home. We understand that these values can change from year to year, and recommend that the Long Island Power Authority consider updating its rating system and minimum requirements to be consistent with the updated national protocols.

Savings from HERS Impact Homes

Due to reduced participation, the ESLH program began a supplemental effort near the end of PY 2012. The program offered $100 to builders for the REM/Rate file of homes that had achieved HERS ratings above code (i.e. below a HERS rating of 70). Though this new effort was not initially part of the 2012 program design, the ESLH program did claim 2012 incremental savings above code for these homes. At that time, the Evaluation Team assigned savings only for those homes constructed by participating builders. We were unable to assign savings to the program from homes constructed by builders with no known past experience with the program. We also recommended conducting additional research on the influence of the ESLH program upon the overall new home construction market on Long Island.

In 2013, the Evaluation Team conducted background research and preliminary stakeholder interviews that indicated that the Long Island Power Authority was very likely to have had a substantial influence on the codes-changing process and efficient building practices on Long Island. Due to these findings, as well as the subsequent inclusion of additional HERS Index home incentives in the ESLH PY 2013 program design, we are assigning full savings for the 305 HERS rated homes in 2013.

9. Solar Photovoltaic (PV) Program

The Long Island Power Authority Solar Photovoltaic (PV) program offers rebates to approved residential customers (through the Solar Pioneer program) and nonresidential customers (through the Solar Entrepreneur program) to defray a portion of the cost of installing solar PV systems. The program provides financial support that encourages the development of customer-sited electric generation, helping customers gain better control over their electric bills and reduce their carbon footprint while also offsetting the Long Island Power Authority's energy and capacity requirements.

The program instituted two major changes in 2013. First, the program transitioned from a capacity-based calculation of the incentive, where the incentive was based on the total output capacity of the PV panels, to an expected performance-based calculation. Under this new approach, the contractor models the system's expected output based on its size, type of equipment, panel orientation, and shading. This modeling allows the program to incentivize more efficient and optimally sited systems. This transition occurred in March 2013.

The Long Island Power Authority also launched the Siebel CRM online application tool in March 2013. This tool allows contractors to input the customer information, model the system, and calculate the rebate for the customer while onsite. Because the contractor enters the information directly into the Long Island Power Authority's Siebel database, the online application also reduces the data entry burden for the Rebate Processing department. Since its rollout, the program has received about 80% of applications through this method, with the remainder received via email as in previous program years. Currently, the program only provides access to the tool to contractors who have high levels of program participation because the time required to learn the tool favors more frequent use.

In 2013 the Long Island Power Authority installed 1,625 solar PV systems, an increase from 975 in 2012. The Long Island Power Authority exceeded program goals for energy savings for the residential Solar Pioneer program but fell short in the nonresidential Solar Entrepreneur program and for the program overall. Additionally, the program surpassed its peak demand reduction goal for the Solar Pioneer program and the commercial Solar Entrepreneur program as well as the program overall, but did not meet its demand goal for the municipal portion of the Solar Entrepreneur program. According to the program manager, alternate financing options, including leasing and power purchase agreements, drove the high participation among residential customers. In 2013, 33% of residential systems were installed and 30% of output capacity used these financing options. In addition to providing more favorable terms for some participants, the addition of leasing companies into the market likely increased customers' exposure to renewable energy and the Long Island Power Authority program. Some leasing companies market their services by having their sales people canvas neighborhoods and going door-to-door. The program manager reported that these promotion efforts may have also led to increased interest in the Solar Pioneer program overall.

The lower participation level of the Solar Entrepreneur program resulted from a drop in available government grants and other sources for municipal projects and the presence of the Clean Solar Initiative Feed-In Tariff. The feed-in tariff, which the Long Island Power Authority instituted in July 2012, pays owners of eligible (>50 kW) systems a fixed rate per kWh generated. Offering this option for solar PV systems has reduced demand for the Solar Entrepreneur program among commercial customers.[31]

Impacts for Goal Comparison

Values in Table 9-1 show the savings by system category. See the definitions in Section 1.1 for the difference between the ex ante and evaluated values.

Table 9-1. Solar PV Residential and Nonresidential Net Impacts for Goal Comparison

Category	N	Ex Ante		Evaluated		Realization Rate	
		kW	kWh	kW	kWh	kW	kWh
Residential	1,546	4,851	15,517,480	5,879	14,042,484	121%	90%
Commercial	51	1,258	4,471,845	1,649	3,939,621	131%	88%
Municipal	28	232	815,162	307	733,093	132%	90%
Total	**1,625**	**6,341**	**20,804,486**	**7,835**	**18,715,198**	**124%**	**90%**

For the PY2013 evaluation, the Evaluation Team reviewed the Long Island Power Authority's solar PV performance analysis that uses contractor- and manufacturer-supplied hourly interval data to calculate realized energy savings from a sample of 2012 solar projects. To normalize capacity versus performance, the Long Island Power Authority performed an in-house analysis of energy output as related to installed DC capacity using actual metered data from 98 customer installations. We used this information in our analysis to assess actual output from contractor information on the program's 1,625 installations in 2013.

To determine long-term PV output over the life of the panels, we normalized solar kWh production from 2013 to 30-year typical meteorological year (TMY) weather for Islip, NY. The data indicates that the typical insolation patterns over the last 30 years are slightly lower than those observed in 2013 alone.

The ex post peak demand analysis used average 14-year peak day/hour information provided by the Long Island Power Authority, along with the 2012 contractor- and manufacturer-supplied hourly output data, to determine the average demand output from installed solar panels during the typical peak hour. The typical peak hour was determined by weighting peak hours from 2000-2013, as outlined in Table 9-2.

[31] Long Island Power Authority commercial customers can participate in both the Solar Entrepreneur program and the feed-in tariff, but the systems in each program must be unique with their own interconnection.

Table 9-2. Solar Peak Hour Weighting Factors

Peak Hour Weighting		
Hour Starting	# Years	Weighting
2 p.m.	2	7.1%
3 p.m.	4	28.6%
4 p.m.	7	57.1%
5 p.m.	1	7.1%

Note: Percentages do not sum to 100% due to rounding.

The Evaluation Team adjusted reported results for line losses to reflect energy and demand savings at the generator.

Impacts for Cost-Effectiveness

Based on research conducted in 2012 to assess the NTGR for this program, we found that the program had substantially influenced the market for solar, and the evaluated NTGR was set to 1.0 (equal to the program-planning value). A summary of the primary and secondary research conducted to estimate the effect of Long Island Power Authority incentives on PV installations on Long Island can be found in the Program Guidance Document for 2011.

Values in Table 9-3 below show the savings by category for the cost-effectiveness calculations. Since the NTGRs for both the ex ante and ex post are the same value, this table is identical to Table 9-1 above. See the definitions in Section 1.1 for the difference between the ex ante and ex post values.

Table 9-3. Solar PV Residential and Nonresidential Net Impacts for Cost-Effectiveness

Category	N	Ex Ante		Ex Post		Realization Rate	
		kW	kWh	kW	kWh	kW	kWh
Residential	1,546	4,851	15,517,480	5,879	14,042,484	121%	90%
Commercial	51	1,258	4,471,845	1,649	3,939,621	131%	88%
Municipal	28	232	815,162	307	733,093	132%	90%
Total	**1,625**	**6,341**	**20,804,486**	**7,835**	**18,715,198**	**124%**	**90%**

Reasons for Differences in Impacts

The program currently uses a coincidence factor of 0.41. Our analysis determined an ex post coincidence factor of 0.50 using the average 14-year peak hour weighting in Table 9-2. This difference is the sole reason for 24% higher ex post peak demand savings as compared with ex ante.

The insolation values from the 30-year TMY data used for the energy savings analysis were lower than insolation data for 2013 alone. This discrepancy caused a 10% reduction in ex post energy savings as compared with ex ante.

10. Solar Hot Water Program

The Long Island Power Authority Solar Hot Water program offers rebates to approved residential customers to defray a portion of the cost of installing solar hot water systems. The customer must have electric hot water heating to participate in this program. The program provides financial support that encourages the market penetration of solar water heating, helping customers gain better control over their electric bills and reduce their carbon footprint while also offsetting the Long Island Power Authority's energy and capacity requirements.

The Solar Hot Water Program continued to have low participation in 2013, providing rebates to only seven projects, and did not meet its energy savings or demand reduction goals. Participation rates are low because the program requires participants to have electric water heating, limiting the number of potential participants on Long Island, where other fuels are more commonly used for water heating. Due to low participation rates, the program was discontinued at the end of 2013.

Impacts for Goal Comparison and Cost-Effectiveness

Values in Table 10-1 show the savings both for comparison to goal and our cost-effectiveness calculations. See the definitions in Section 1.1 for the difference between the ex ante and evaluated values.

Table 10-1. Solar Hot Water Net Impacts for Goal Comparison and Cost-Effectiveness

Category	N	Ex Ante		Evaluated		Realization Rate	
		kW	kWh	kW	kWh	kW	kWh
Solar Hot Water	7	3.69	28,173	3.69	28,173	100%	100%

Note: The evaluated value for this program is also the ex post value, as the NTGR is 1.0 in both cases. We used this same information in the cost-effectiveness analysis.

These projects resulted in ex ante energy savings that account for approximately 0.1% of the total Renewable Energy Portfolio savings. Given the relatively small overall savings, the Evaluation Team has assigned a realization rate of 100% for both energy and peak demand.

11. BACKYARD WIND PROGRAM

The Backyard Wind program promotes the use of wind energy by increasing consumer awareness and demand for small wind systems, accelerating development of local infrastructure for wind turbine maintenance and delivery, and overcoming financial barriers to purchasing systems. The program seeks to address economic barriers to wind energy by offering rebates, building partnerships with equipment distributors, working with town government officials to modify zoning regulations where appropriate, and training market actors.

One wind turbine was installed through the program in the 2013 program year and five additional projects received supplemental rebate payments. As such, the program fell short of its energy savings and demand reduction goals. The program has not met the targeted number of systems in each of the past four years, suggesting that the potential penetration of small wind systems on Long Island is limited and the goals may be set too high.

Impacts for Goal Comparison and Cost-Effectiveness

Table 11-1 shows the impacts from this program used for both comparison to goal and our cost-effectiveness analysis. We assessed the gross impact, but not the net impact. As such, we applied the program-planning NTGR of 1.0, meaning the impacts for comparison to goal and our ex post impacts are identical. See the definitions in Section 1.1 for the difference between the ex ante and evaluated values.

Table 11-1. Backyard Wind – Net Impacts for Goal Comparison and Cost-Effectiveness

Program Component	Number of Units		Ex Ante		Evaluated/Ex Post		Realization Rate	
	2012[1]	2013[2]	kW	kWh	kW	kWh	kW	kWh
Residential	0	0	-	-	-	-	N/A	N/A
Commercial	5	0	-	84,249	-	70,481	N/A	84%
Municipal	0	1	10.00	4,968	2.48	4,156	25%	84%
Total	**5**	**1**	**10.00**	**89,217**	**2.48**	**74,637**	**25%**	**84%**

[1] The program claims a 35% carryover of energy savings from 2012 projects.

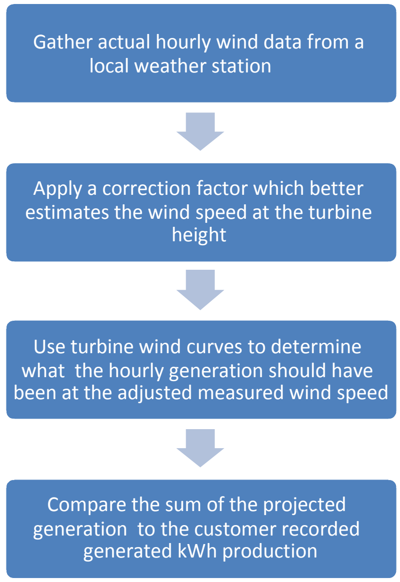
[2] The program claims 65% of energy savings from 2013 projects.

Estimation of Savings

To determine evaluated and/or ex post gross energy and demand impacts, the Evaluation Team conducted a review of performance data for wind turbines incentivized through the Long Island Power Authority's Backyard Wind program. The system performance data consisted of monthly interval data collected from meters on the installed turbines' inverters. Because complete 2013 site-specific data was not available, we based our impact evaluation on the performance of the three 2012, one 2011, and one 2010 installation which received rebate payments in 2013 and for which 2012 interval data were available.

We normalized the reported annual savings to a typical wind speed year so that impacts reflect the efficiency of the wind turbine at capturing wind energy, and not necessarily the particular annual fluctuation in any single year. Figure 11-1 below illustrates the steps in the normalization process.

Figure 11-1. Wind Energy Savings Normalization Steps



The Evaluation Team started by acquiring both the hourly typical wind speed (Typical Meteorological Year [TMY] weather data), and actual hourly wind speed from the nearest weather station (East Hampton Airport). Next, we converted the ratio of the annual average wind speed at the airport to the hub-height annual average wind speed. AWS Wind Navigator was the source of the wind speed as a function of height. We applied this ratio as an adjustment factor to scale the weather station wind speeds to reflect those at the sites at hub-height.

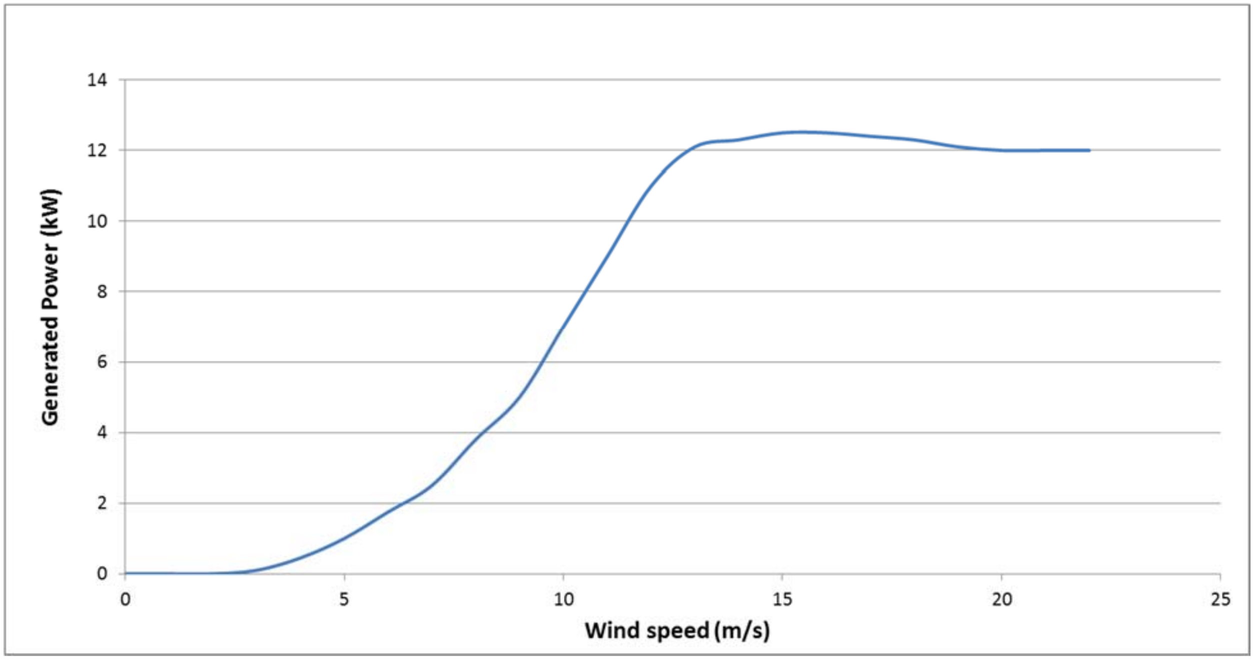
We acquired the turbine power curves for each turbine installed and used these to calculate the predicted generation for each hour, based on actual wind conditions. The turbine efficiency is the sum of the actual production of the turbine recorded by the owner divided by the sum of the predicted performance for every hour in the period.

The ex post gross energy savings for any one project is the product of the generation projected using TMY wind data (this is equal to the ex ante savings estimates) and the turbine efficiency.[32]

To determine ex post demand savings, the Evaluation Team used the average wind speed during each of the Long Island Power Authority's annual peak hours, dating back to 2000. We obtained wind speed data from the National Oceanic and Atmospheric Administration (NOAA) during Long Island Power Authority system peak hours from the East Hampton Beach Airport. We then adjusted wind speeds to represent estimated hub-height wind speed. We used these data, along with the power curve for the installed wind turbine presented in Figure 11-2 below, to determine ex post demand savings.

[32] These calculations essentially replicate the methodology used by Long Island Power Authority's software to predict performance using actual wind speed rather than typical wind speed.

Figure 11-2. Power Curve for Bergey Excel 10 kW Turbine



The Evaluation Team determined that the installed turbines delivered higher energy and demand generation than was reported in the program-tracking system. Table 11-1 and Table 11-2 provide a summary of the impact evaluation results. Note that due to the intermittent nature of wind power, the program claims only 65% of first-year savings and then claims the remaining 35% of savings in the following year if the system met its expected production. However, the site-expected annual production values in Table 11-2 are for the full year. This difference means that the totals between the two tables do not match.

Table 11-2. 2013 Site-Level Results (at Customer Meter)

Project #	Type	Installed kW	Technology	2012 On-Line Date	Expected Annual Production (kWh)	RR on Expected Production	Ex Ante kWh	Ex Post kWh	RR on Ex Ante kWh
1	Municipal	10	Bergey Excel	Dec-13	7,329	54%	4,764	3,985	84%

Reasons for Differences in Impacts

The evaluation findings indicate that the Long Island Power Authority's method of estimating ex ante energy savings is reasonably accurate, if the turbines are all working properly. We believe that the lower energy realization rates are due to interruption in service within each of the months for the installed turbines. Additionally, in 2013 the program underestimated turbine output during the peak hour by claiming the rated output of the turbine as the peak demand savings. Even a slight change in wind speed can result in a significant change in turbine output; we determined that the wind speed at the peak hour is considerably lower than the wind speed needed to reach rated turbine output.

Based on our evaluation, we provide the following observations and recommendations:

- Demand impacts will vary significantly from year to year. Ten years of wind data showed a range of 2.3 to 12.2 meters per second (average of 6.3 m/s) during the peak hour. Our analysis incorporated the average peak wind speed to determine program kW impact.
- The Evaluation Team continues to observe periodic downtimes among turbines installed in 2012 and prior. The Long Island Power Authority may consider applying a service factor to the ex ante savings to account for potential equipment failures, or a sufficient shakedown period should occur before considering a unit online and counting the energy generated at the site. However, the existing data set across the five program years (i.e., 17 turbines) is too small to be used to determine a service factor.
- Turbines are currently monitored using monthly interval kWh data. Evaluators recommend the establishment of a more advanced, real-time turbine monitoring system that can provide 15-minute hub wind speeds and power generation data for incentivized turbines. This information could be analyzed to better predict program demand savings during the peak hour, as well as the magnitude of temporary downtime on annual energy output.

12. 2014 Program-Specific Implementation Models and Data Flow

The Evaluation Team created implementation models for each of the programs evaluated in 2013.[33] An implementation model is a graphic presentation of a program's intervention – what occurs and who undertakes the functional activities of the program. The models present the various functions in rows, and key stakeholders and populations in columns. The functions, stakeholders, and process flow models were determined through a review of the available program documentation and further refined based on our interviews with program managers and implementation staff. The models do not attempt to assess the effects of the program, which is typically done in an impact model.

This section presents implementation models that are forward looking and show the processes of the program planned for 2014. As such, we reference PSEG Long Island, and not the Long Island Power Authority or National Grid, as the stakeholder responsible for most program functions.

The models are organized by function and the stakeholders involved. Each model includes a series of functions which vary across programs, diverse stakeholders involved, and detailed process flow models for various service delivery activities.

- Functions: These represent the discrete functions inherent in most programs. These functions include program administration and design, marketing and outreach, education, service delivery, and evaluation. Service delivery encompasses activities that are directed towards intervention recipients and, for these models, is a catch-all for any activity not included in the other functions. These functional areas may vary across programs.
- Stakeholders: These include the various providers who are involved in or receive program delivery. Stakeholders include the customer, market actors, PSEG Long Island, and variety of subcontractors. Stakeholders vary across programs.
- In addition, programs' models may contain additional "process flow models" that document service delivery processes in greater detail. For example, some models document rebate application process flows. The number and type of process flow models vary across programs.

While each program has a unique implementation process and flow of information, we did identify several key points in each the functions where stakeholder responsibilities are similar across all programs. These include:

- Program Administration and Design: PSEG Long Island staff are responsible for program design, goals, and incentive structure and collaborate with program-specific subcontractors as needed.
- Marketing & Outreach: Most often PSEG Long Island staff are responsible for the creation and updating of program marketing materials. In some cases, this is done in partnership with

[33] The Evaluation Team did not create an implementation model for the Solar Hot Water program because it is being discontinued in 2014.

implementation contractor staff, but PSEG Long Island is responsible for the final approval of the marketing materials.

- Education: The implementation contractor, often with support from PSEG Long Island staff, is responsible for market actor/trade ally training activities.
- Service Delivery (Customer Facing Activities): The implementation contractor is typically responsible for all “customer-facing” aspects of program delivery including performing audits, installations, marketing efforts, etc. One exception to this is the CEP Mid-Market program where PSEG Long Island is responsible for the “customer-facing” activities.
- Service Delivery (QA/QC and Reporting): The implementation contactor conducts most of the quality control and verification activities for the programs, provided weekly and/or monthly reports to PSEG Long Island staff.
- Service Delivery (Rebates and Incentives): Where applicable, the implementation contractor collects and processes the payment information and submits prepared invoices to PSEG Long Island, who is responsible for mailing payment to customers and contractors.

The program-by-program implementation models are included below.

Figure 12-1. Commercial Efficiency Program (CEP) Implementation Model

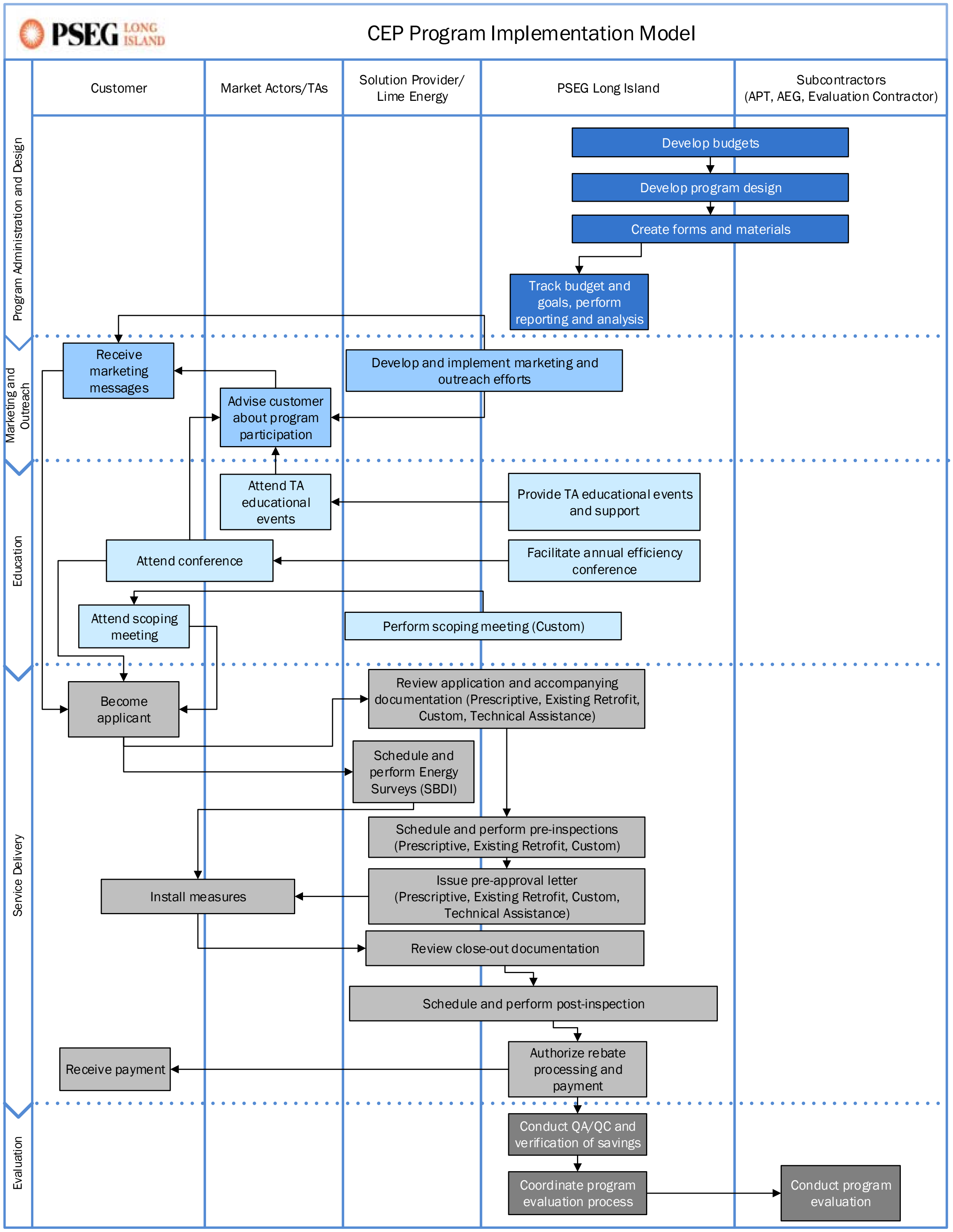


Figure 12-2. Energy Efficient Products (EEP) Program Implementation Model

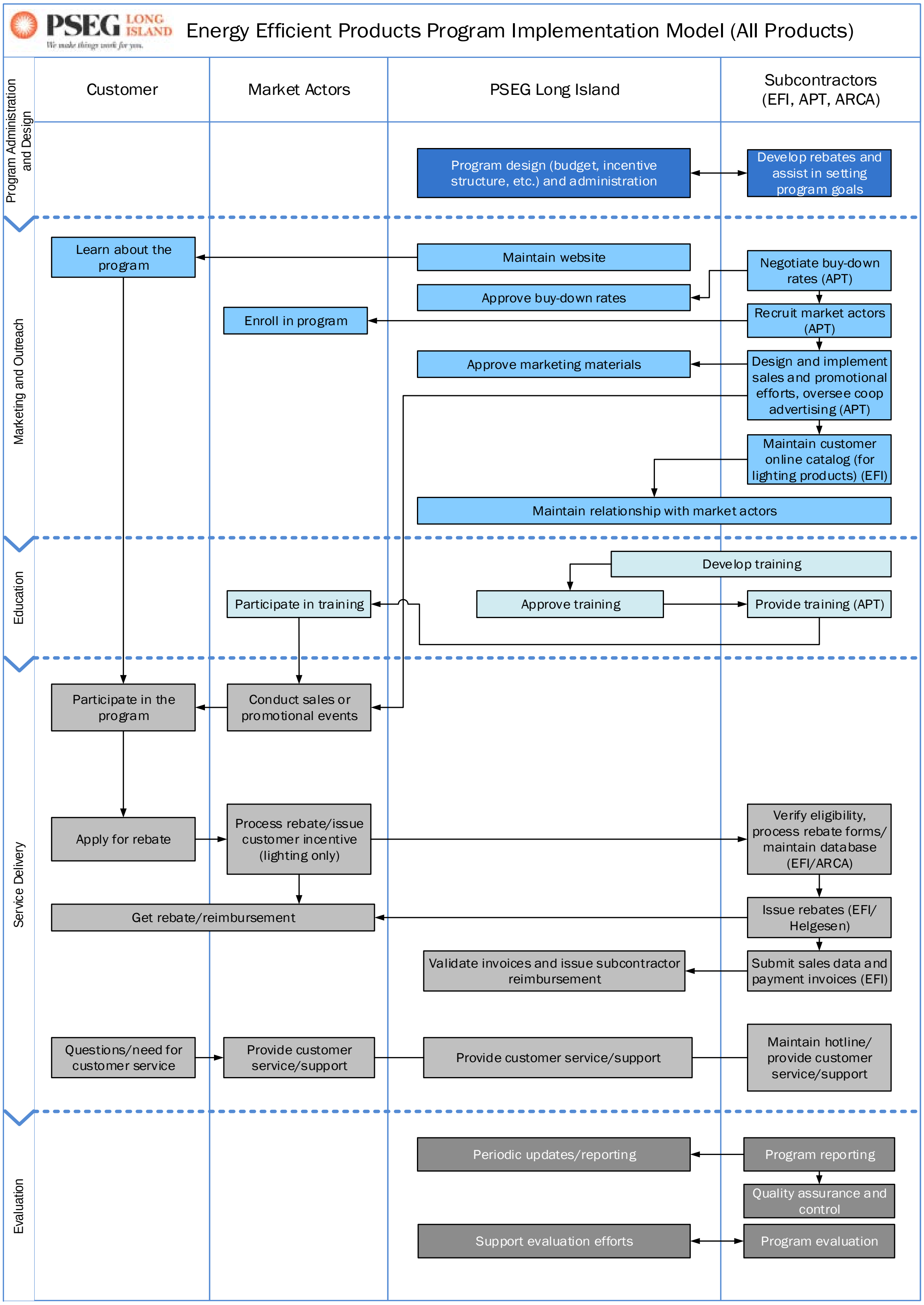


Figure 12-3. Cool Homes Program Implementation Model

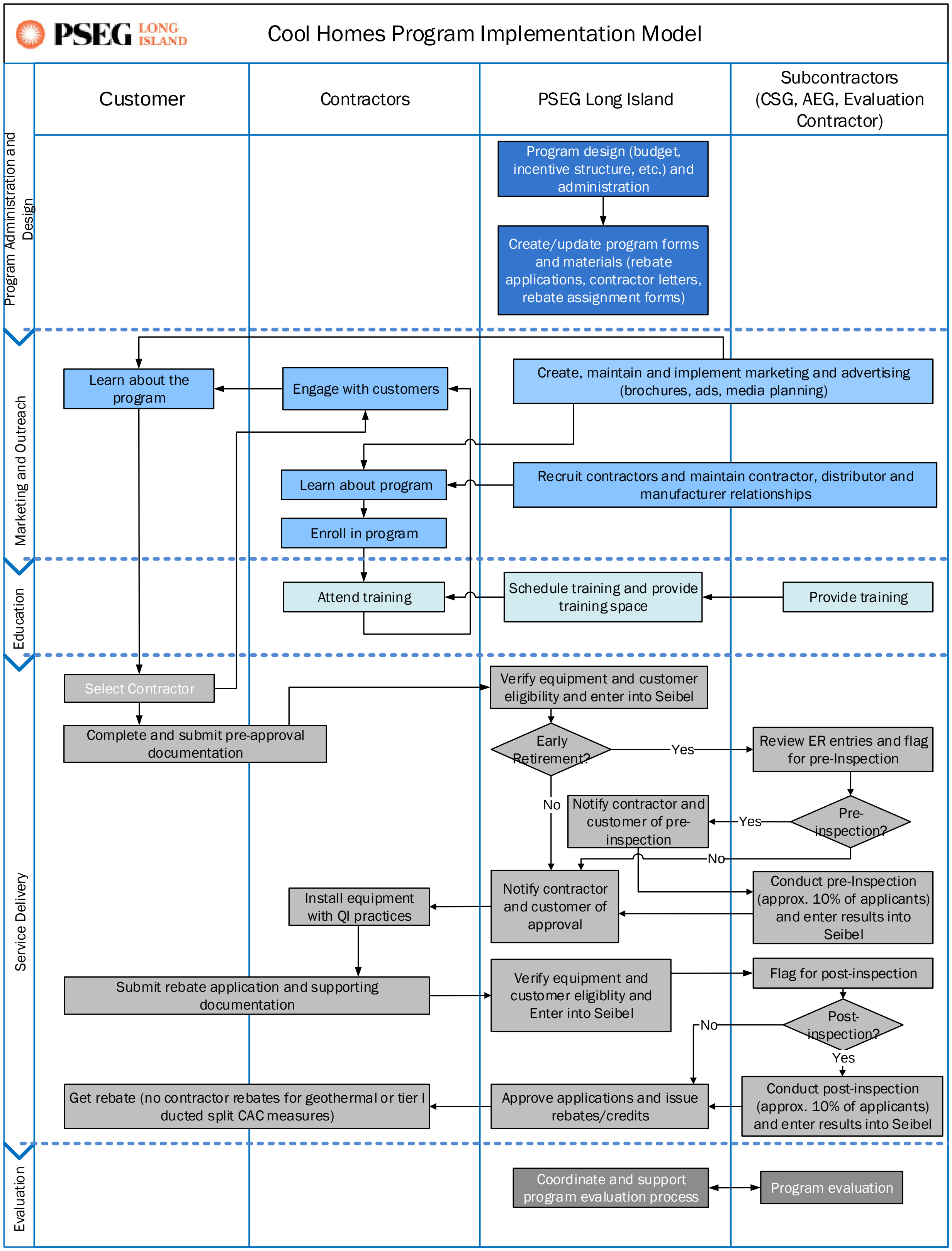


Figure 12-4. Home Performance with ENERGY STAR (HPwES) Program Implementation Model

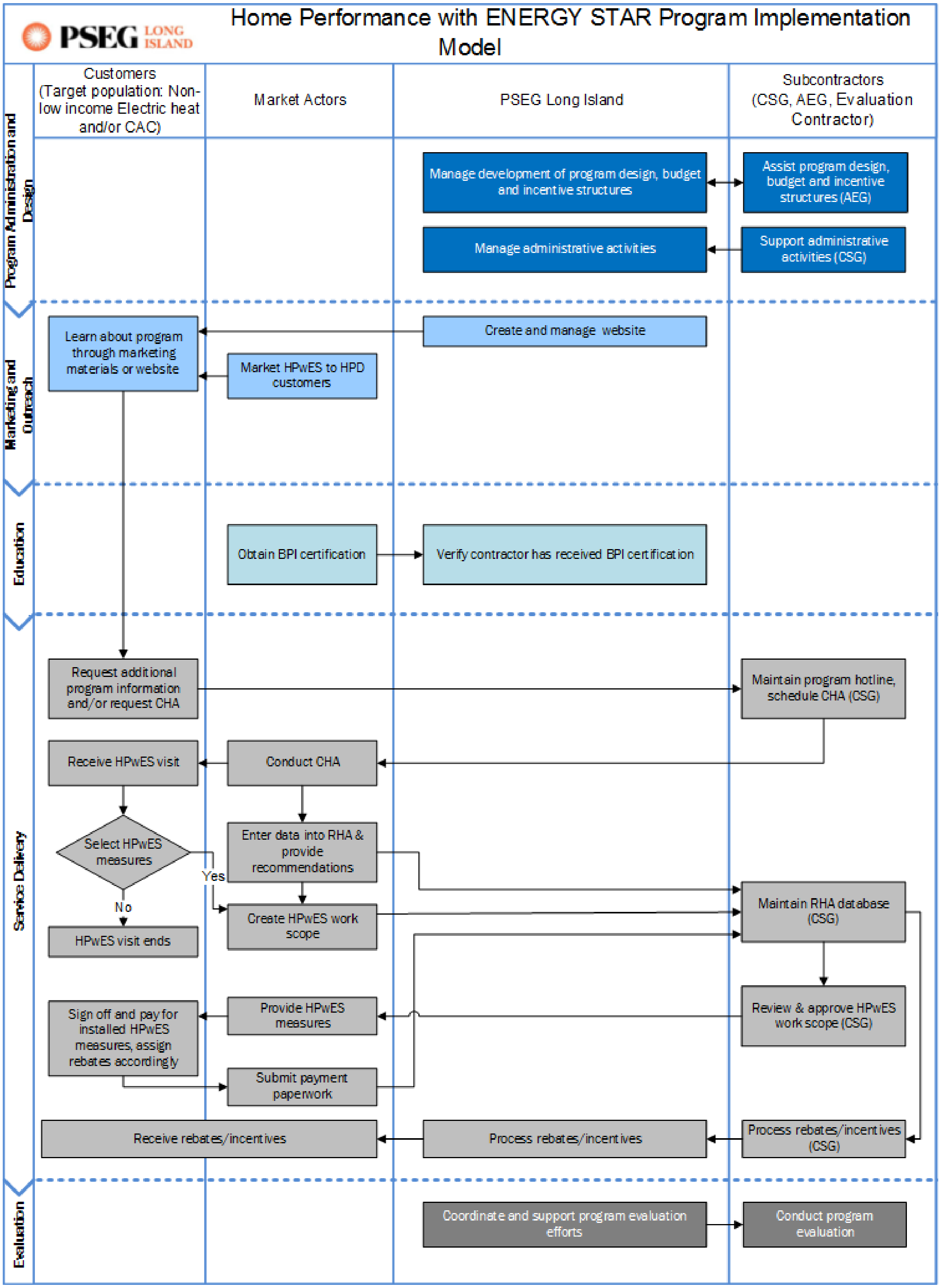


Figure 12-5. Home Performance with ENERGY STAR (HPwES) Program Payment Process Flow

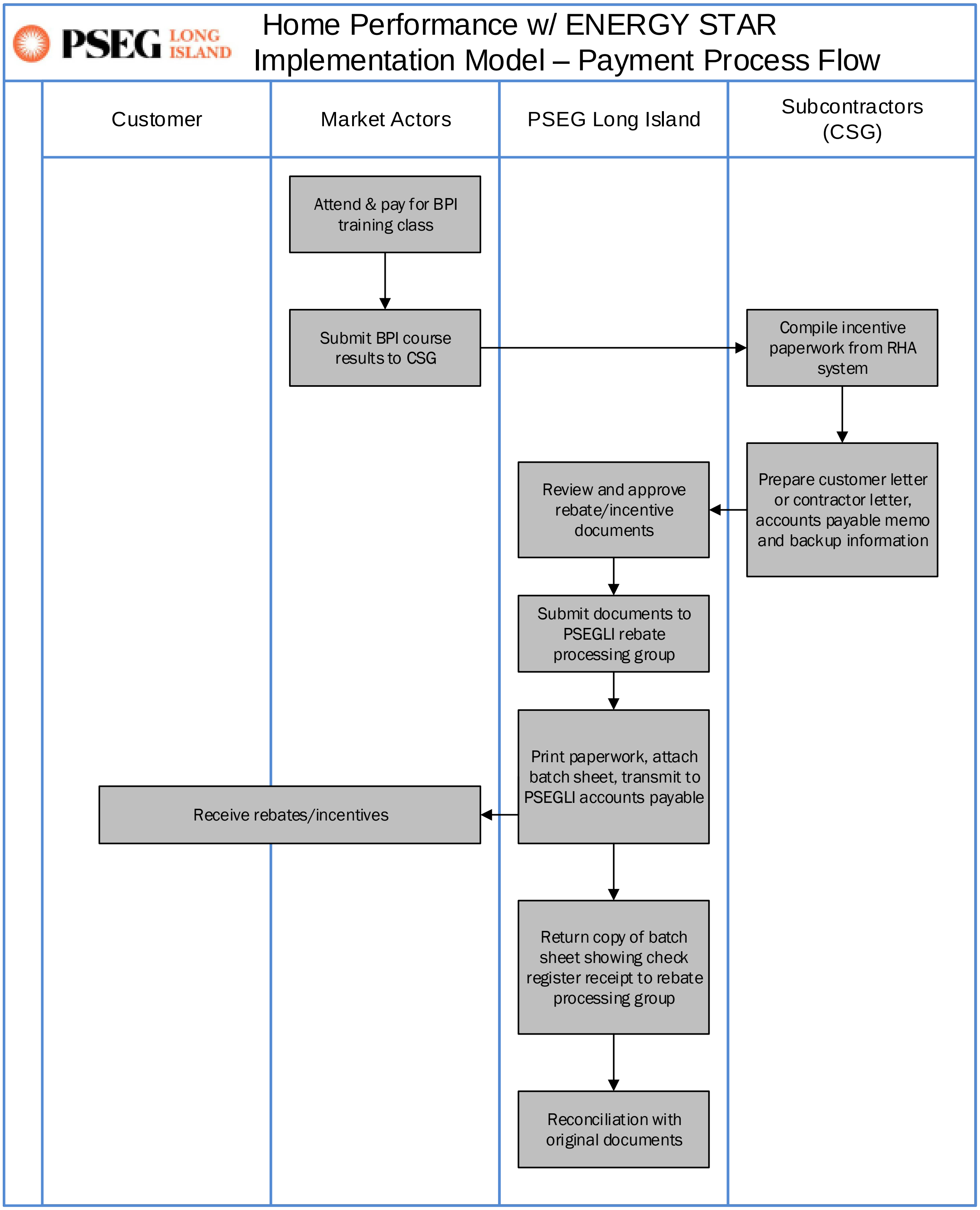


Figure 12-6. Home Performance Direct (HPD) Program Implementation Model

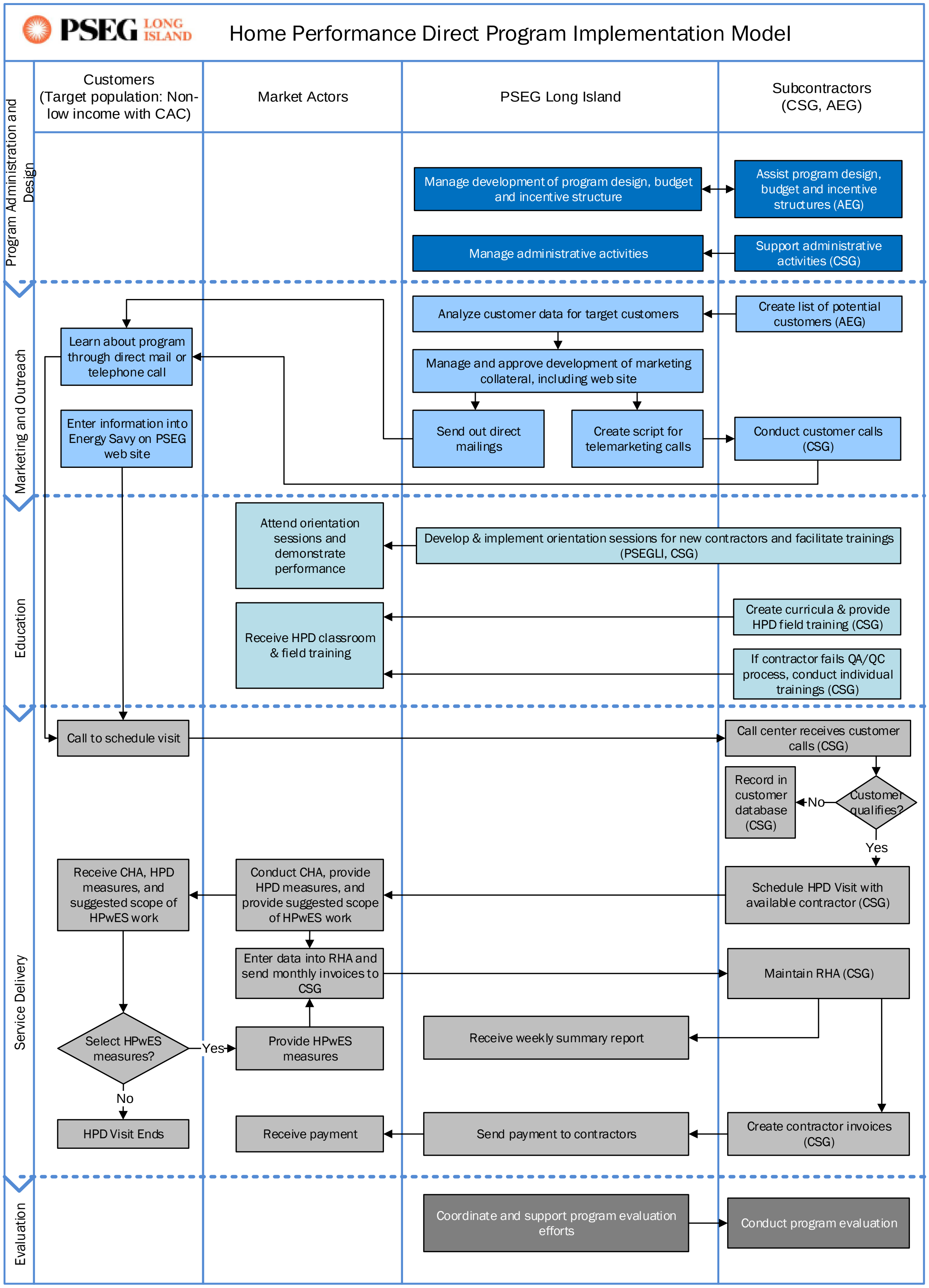


Figure 12-7. Home Performance Direct (HPD) Program Payment Process Flow

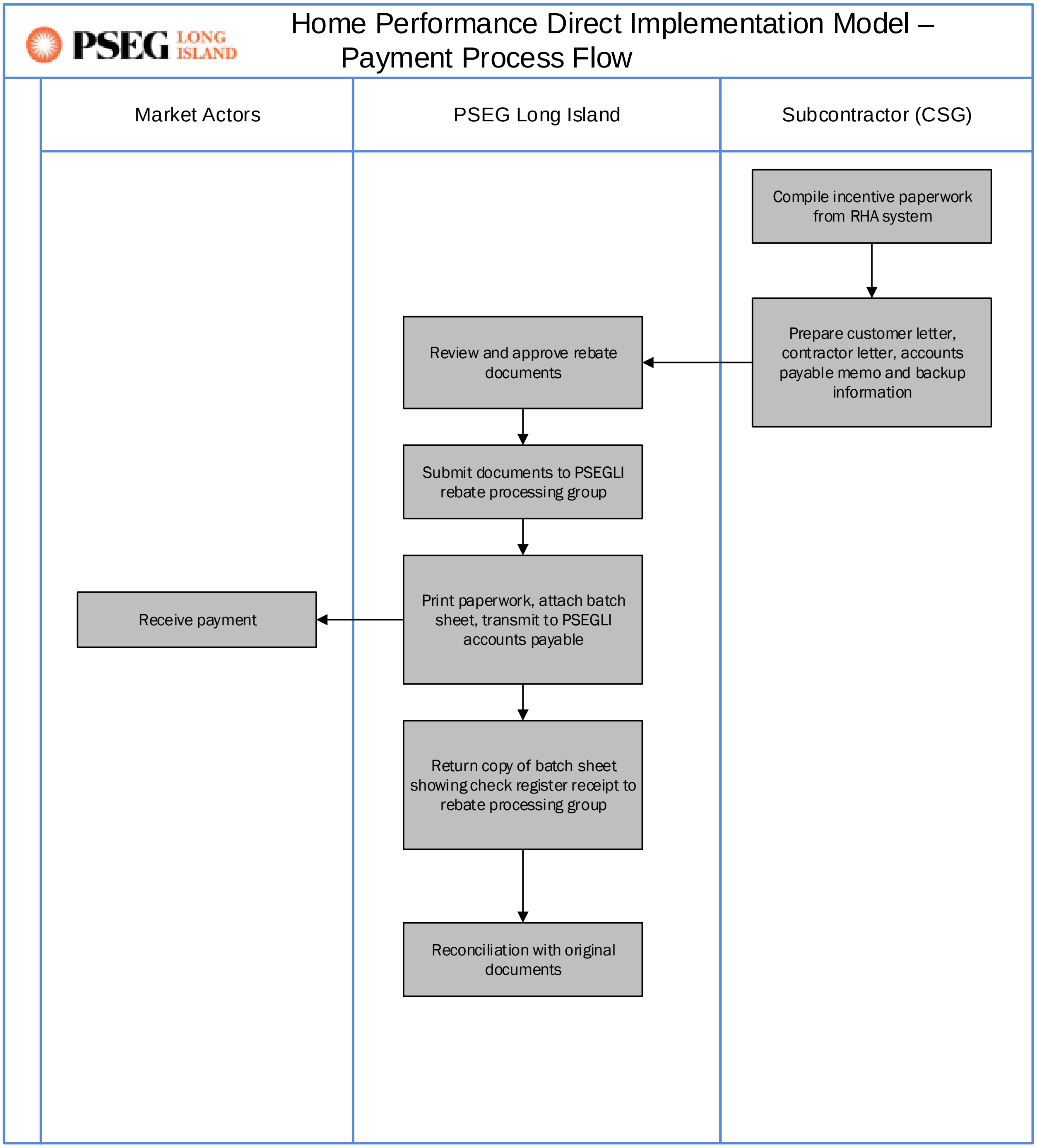


Figure 12-8. Residential Energy Affordability Program (REAP) Implementation Model

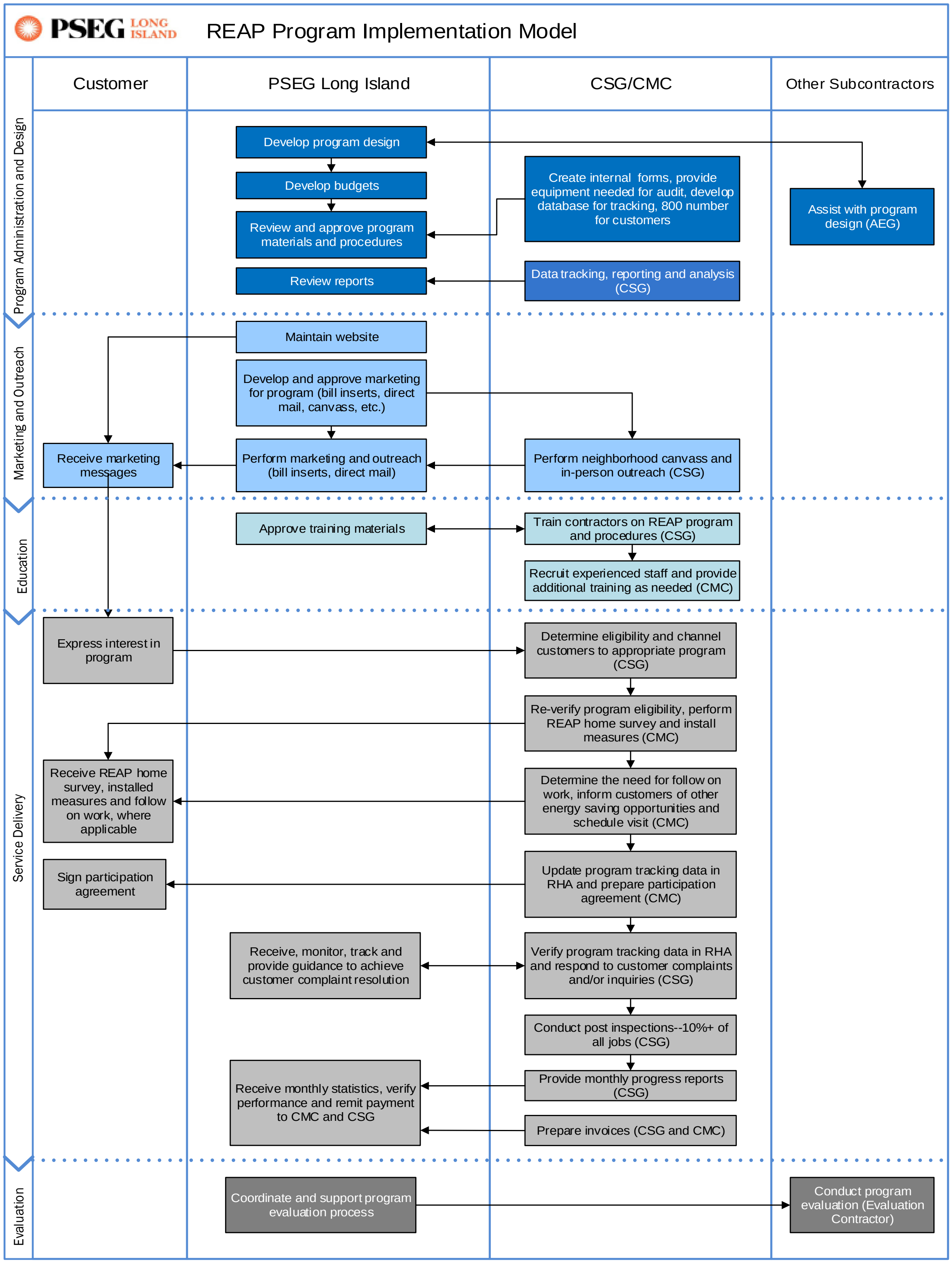


Figure 12-9. REAP Targeted Outreach Process Flow

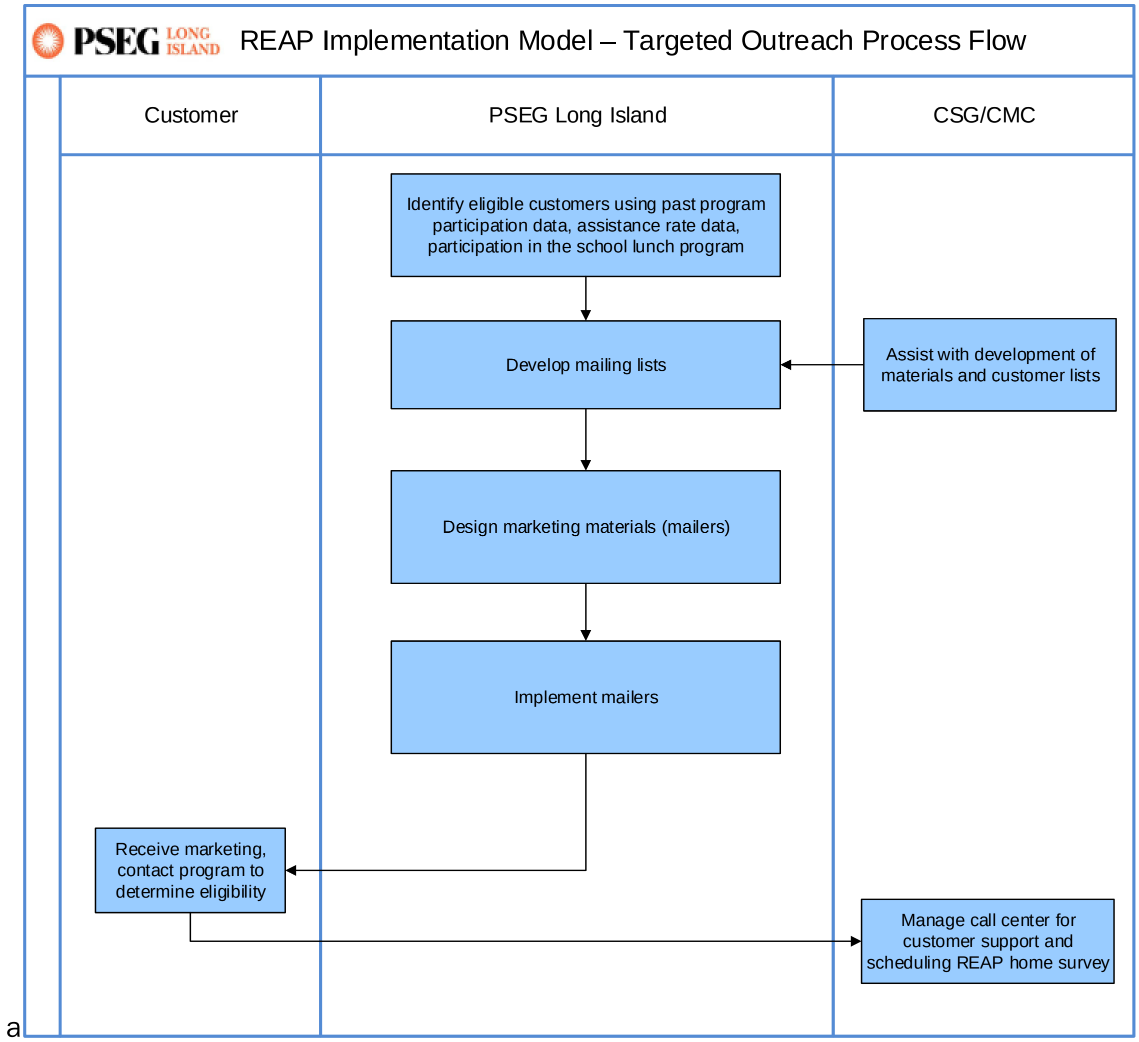


Figure 12-10. ENERGY STAR® Labeled Homes (ESLH) Program Implementation Model

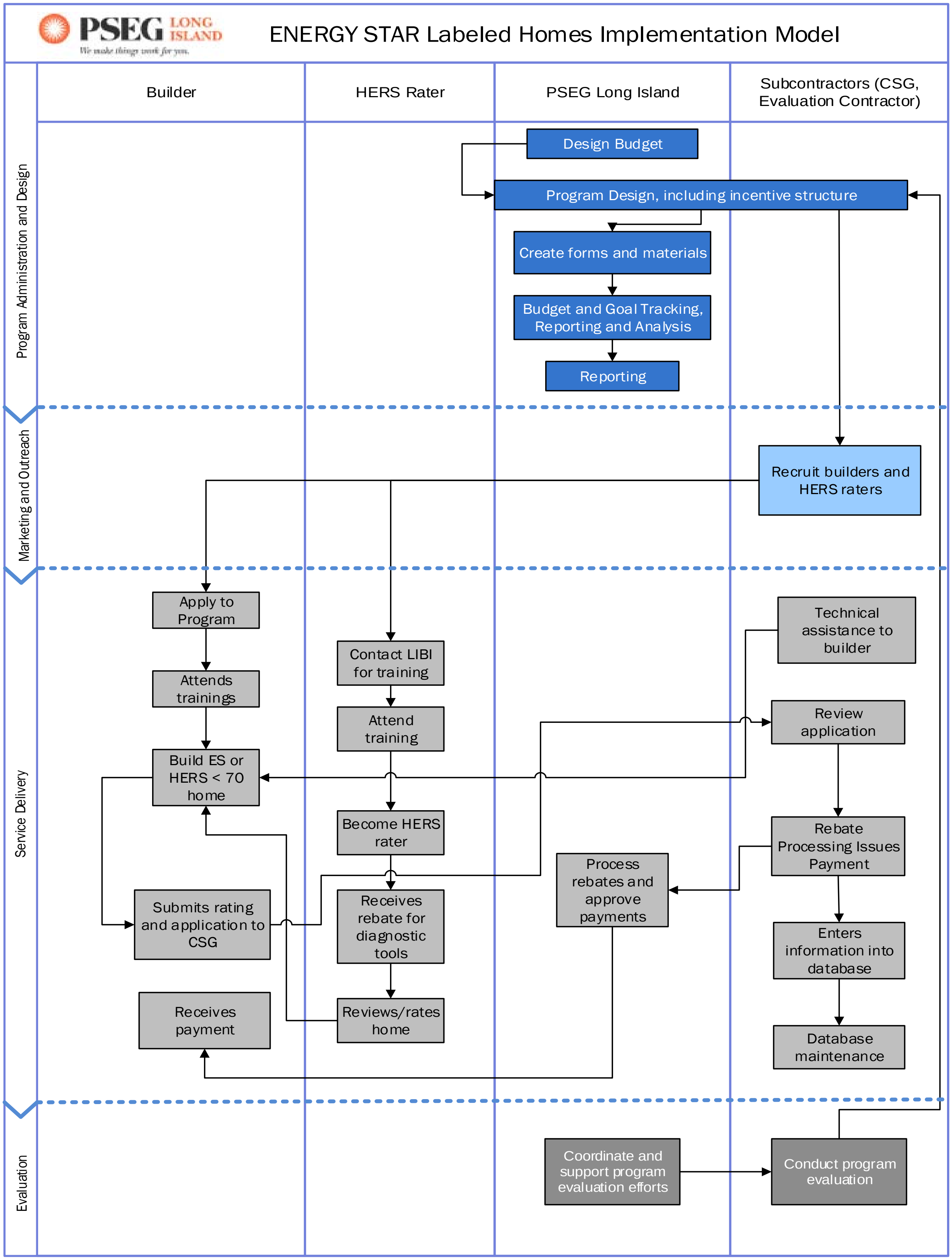


Figure 12-11. Solar Pioneer Program Implementation Model

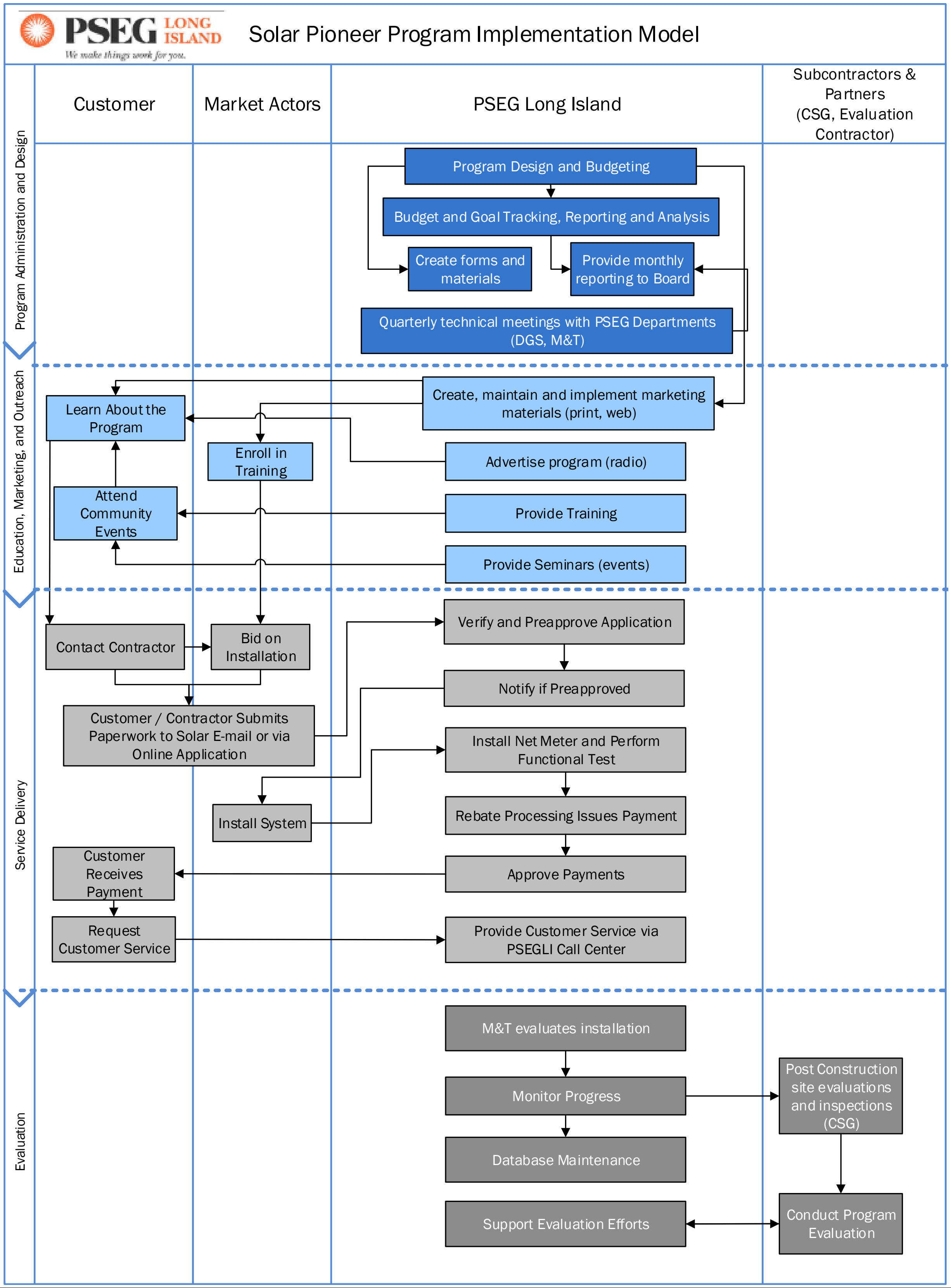


Figure 12-12. Backyard Wind Program Implementation Model

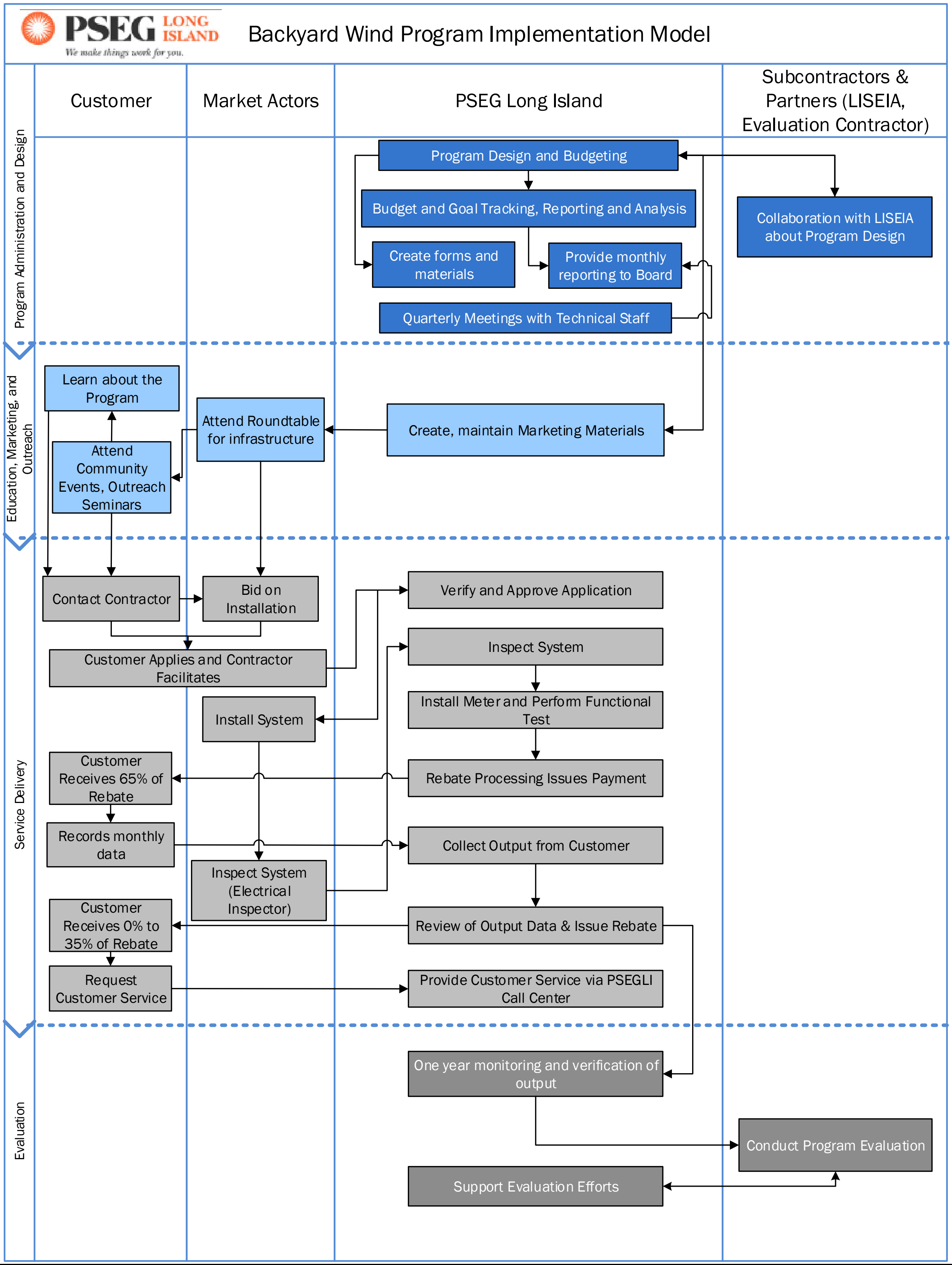
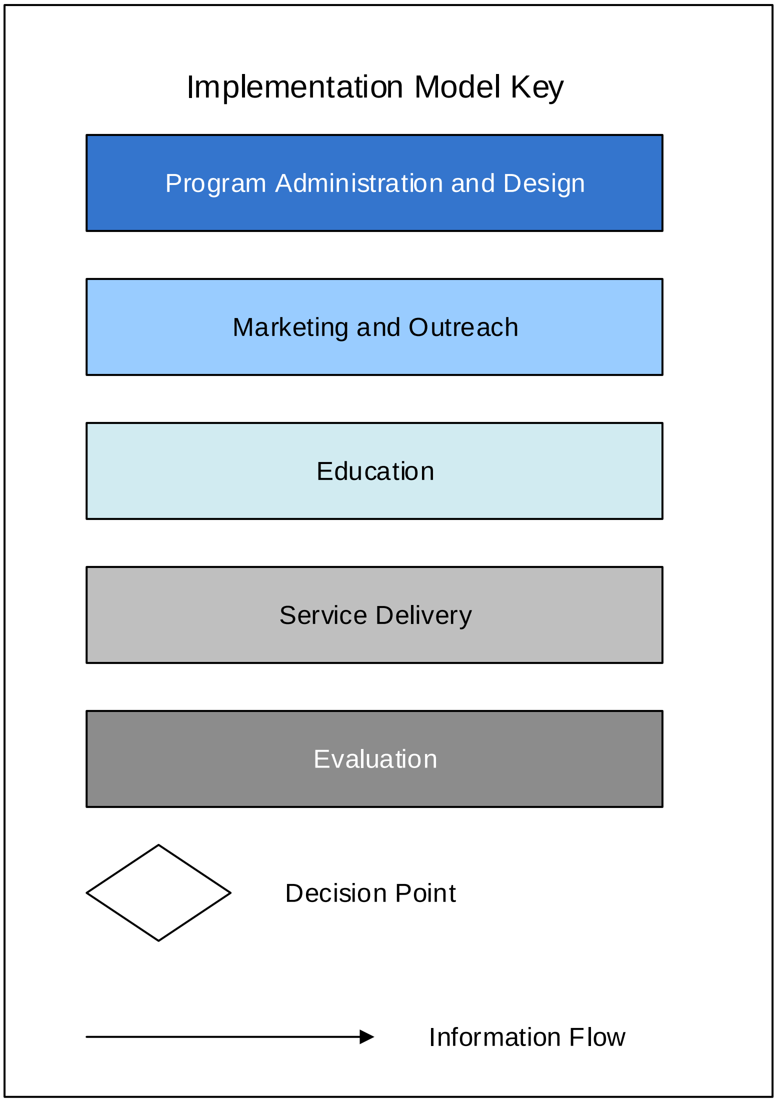


Figure 12-13. Implementation Model Key



The Evaluation Team also conducted analysis of quality control and quality assurance (QA/QC) procedures and protocols that are currently in place for PSEG Long Island's programs. Based on our review of program materials and interviews with program staff, we developed flowcharts documenting quality assurance, data entry and data transfer steps. The flowcharts also contain indicators of presence of documented protocols for each of the steps. For each of the flowcharts, we summarize the respective program or program component's QA/QC procedures and protocols. Within these summaries, we identify what QA/QC activities take place at each stage of data transfer, what entity is responsible for conducting the transfer and the QA/QC procedure, and whether or not the step is documented by any of the entities involved in implementation.

The figure below contains the legend defining the symbols and icons within the flowcharts. The icons are meant to illustrate if QA/QC occurs at that point of data transfer, if that step is documented, in what form the data exist at that stage, and exactly when the format of the data changes. The data transfer stages we included are those where an error in data could potentially occur. The numeric references alongside each of the QA/QC stages link to the numbering in the description that follows the respective chart. Program-specific QA/QC flowcharts follow.

Figure 12-14. QA/QC Model Key

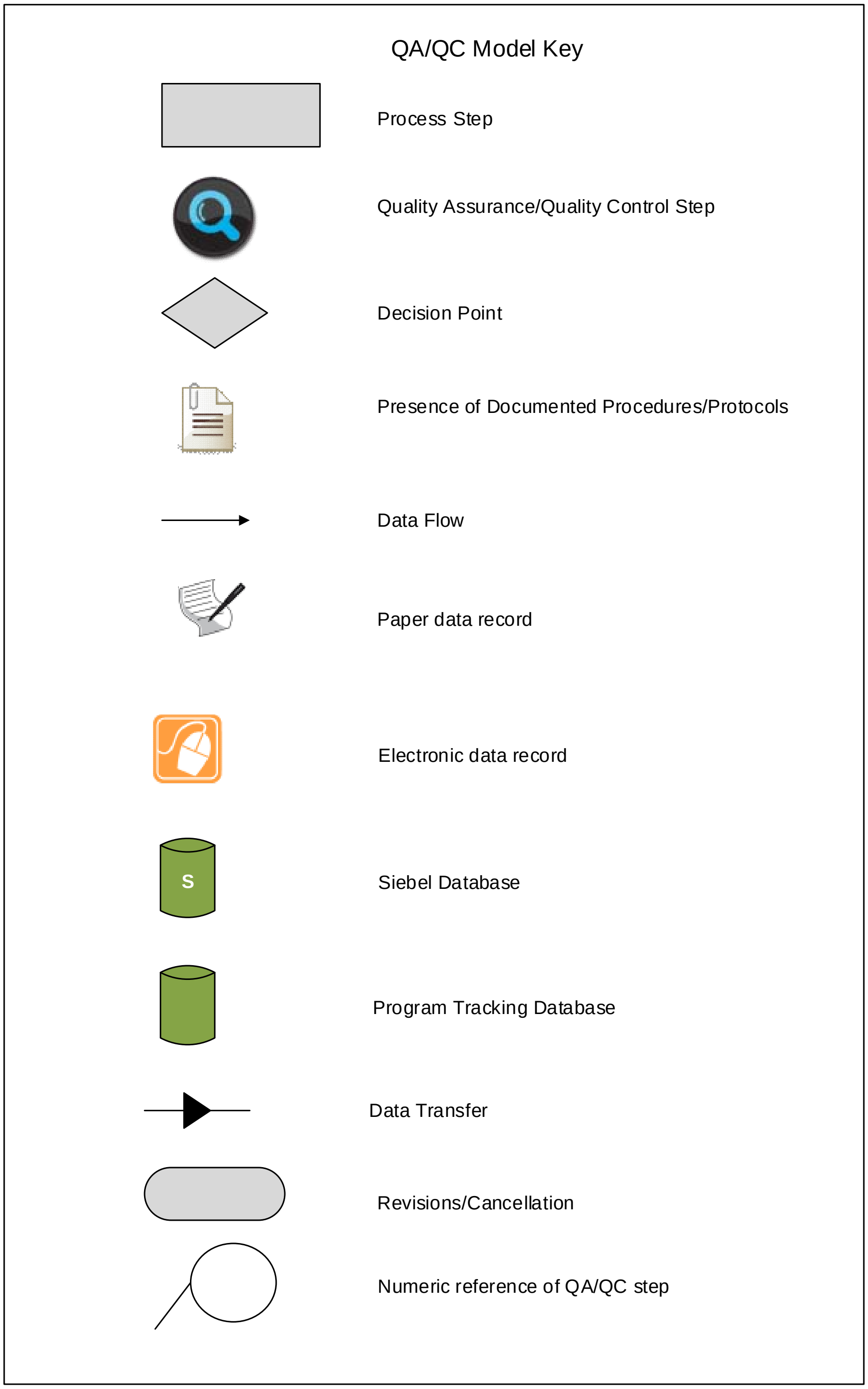
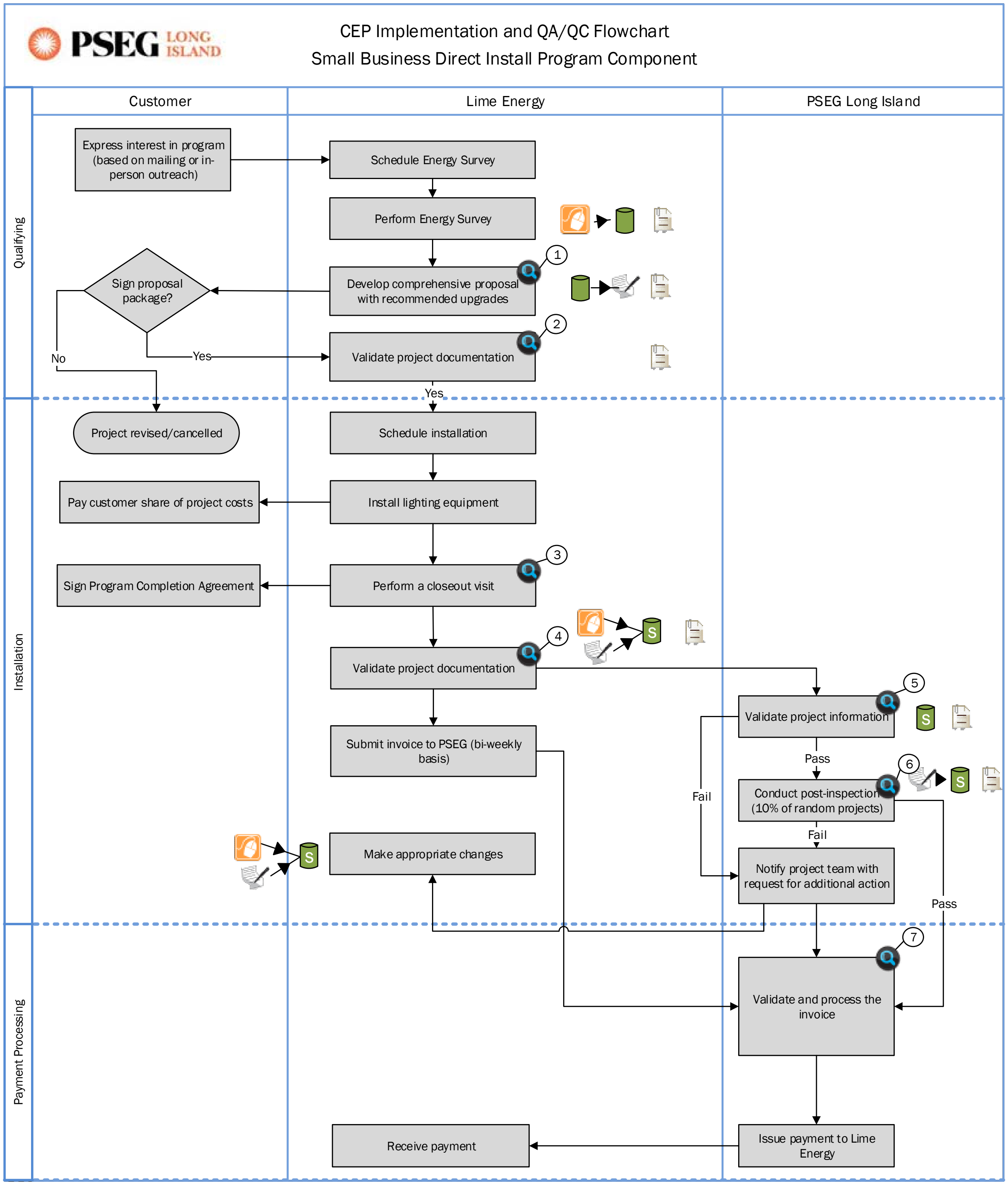


Figure 12-15. Small Business Direct Install Program QA/QC Flowchart



Throughout the implementation process of the SBDI program component, quality assurance is performed at seven points.

(1) Review of Proposed Improvements. The first quality assurance step is performed after completion of the Energy Survey and prior to the development of a formal written project proposal that is presented to the customer. Once the Energy Survey is performed, Lime Energy program staff checks the survey results to ensure that there are no anomalies or data inconsistencies and that recommended lighting improvements qualify for the SBDI program incentives. According to program staff, there is a set of documented protocols that should be followed when developing a proposal. The Evaluation Team, however, was unable to obtain and validate these documents. Every project undergoes this step.

(2) Validation of Project Documentation. The second quality assurance step occurs after the customer signs the proposal agreeing to some or all of the recommended improvements. Program staff verifies the presence of the needed paperwork and customer signatures based on an internal checklist developed for this purpose. The Evaluation Team, however, was unable to obtain and validate this document. Every project undergoes this step.

(3) Closeout Visit. After the lighting equipment is installed, program staff schedules and performs a so-called “closeout” visit. This visit includes a walk-through of the customer’s facility and verification of equipment installation and operation. As part of the closeout visit, the customer signs a closeout document (called Program Completion Agreement). Every project undergoes this step. There is no documentation with guidelines on how to perform a closeout visit.

(4) Final Validation of Project Documentation (Lime). Following the closeout visit, Lime Energy staff reviews and validates project documentation for completeness and updates the Siebel database with the necessary information (including filling out Siebel data fields and uploading project documentation as attachments). *Program Implementation Guide (V2.0, Updated June 21, 2013)* outlines how to enter projects into Siebel and what quality assurance steps to perform. Every project undergoes this step.

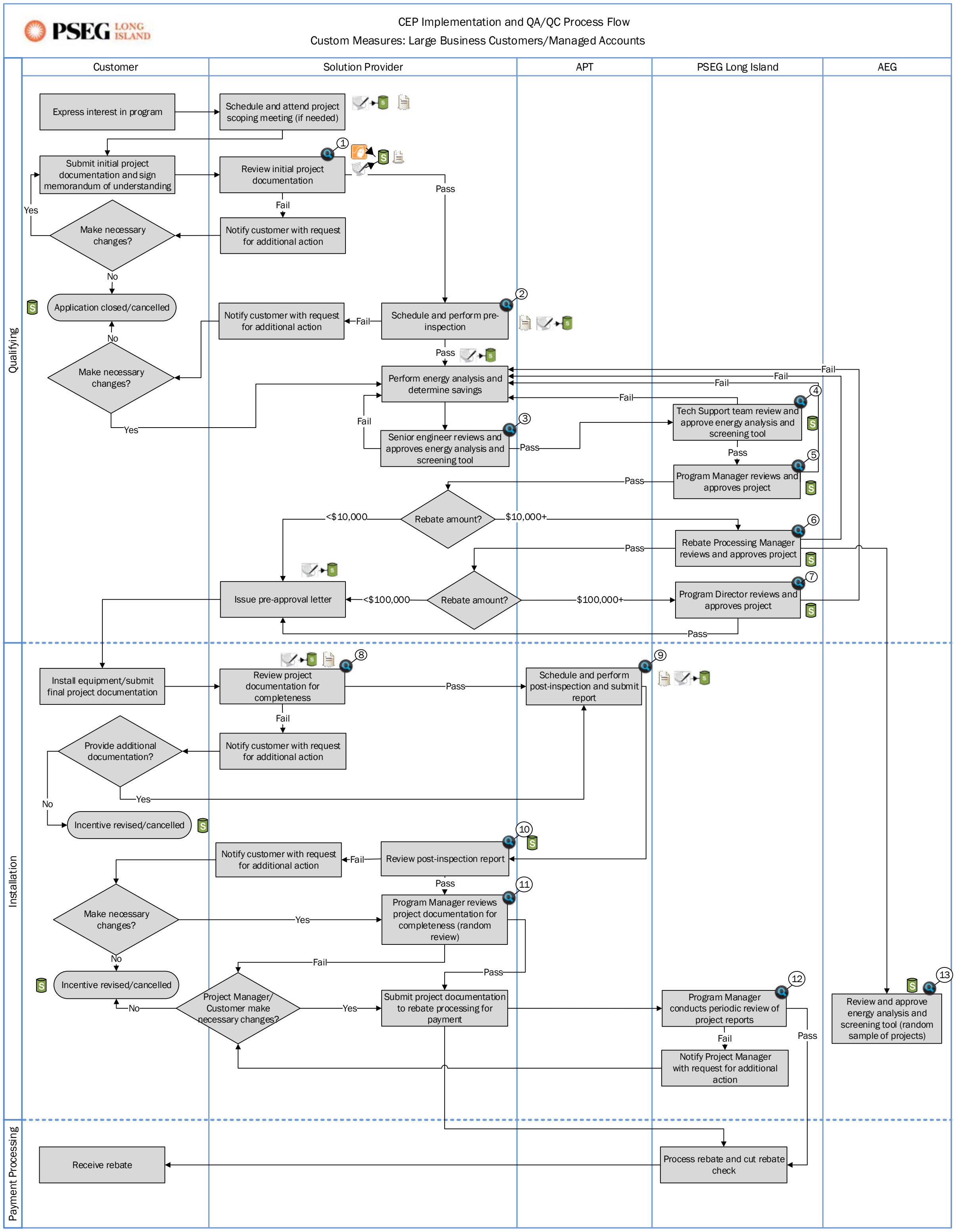
(5) Final Validation of Project Documentation (PSEG Long Island). In addition to the documentation review by Lime Energy, the SBDI Program Manager at PSEG Long Island performs additional validation. PSEG Long Island validation is triggered when the project is transferred into the payment processing stage in Siebel and includes verification of the presence of required project documentation, such as before and after pictures of the customer’s facility, the Program Participation Agreement, the Program Completion Agreement, etc. The *SBDI Program Manager Handbook* which details required documentation is used to guide this step. Every project undergoes this step.

(6) Post-Inspection (PSEG Long Island). Random 10% of SBDI projects undergo post-inspections to verify equipment installation and proper operation. Every post-inspection should be conducted in accordance with the guidelines outlined in the *Program Implementation Guide*. Post-inspection is recorded as an activity in Siebel. The activity contains the name of the person who entered it (TRC staff member), the result of the activity, and the time stamp. It is important to note that this step can take place at any time after the project enters into the payment processing stage in Siebel.

(7) Invoice Validation. PSEG Long Island performs the last quality control step. This step consists of a review of invoices submitted by Lime Energy and verification of billed amounts, before the invoices are processed and paid. Every invoice submitted by Lime Energy undergoes this quality assurance step. No documented protocols guide this step.

No timelines are currently set for any of the SBDI program delivery steps. The SBDI program component uses two databases – IPLAN and Siebel. IPLAN is the software proprietary to Lime Energy and is used to schedule and administer Energy Surveys and prepare proposals for energy efficiency improvements. Siebel is PSEG Long Island's program tracking database that is designed to serve as a repository of customer leads, project documentation, and any activities associated with projects. At the initial stages of any project, all project-related data is stored in IPLAN or in paper format until the project is ready to enter the payment processing stage, at which point Lime Energy uploads all of the required project documentation into Siebel and imports project spreadsheets. Prior to payment processing, Lime Energy only updates the project status in Siebel.

Figure 12-16. CEP Custom Measures: Large Customers QA/QC Flowchart



Throughout the implementation process of the Custom component of the Commercial Efficiency program as pertaining to TRC – the Long Island Power Authority's Commercial Efficiency program Solution Provider – quality assurance is performed at 13 points.

(1) Review of Initial Project Documentation. The first quality assurance step occurs when initial project documentation is received. Initial project documentation such as initial application, statement of work, project cost estimates, etc., can arrive at different times during the project inception process. A customer can submit all needed documentation prior to pre-inspection, or such documentation can arrive once pre-inspection is complete and the project is ready to move into the energy analysis and savings estimation phase. TRC program staff has to verify the presence of the needed documents before energy analysis is performed. The staff is guided by a checklist that contains required documentation at each step of the project implementation process. This QA/QC step has to be performed for each custom project, but is not consistently recorded in the Siebel database. Program staff is guided by the *Program Implementation Guide (V2.0, Updated June 21, 2013)* in terms of steps and processes that need to be followed when conducting documentation review and handling project entries and updates in Siebel.

(2) Pre-Inspection. Pre-inspections follow the review of initial project documentation and constitute the second QA/QC step. TRC program staff schedules and conducts pre-inspection during which existing building conditions are recorded and additional energy saving opportunities are explored. Every custom project needs to undergo a pre-inspection. Completed pre-inspection forms are uploaded into Siebel as part of the project folder, and project activity status is updated to reflect project progress. The pre-inspection activity update contains the name of the person who entered it, the outcome, and the time stamp. To facilitate the pre-inspection process and eliminate data entry errors, TRC staff uses electronic pre-inspection forms.

Based on the staff interviews, in some cases pre-inspections can be performed before project initiation. For example, any energy assessment performed under the Audit Program within the last three years that references the measures to be rebated may be accepted in lieu of a pre-inspection on the appropriate inspection form.

Program staff is guided by the *Program Implementation Guide* in terms of pre-inspection processes and the required documentation.

(3) Engineering Review. The third QA/QC step takes place after the TRC engineering team has performed energy calculations based on the results of a pre-inspection and proposed equipment options and determined or confirmed vendor-calculated energy savings and incentives for a project. Senior engineers or Technical Pipeline Managers perform this quality control step, which includes a review and approval of the "*Energy Analysis*" and "*Screening Tool*" documents. Based on our interviews with the program staff, every custom project's energy analysis and screening tool needs to be approved by a senior engineer or a Pipeline Manager at TRC. However, no documented protocols describe what data checks this quality assurance step includes. It is our understanding that this quality assurance step is recorded as an activity in Siebel. The activity contains the name of the person who entered it, the result, and the time stamp.

(4) Technical Review Team Review and Approval. Having undergone the TRC Manager's approval, the "*Screening Tool*" document undergoes yet another approval at PSEG Long Island by the technical review team. When reviewing and approving the "*Screening Tool*," the technical review team at PSEG Long Island relies on the *Program Implementation Guide* for step-by-step instructions on how to ensure equipment eligibility and presence of the necessary project documentation. Every project undergoes this quality assurance step. All energy analysis and screening tool approvals are recorded as an activity in Siebel. The activity contains the name of the person who entered it, the result, and the time stamp.

(5) Program Manager Review and Approval (PSEG Long Island). Once the technical review team at PSEG Long Island approves the project, the Solution Provider dedicated Program Manager at PSEG Long Island performs yet another check of the project documentation. The purpose of this check is to ensure presence of the required documents (screening tool, etc.), as well as to review the screening tool for any anomalies (e.g., zero kW savings). Every project undergoes this step. The Program Manager verifies the presence of information for expected kW and kWh savings, expected rebate amount, and maximum rebate amount data fields in Siebel. It is our understanding that there is currently no documentation that accompanies this step. Program Manager approval is recorded as an activity in Siebel. The activity contains the name of the person who entered it, the result of the activity, and the time stamp.

(6) Rebate Processing Team Review and Approval (PSEG Long Island). Projects with incentives of $10,000 and higher require an additional review and approval of the screening tool by the rebate processing team. Similar to the Program Manager approval, before a pre-approval letter is generated, the Rebate Processing Manager checks the project documentation for completeness, confirming presence of the required documents and reviewing the screening tool for any anomalies. It is our understanding that there is currently no documentation that accompanies this step. Rebate Processing Manager approval is recorded as an activity in Siebel. The activity contains the name of the person who entered it, the result of the activity, and the time stamp.

(7) Program Director Review and Approval (PSEG Long Island). Large and complex projects with incentives of $100,000 and higher require a final review and approval of the screening tool by the Program Director at PSEG Long Island. Similar to the review by the PSEG Long Island Program Manager, the Program Director checks the project documentation for completeness, confirming presence of the required documents and reviewing the screening tool for any anomalies. Program Director Approval is recorded as an activity in Siebel. The activity contains the name of the person who entered it, the result of the activity, and the time stamp.

(8) Final Review of Project Documentation. The next quality assurance step takes place once the customer installs the equipment and submits final project documentation, such as itemized equipment invoices and schedules. TRC program staff reviews project documentation for completeness and updates Siebel with additional information (which includes uploading project documentation as attachments in Siebel). *Program Implementation Guide* contains a checklist of required documents for a project to move forward, as well as outlines the process for how Siebel should be updated. Every project undergoes this QA/QC step.

(9) Post-Inspection. Once TRC program staff checks project documentation for completeness, it notifies APT (via Siebel) that the project is ready for post-inspection.[34] APT field staff schedules a visit with the facility contact, conducts a walk-through of the facility, and verifies equipment installation and proper operation. Every post-inspection should be conducted in accordance with the guidelines outlined in the *Program Implementation Guide*. Post-inspection is recorded as an activity in Siebel. The activity contains the name of the person who entered it (TRC staff member), the result of the activity, and the time stamp.

[34] APT (Applied Proactive Technologies) is a contractor recruited by Long Island Power Authority to conduct post-inspection for Commercial program projects that are implemented by TRC.

Currently, Siebel capabilities allow automated post-inspection notifications. That is, once the project is ready for post-inspection, APT staff is automatically alerted via Siebel of this update. Upon completion of the post-inspection, APT can upload the inspection reports into Siebel and update the activity status in Siebel accordingly.

(10) Review of Post-Inspection Reports. Completed post-inspection reports are sent back to TRC, at which point TRC program staff conducts yet another quality check of the data collected in the report to ensure that the invoices, costs, and project scope previously developed correspond with the results of the post-inspection. TRC staff is also responsible for uploading the post-inspection documentation into Siebel. This QA/QC step is performed for every project. There is no documentation to guide the program staff through this QA/QC step. In Siebel, post-inspection status is updated as "approved."

(11) Program Manager Review (TRC). TRC Program Manager further ensures data quality through a periodic review of custom projects. Not all projects are checked for quality, and there are no written guidelines as to what information Program Managers check and what projects (as well as the quantity of the projects) should undergo this QA/QC step. Based on the interviews with the program staff, usually more complex, bigger projects undergo this quality assurance step. This QA/QC step is not recorded in Siebel.

(12) Program Manager Review (PSEG Long Island). Periodically, the TRC dedicated Program Manager at PSEG Long Island also conducts quality assurance of projects that are in the "Payment Processing" stage in Siebel through a review of Siebel-generated reports. Based on our interviews with program staff, this quality assurance step involves checking that the project status and anticipated project close date are up to date, that core data inputs do not contain anomalies (e.g., zero kW savings), and that the projects are correctly assigned to the program implementer based on rate codes. Not all projects are checked for quality, and there are no written guidelines as to what information Program Managers check and what projects (as well as the quantity of the projects) should undergo this QA/QC step. This step is not recorded in Siebel.

(13) Planning Contractor Review and Approval (AEG). Project screening tool and savings calculations are also reviewed by AEG, the Long Island Power Authority's planning contractor for a random sample of projects. This review takes place during the installation process. There are no written guidelines explaining what data needs to be checked and how it is checked. AEG approval is recorded as an activity in Siebel. The activity contains the name of the person who entered it, the result of the activity, and the time stamp.

Each custom project undergoes additional QA/QC steps at the payment processing stage. Those steps are common across several program components and are reflected in the Payment Processing QA/QC diagram further down in this section.

Program Implementation Guide (V2.0, Updated June 21, 2013) represents a fairly comprehensive repository of procedures and forms that guide program delivery and ensure high quality data. For example, the *Implementation Guide* contains detailed instructions on the naming conventions for Siebel attachments, how to manage projects in Siebel, checklists with required documentation, etc.

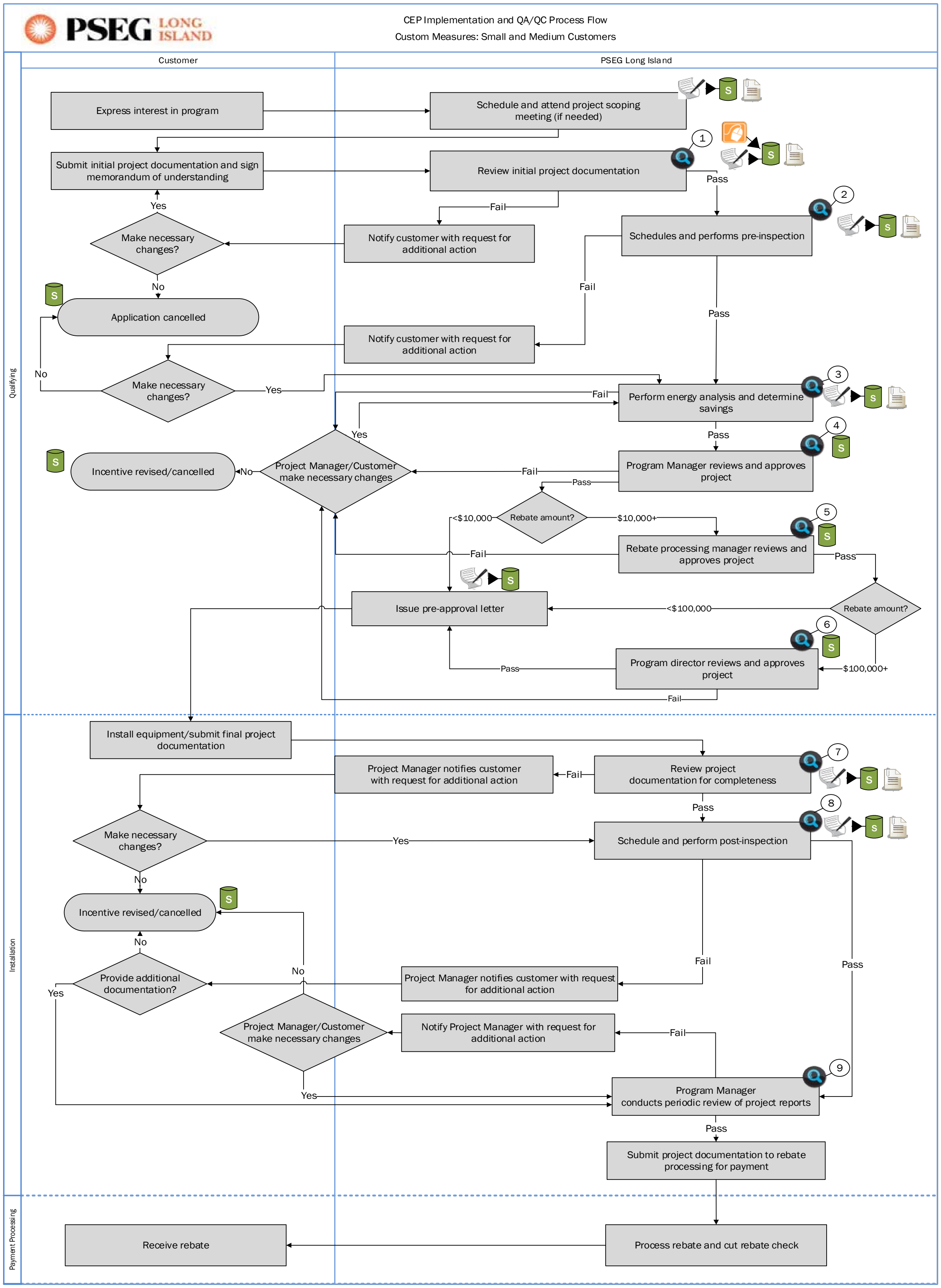
If changes or deviations from the standard program processes are needed, TRC is required to formally file a request and obtain an approval through the PSEG Long Island Program Manager. There is a list of documented guidelines that govern how deviations from the required protocols need to be processed and filed. Such documents are contained in the Program Implementation Guide. Examples of deviations from standard program protocols include waiver of pre-approval, uncertainties about equipment eligibility, etc.

As described above, project data and documentation resides in Siebel from project inception to project completion. There are no data transfers from other program tracking databases. Project staff either manually populates critical data fields in Siebel (e.g., savings information, incentive amounts, product/measure specifics, customer and lead partner contact information, etc.) or uses a Siebel import tool.

In Siebel, custom projects undergo the following stages with the following expectations in terms of timelines:

- Lead – while conceptually a project can stay in the lead phase indefinitely, Project Managers are encouraged to check the projects in this stage every six months, follow up with customers, if needed, and update the status. This stage is not reflected in the QA/QC diagram.
- Qualifying – while conceptually, it can be many months between the time that an application is submitted and the custom project is completed, Project Managers are encouraged to follow up on the qualifying projects every six months or sooner. Once all qualifying documentation is received, however, it should take no longer than five days to submit the project for tech review. The tech support team should take no more than two weeks to qualify a project. Upon approval of the tech support team, projects should be pre-approved within five days.
- Installation – while conceptually a project can remain in the installation phase indefinitely, Project Managers are encouraged to review their projects every six months and follow up with customers appropriately. However, once final project documentation is received, project must be moved to the next stage (see below) within ten days.
- Payment processing – projects can remain in this stage no longer than three days.
- Closed – this stage indicates that a project is completed and closed. This stage is not reflected in the QA/QC diagram.

Figure 12-17. CEP Custom Measures: Small and Medium Customers QA/QC Flowchart



Throughout the implementation process of the Custom component of the Commercial Efficiency program as pertaining to PSEG Long Island, quality assurance is performed at nine points.

(1) Review of Initial Project Documentation. The first quality assurance step occurs when initial project documentation is received. Initial project documentation, such as initial application, statement of work, project cost estimates, etc., can arrive at different times during the project inception process. A customer can submit all needed documentation prior to pre-inspection, or such documentation can arrive once pre-inspection is complete and the project is ready to move into the energy analysis and savings estimation phase. Project Managers at PSEG Long Island have to verify presence of the needed documents before energy analysis is performed. Program staff is guided by the *Program Implementation Guide (V2.0, Updated June 21, 2013)* in terms of steps and processes that need to be followed when conducting documentation review and handling project entries and updates in Siebel. This QA/QC step has to be performed for each custom project, but is not consistently recorded in the Siebel database.

(2) Pre-Inspection. Pre-inspections follow the review of initial project documentation and constitute the second QA/QC step. PSEG Long Island Project Managers or Senior Territory Managers schedule and conduct pre-inspection during which they record existing building conditions and explore additional energy saving opportunities. Every custom project needs to undergo a pre-inspection using an electronic form. Completed pre-inspection forms are uploaded into Siebel as part of the project folder, and project activity status is updated to reflect project progress. The pre-inspection activity update contains the name of the person who entered it, the outcome, and the time stamp. To facilitate the pre-inspection process and eliminate data entry errors, PSEG Long Island staff uses electronic pre-inspection forms.

Based on the staff interviews, in some cases pre-inspections can be performed before project initiation. For example, any energy assessment performed under the Audit Program within the last three years that references the measures to be rebated may be accepted in lieu of a pre-inspection on the appropriate inspection form.

Program staff is guided by the *Program Implementation Guide* in terms of pre-inspection processes and the required documentation.

(3) Energy Analysis and Savings Determination. The technical review team generally performs energy analysis of projects under the purview of PSEG Long Island. Energy analysis for custom projects is performed using a screening tool. Project Managers, however, often perform lighting project energy analyses, as they are frequently less complex and contain less potential for error. The technical review team relies on the *Program Implementation Guide,* which contains step-by-step instructions on how to ensure equipment eligibility and presence of necessary project documentation. Every project where energy analysis and the screening tool are prepared by Project Managers has to undergo the approval of the technical review team. When this QA/QC step takes place, it is recorded by a technical review team representative as an activity in Siebel with outcome and date stamp.

(4) Program Manager Review and Approval. Once the technical review team approves the project, the Program Manager at PSEG Long Island dedicated to small and medium customers performs yet another check of the project documentation to ensure the required documents (screening tool, etc.) are present, and also reviews the screening tool for any anomalies (e.g., zero kW savings). The Program Manager verifies the presence of information for expected kW and kWh savings, as well as expected rebate amount and maximum rebate amount data fields in Siebel. Every project has to undergo this step. Program Manager approval is recorded as an activity in Siebel. The activity contains the name of the person who entered it, the result of the activity, and the time stamp. There

are no written guidelines on the types of checks that the Program Manager performs at this step in the process.

(5) Rebate Processing Team Review and Approval. Projects with incentives of $10,000 and higher require an additional review and approval of the screening tool by the rebate processing team. Similar to the Program Manager's approval, before a pre-approval letter is generated, the Rebate Processing Manager checks the project documentation for completeness, confirming presence of the required documents and reviewing the screening tool for any anomalies. Rebate Processing Manager approval is recorded as an activity in Siebel. The activity contains the name of the person who entered it, the result of the activity, and the time stamp. This QA/QC step is not accompanied by written guidelines on the types of checks that should be performed.

(6) Program Director Review and Approval (PSEG Long Island). Large and complex projects with incentives of $100,000 and higher require a final review and approval of the screening tool by the Program Director at PSEG Long Island. Similar to the review by the PSEG Long Island Program Manager, the Program Director checks the project documentation for completeness, confirming presence of the required documents and reviewing the screening tool for any anomalies. Program Director Approval is recorded as an activity in Siebel. The activity contains the name of the person who entered it, the result of the activity, and the time stamp.

(7) Final Review of Project Documentation. The next quality assurance step takes place once the customer installs equipment and submits final project documentation, such as itemized equipment invoices and schedules. Project Managers review project documentation for completeness and update Siebel with additional information (which includes uploading project documentation as attachments in Siebel). *Program Implementation Guide* contains a checklist of required documents for a project to move forward, as well as outlines the process for how Siebel should be updated. Every project undergoes this QA/QC step.

(8) Post-Inspection. Once PSEG Long Island Project Managers check project documentation for completeness, they schedule post-inspection of the facility where the equipment was installed. Every custom project has to undergo a post-inspection. Either PSEG Long Island Project Managers or Senior Territory Managers perform post-inspection, which includes verification of equipment installation and proper operation. Every post-inspection should be conducted in accordance with the guidelines outlined in the *Program Implementation Guide*. Post-inspections are recorded as an activity in Siebel and contain the name of the person who entered it, the result of the activity, and the time stamp. Post-inspection forms should be uploaded into Siebel as attachments.

(9) Program Manager Review. Data quality is further ensured through a periodic (daily) review of the custom project reports by the Program Manager at PSEG Long Island dedicated to small and medium customers. Based on our interviews with the program staff, this quality assurance step involves checking that the project status and anticipated project close date are up to date, that core data inputs do not contain anomalies (e.g., zero kW savings), and that the projects are correctly assigned to the program implementer based on rate codes. Not all projects are checked for quality, and there are no written guidelines as to what information Program Managers check and what projects (as well as the quantity of the projects) should undergo this QA/QC step. This step is not reflected in Siebel.

Each custom project undergoes additional QA/QC steps at the payment processing stage. Those steps are common across several program components and are reflected in the Payment Processing QA/QC diagram further down in this section.

Program Implementation Guide (V2.0, Updated June 21, 2013) represents a fairly comprehensive repository of procedures and forms that guide program delivery and ensure high quality data. For example, the *Guide* contains detailed instructions on the naming conventions for Siebel attachments, how to manage projects in Siebel, checklists with required documentation, etc.

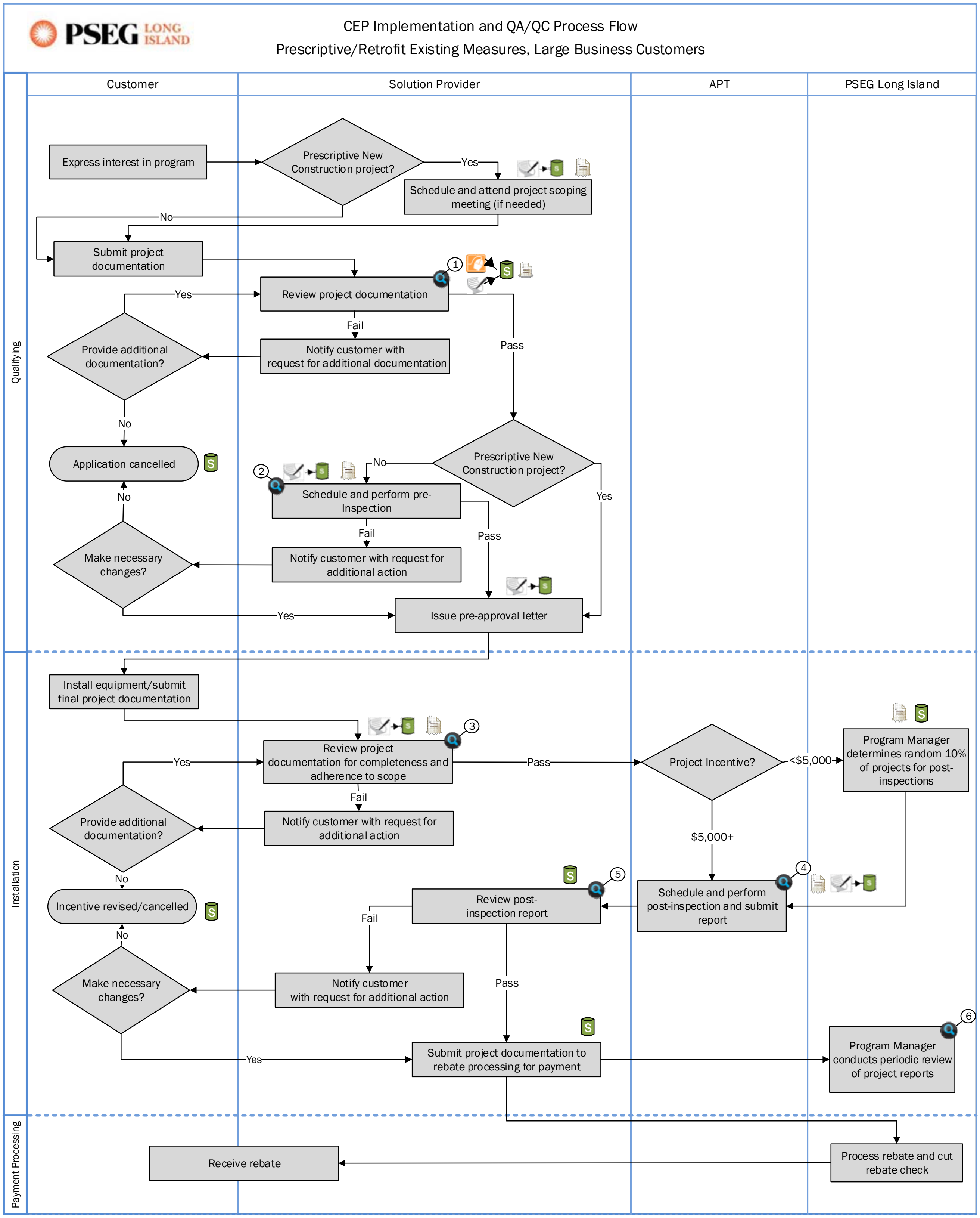
If changes or deviations from the standard program processes are needed, PSEG Long Island Project Managers are required to formally file a request and obtain an approval through the PSEG Long Island Program Manager. There is a list of documented guidelines that govern how deviations from the required protocols need to be processed and filed. Such documents are contained in the *Program Implementation Guide*. Examples of deviations from standard program protocols include waiver of pre-approval, uncertainties about equipment eligibility, etc.

As described above, project data and documentation resides in Siebel from project inception to project completion. There are no data transfers from other program tracking databases. Project staff either manually populates critical data fields in Siebel (e.g., savings information, incentive amounts, product/measure specifics, customer and lead partner contact information, etc.) or uses a Siebel import tool.

In Siebel, custom projects undergo the following stages with the following expectations in terms of timelines:

- Lead – while conceptually a project can stay in the lead phase indefinitely, Project Managers are encouraged to check the projects in this stage every six months, follow up with customers, if needed, and update the status. This stage is not reflected in the QA/QC diagram.
- Qualifying – while conceptually, it can be many months between the time that an application is submitted and the custom project is completed, Project Managers are encouraged to follow up on the qualifying projects every six months or sooner. Once all qualifying documentation is received, however, it should take no longer than five days to submit the project for tech review. The tech support team should take no more than two weeks to qualify a project. Upon approval of the tech support team, projects should be pre-approved within five days.
- Installation – while conceptually a project can remain in the installation phase indefinitely, Project Managers are encouraged to review their projects every six months and follow up with customers appropriately. However, once final project documentation is received, project must be moved to the next stage (see below) within ten days.
- Payment processing – projects can remain in this stage no longer than three days.
- Closed – this stage indicates that a project is completed and closed. This stage is not reflected in the QA/QC diagram.

Figure 12-18. CEP Prescriptive/Existing Retrofit Measures: Large Customers QA/QC Flowchart



Throughout the implementation process of the Prescriptive and Existing Retrofit component of the Commercial Efficiency program as pertaining to Solution Provider, quality assurance is performed at six points.

(1) Application Review. The first quality assurance step occurs when a customer submits initial project documentation. This includes the completed customer information section of the application form and appropriate equipment worksheets. TRC staff (Solution Provider) reviews project documentation for completeness, starts a new opportunity in Siebel, if one was not already created in the lead stage, and uploads received project documentation into Siebel. Documentation for Existing Retrofit projects is imported directly into Siebel through Excel worksheets that customers submit as part of the project documentation. Documentation for Prescriptive projects is uploaded as attachments and entered into Siebel manually. Every Prescriptive/Existing Retrofit project needs to undergo this step. Program staff is guided by the *Program Implementation Guide (V2.0, Updated June 21, 2013)* in terms of the steps and processes that need to be followed when conducting documentation review and handling project entries and updates in Siebel.

(2) Pre-Inspection. Pre-inspections, which are required for all projects that are not new construction, follow the review of initial program documentation and constitute the second QA/QC step. The pre-inspection process includes a walk-through of a customer's facility during which existing building conditions are recorded and additional energy saving opportunities are explored. TRC program staff performs pre-inspections. Completed pre-inspection forms are validated against the project worksheet, uploaded into Siebel as part of the project folder, and project activity status is updated to reflect pre-inspection outcome. Pre-inspection activity update contains the name of the person who entered it, the result, and the time stamp.

Based on the staff interviews, in some cases pre-inspections can be performed before project initiation. For example, any energy assessment performed under the Audit Program within the last six months that references the measures to be rebated may be accepted in lieu of a pre-inspection on the appropriate inspection form.

Program staff is guided by the *Program Implementation Guide* in terms of pre-inspection processes and the required documentation.

(3) Final Review of Project Documentation. The next quality assurance step takes place once the customer installs equipment and submits final project documentation, such as itemized equipment invoices and schedules. TRC program staff reviews project documentation for completeness and updates Siebel with additional information (which includes uploading project documentation as attachments in Siebel). *Program Implementation Guide* contains a checklist of required documents for a project to move forward, as well as outlines the process for how Siebel should be updated. Every project undergoes this QA/QC step. If there is has been a change in the project scope, projects documentation will need to undergo full review and approval.

(4) Post-Inspection. Once TRC program staff checks project documentation for completeness, the project is ready for post-inspection. All projects over $5,000 in incentives and a random 10% of projects under $5,000 in incentives have to undergo a post-inspection. In addition, any projects where the invoice quantity is greater than 10% difference than preapproved amount, the cut sheets do not match what is on an invoice or that were not physically pre-inspected are required to undergo post-inspection. A document *"Procedure for Random Post-Inspection for Projects under $5,000"* outlines post-inspection requirements and eligibility. For projects with incentives under $5,000, PSEG Long Island Program Manager assigns which 10% of projects are to be post-inspected. These assignments are made at least on a weekly basis. Once assignments are made, the Program Manager notifies the APT staff (through Siebel updates) when the project is ready for post-

inspection.[35] APT field staff schedules a visit with the facility contact, conducts a walk-through of the facility, and verifies equipment installation and proper operation. Post-inspection includes verification of equipment installation and proper operation. Every post-inspection should be conducted in accordance with the guidelines outlined in the *Program Implementation Guide*. Post-inspections are recorded as an activity in Siebel. The activity contains the name of the person who entered it (TRC staff member), the result of the activity, and the time stamp.

Currently, Siebel capabilities allow automated post-inspection notifications. That is, once the project is ready for post-inspection, APT staff is automatically alerted via Siebel of this update. Upon completion of the post-inspection, APT can upload the inspection reports into Siebel and update the activity status in Siebel accordingly.

(5) Review of Post-Inspection Reports. Upon completion of post-inspections, TRC program staff conducts yet another quality check of the data collected in the report to ensure that the invoices, costs, and project scope previously developed correspond to the results of the post-inspection. This QA/QC step is performed for every project. There are currently no written documentation with guidelines on how to perform this step. In Siebel, post-inspection status is updated as “approved.”

(6) Program Manager Review (PSEG Long Island). Program Manager at PSEG Long Island further ensures data quality through a periodic review of Prescriptive and Existing Retrofit projects. Not all projects are checked for quality, and there are no written guidelines as to what information is checked by Program Managers and what projects (as well as the quantity of the projects) should undergo this QA/QC step. This QA/QC step is not recorded in Siebel.

Each prescriptive and existing retrofit project undergoes additional QA/QC steps at the payment processing stage. Those steps are common across several program components and are reflected in the Payment Processing QA/QC diagram further down in this section.

Throughout the participation process, whenever a customer drops out from the participation process, the records are updated in Siebel. Program staff is required to indicate the reason why the customer did not continue with the program.

Program Implementation Guide (V2.0, Updated June 21, 2013) represents a fairly comprehensive repository of procedures and forms that guide program delivery and ensure high quality data. For example, the *Implementation Guide* contains detailed instructions on the naming conventions for Siebel attachments, how to manage projects in Siebel, checklists with required documentation, etc.

If changes or deviations from the standard program processes are needed, TRC is required to formally file a request and obtain an approval through the PSEG Long Island Program Manager. There is a list of documented guidelines that govern how deviations from the required protocols need to be processed and filed. Such documents are contained in the *Program Implementation Guide*. Examples of deviations from standard program protocols include waiver of pre-approval, uncertainties about equipment eligibility, etc.

As described above, project data and documentation resides in Siebel from project inception to project completion. There are no data transfers from other program tracking databases. Project staff either manually populates critical data fields in Siebel (e.g., savings information, incentive amounts,

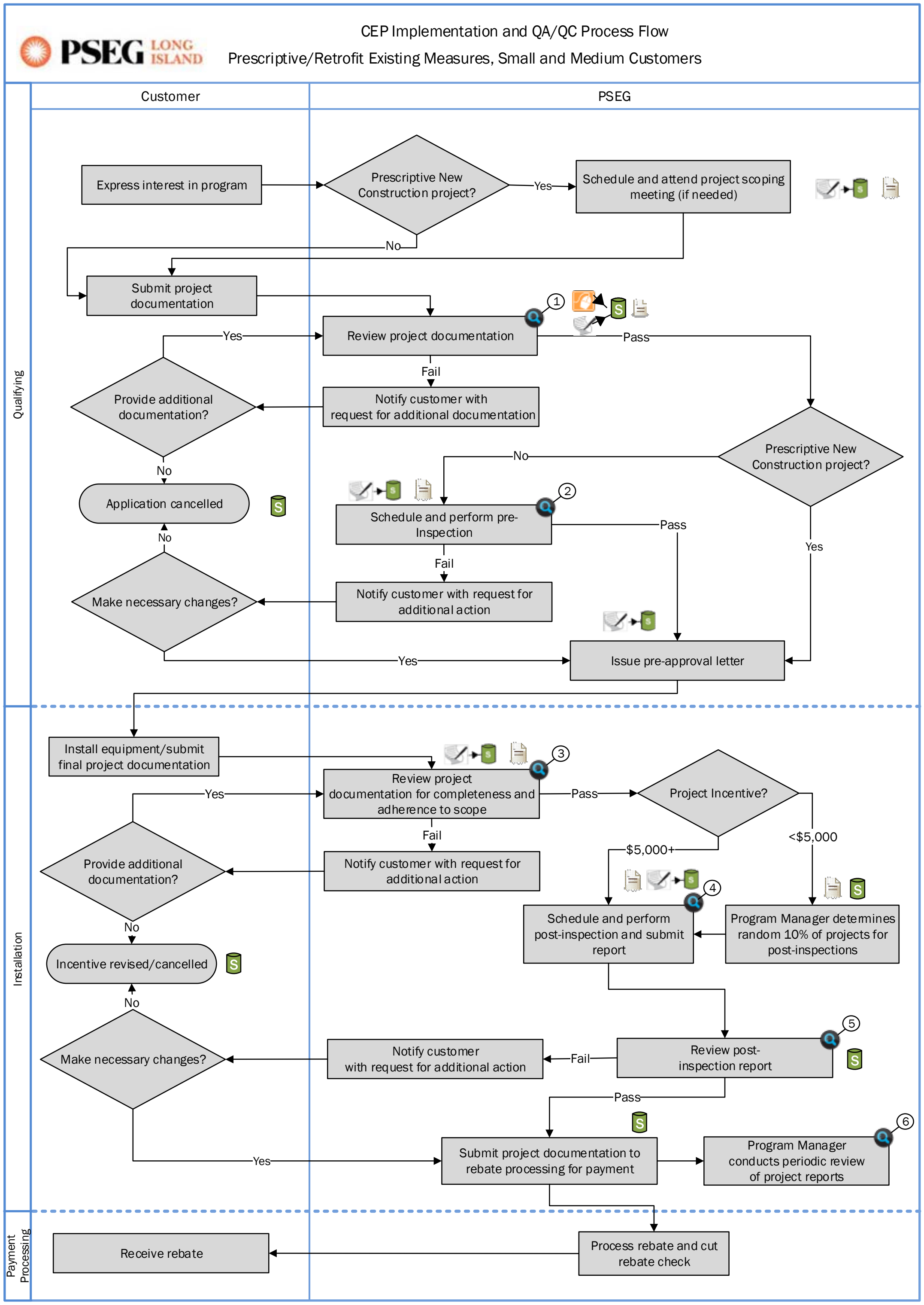
[35] APT (Applied Proactive Technologies) is a contractor recruited by Long Island Power Authority to conduct post-inspection for Commercial program projects that are implemented by TRC.

product/measure specifics, customer and lead partner contact information, etc.) or uses a Siebel import tool.

In Siebel, prescriptive and existing retrofit projects undergo the following stages with the following expectations in terms of timelines:

- Lead – most prescriptive and existing building retrofit projects will skip this stage. If a prescriptive/existing retrofit project is in this stage for more than a month, appropriate notes must be made in Siebel. Projects that remain in this stage for six months need customer follow-up. This stage is not reflected in the QA/QC diagram.
- Qualifying – projects should not be in qualifying stage longer than ten days. Project Managers are encouraged to investigate the delay in further project processing after ten days.
- Installation – while conceptually a project can remain in the installation phase indefinitely, Project Managers are encouraged to review their projects every six months and follow up with customers appropriately. However, once final project documentation is received, project must be moved to the next stage (see below) within ten days.
- Payment processing – projects can remain in this stage no longer than three days.
- Closed – this stage indicates that a project is completed and closed. This stage is not reflected in the QA/QC diagram.

Figure 12-19. CEP Prescriptive/Existing Retrofit Measures: Small and Medium Customers QA/QC Flowchart



Throughout the implementation process of the Prescriptive and Existing Retrofit component of the Commercial Efficiency program as pertaining to PSEG Long Island, quality assurance is performed at six points.

(1) Application Review. The first quality assurance step occurs when a customer submits initial project documentation. This includes the completed customer information section of the application form and appropriate equipment worksheets. PSEG Long Island Project Managers review project documentation for completeness, start a new opportunity in Siebel, if one was not already created in the lead stage, and upload available documentation into Siebel. Documentation for Existing Retrofit projects is imported directly into Siebel through Excel worksheets that customers submit. Documentation for Prescriptive projects is uploaded as attachments and entered into Siebel manually. Every Prescriptive/Existing Retrofit project needs to undergo this step. Program staff is guided by the *Program Implementation Guide (V2.0, Updated June 21, 2013)* in terms of steps and processes that need to be followed when conducting documentation review and handling project entries and updates in Siebel.

(2) Pre-Inspection. Pre-inspections, which are required for all projects that are not new construction, follow the review of initial program documentation and constitute the second QA/QC step. The pre-inspection process includes a walk-through of a customer's facility during which existing building conditions are recorded and additional energy saving opportunities are explored. PSEG Long Island Project Managers, Senior Territory Managers or Commercial Efficiency Consultants usually perform pre-inspections. Completed pre-inspection forms are validated against the project worksheet, uploaded into Siebel as part of the project folder, and project activity status is updated to reflect pre-inspection outcome. Pre-inspection activity update contains the name of the person who entered it, the result, and the time stamp.

Based on the staff interviews, in some cases pre-inspections can be performed before project initiation. For example, any energy assessment performed under the Audit Program within the last 6 months that references the measures to be rebated may be accepted in lieu of a pre-inspection on the appropriate inspection form.

Program staff is guided by the *Program Implementation Guide* in terms of pre-inspection processes and the required documentation.

(3) Final Review of Project Documentation. The next quality assurance step takes place once the customer installs equipment and submits final project documentation, such as itemized equipment invoices and schedules. PSEG Long Island Project Managers review project documentation for completeness and update Siebel with additional information (which includes uploading project documentation as attachments in Siebel). *Program Implementation Guide* contains a checklist of required documents for a project to move forward, as well as outlines the process for how Siebel should be updated. Every project undergoes this QA/QC step. If there is has been a change in the project scope, projects documentation will need to undergo full review and approval.

(4) Post-Inspection. Once Long Island Project Managers check project documentation for completeness, they schedule post-inspection of the facility where the equipment was installed. All projects over $5,000 in incentives and a random 10% of projects under $5,000 in incentives have to undergo post-inspection. In addition, any projects where the invoice quantity is greater than 10% difference than preapproved amount, the cut sheets do not match what is on an invoice or that were not physically pre-inspected are required to undergo post-inspection. A document *"Procedure for Random Post-Inspection for Projects under $5,000"* outlines post-inspection requirements and eligibility. PSEG Long Island Program Manager selects projects with incentives under $5,000 for post-inspection and notifies the staff once the selection has been made. Post-inspection includes

verification of equipment installation and proper operation and is performed by either PSEG Long Island Project Managers, Senior Territory Managers, or Commercial Efficiency Consultants. Every post-inspection should be conducted in accordance with the guidelines outlined in the *Program Implementation Guide*. Post-inspections are recorded as an activity in Siebel and contain the name of the person who entered it, the result of the activity, and the time stamp. Post-inspection forms and any supporting form that the PSEG Long Island representative uses to complete the post-inspection should be uploaded into Siebel as attachments.

(5) Review of Post-Inspection Reports. Upon completion of post-inspections, Project Managers review post-inspection reports to verify that the invoices, costs, and project scope previously developed correspond to the results of the post-inspection reports. This represents yet another QA/QC step. There are currently no written documentation with guidelines on how to perform this step. In Siebel, post-inspection status is updated as “approved.”

(6) Program Manager Review. The Program Manager at PSEG Long Island dedicated to small and medium customers further ensures data quality through periodic review of Prescriptive and Existing Retrofit project reports. This quality assurance step involves checking that the project status and anticipated project close date are up to date, that core data inputs do not contain anomalies (e.g., zero kW savings), and that the projects are correctly assigned to the program implementer based on rate codes. As part of this activity, Program Manager will also ensure that post-inspections are performed in accordance with guidelines (in all cases for projects with $5,000 or more in incentives and random 10% for projects with less than $5,000 in incentives. Not all projects are checked for quality, and aside from the document *“Procedure for Random Post-Inspection for Projects under $5,000”* there are no written guidelines as to what information Program Managers check and what projects (as well as the quantity of the projects) should undergo this QA/QC step. This step is not reflected in Siebel.

Each prescriptive and existing retrofit project undergoes additional QA/QC steps at the payment processing stage. Those steps are common across several program components and are reflected in the Payment Processing QA/QC diagram further down in this section.

Throughout the participation process, whenever a customer drops out from the participation process, project records are updated in Siebel. Program staff is required to indicate the reason why the customer did not continue with the program.

Program Implementation Guide (V2.0, Updated June 21, 2013) represents a fairly comprehensive repository of procedures and forms that guide program delivery and ensure high quality data. For example, the *Guide* contains detailed instructions on the naming conventions for Siebel attachments, how to manage projects in Siebel, checklists with required documentation, etc.

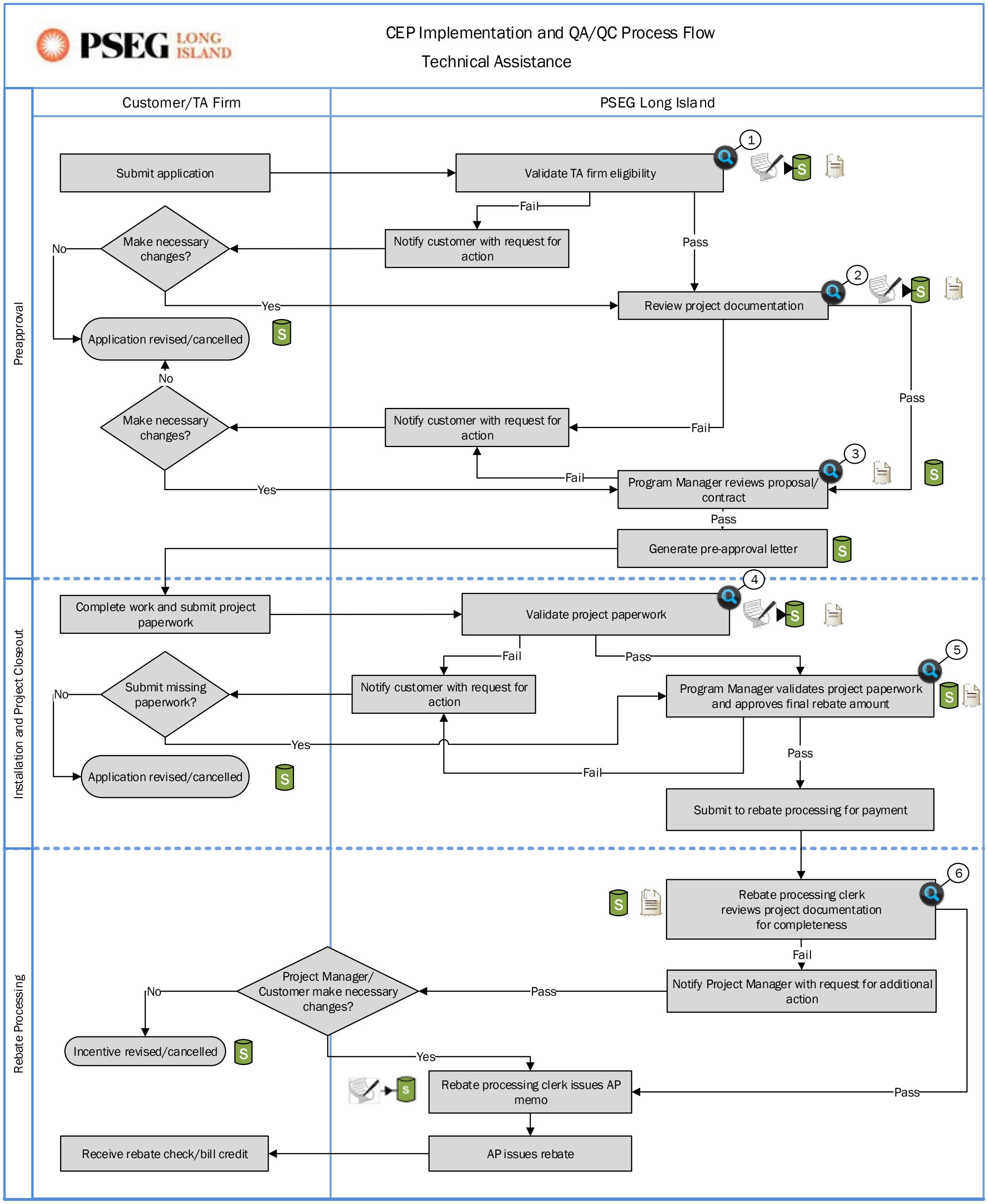
If changes or deviations from the standard program processes are needed, PSEG Long Island Project Managers is required to formally file a request and obtain an approval through the PSEG Long Island Program Manager. There is a list of documented guidelines that govern how deviations from the required protocols need to be processed and filed. Such documents are contained in the Program Implementation Guide. Examples of deviations from standard program protocols include waiver of pre-approval, uncertainties about equipment eligibility, etc.

As described above, project data and documentation resides in Siebel from project inception to project completion. There are no data transfers from other program tracking databases. Project staff either manually populates critical data fields in Siebel (e.g., savings information, incentive amounts, product/measure specifics, customer and lead partner contact information, etc.) or uses a Siebel import tool.

In Siebel, prescriptive and existing retrofit projects undergo the following stages with the following expectations in terms of timelines:

- Lead – most prescriptive and existing building retrofit projects will skip this stage. If a prescriptive/existing retrofit project is in this stage for more than a month, appropriate notes must be made in Siebel. Projects that remain in this stage for six months need customer follow-up.
- Qualifying – projects should not be in qualifying stage longer than ten days. Project Managers are encouraged to investigate the delay in further project processing after ten days.
- Installation – while conceptually a project can remain in the installation phase indefinitely, Project Managers are encouraged to review their projects every six months and follow-up with customers appropriately. However, once final project documentation is received, project must be moved to the next stage (see below) within ten days.
- Payment processing – projects can remain in this stage no longer than three days.
- Closed – this stage indicates that a project is completed and closed.

Figure 12-20. CEP Technical Assistance QA/QC Flowchart



Throughout the implementation process of the Technical Assistance program component of the Commercial Efficiency program, quality assurance is performed at six points.

(1) TA Firm Eligibility Validation. The first quality assurance step occurs when a customer submits initial project application and supporting documentation. During this stage, TA Program Manager creates a project opportunity in Siebel and validates that the TA firm is approved for the services that customer is requesting. *"2013 Technical Assistance Program Implementation Guide"* provides guidance on the appropriate processes related to this step. This step is performed for all TA applications. At the end of the step, TA Program Manager uploads the appropriate check sheet for the Project Manager to validate, as well as creates a document review activity in Siebel that has the name of the person who entered it and the time stamp.

(2) Project Documentation Review. The second quality assurance step includes Project Managers reviewing submitted application forms and supporting documentation for completeness. As part of this step, the Project Manager will determine whether any other Commercial Efficiency Program opportunities exist for the customer and ensure that all existing Commercial Efficiency Program projects are referenced in the TA opportunity in Siebel. *"2013 Technical Assistance Program Implementation Guide"* provides guidance on the appropriate processes related to this step. This step is performed for all TA applications. At the conclusion of this step, Project Manager updates the status of the document review activity as "Done."

(3) Program Manager Review. TA Program Manager conducts yet another validation of the proposal/contract to ensure it meets program requirements and is in line with best practices. This quality assurance step is performed for every project and is frequently performed concurrently with the Project Manager document review. *"2013 Technical Assistance Program Implementation Guide"* provides guidance on the appropriate processes related to this step. Upon completion of the review process, Program Manager updates Siebel.

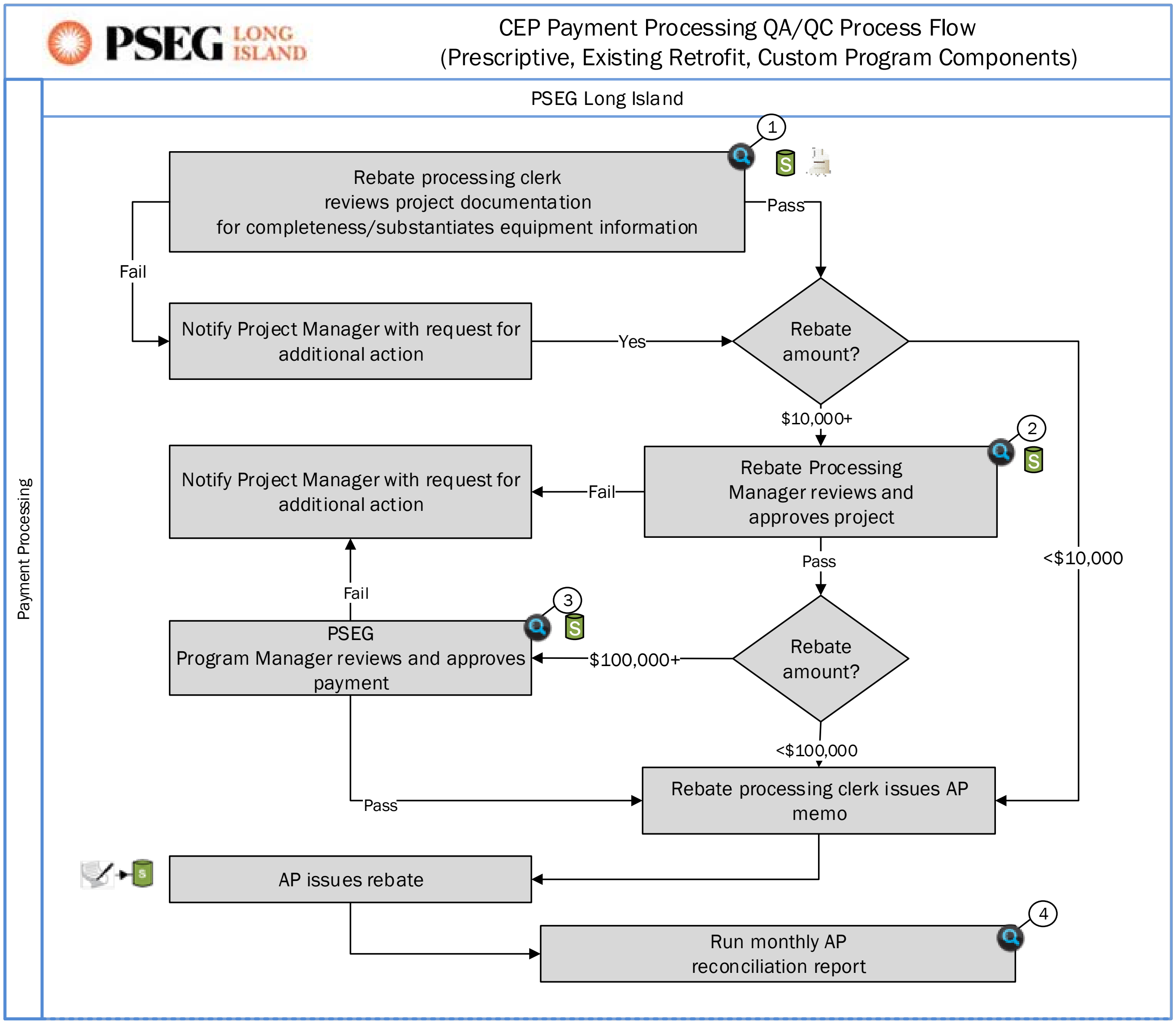
(4) Project Paperwork Validation. After the customer conducts the work and submits the project paperwork, Project Manager is responsible for validating the paperwork, including making sure that all needed documentation was submitted, and that the information in the documents is accurate (e.g., ensuring that proof of payment amount matches preapproval letter). This quality assurance step is performed for every project. *"2013 Technical Assistance Program Implementation Guide"* provides guidance on the appropriate processes related to this step. In Siebel this step is recorded as an activity with date and time stamp. Project Manager uploads all of the relevant project documentation as attachments in Siebel.

(5) Program Manager Paperwork Validation and Rebate Approval. In addition to the Project Manager review of the project documentation, TA Program Manager also validates proposals and deliverables for every submitted project and approves the final rebate payment. *"2013 Technical Assistance Program Implementation Guide"* provides guidance on the appropriate processes related to this step. This step is updated in Siebel. This step is performed for every TA project.

(6) Rebate Processing Review and Approval. Once the TA Program Manager approves the rebate amount, the project is sent to the rebate processing team for payment processing. This constitutes the next quality assurance step. For every project, the rebate processing team at PSEG Long Island reviews the application documentation for presence and completeness, substantiates Siebel entries for the performed work, and updates project status in Seibel. The rebate processing team relies on the *Program Implementation Guide* to ensure presence of the needed documentation. Aside from this, there are no protocols to provide directions to the rebate processing team.

TA project timelines could be quite extensive and, depending on the customer, can last from a few months to several years.

Figure 12-21. CEP Payment Rebate Processing QA/QC Flowchart



(1) Rebate Processing Review and Approval. Once the final project documentation is received and uploaded in Siebel and post-inspections are performed and checked for quality, the rebate processing team at PSEG Long Island reviews the application documentation for each project for presence and completeness, substantiates Siebel entries for installed equipment, and updates project status in Seibel. This step is performed for each project. The rebate processing team relies on the *Program Implementation Guide* to ensure presence of the needed documentation. Aside from this, there are no protocols to provide directions to the rebate processing team.

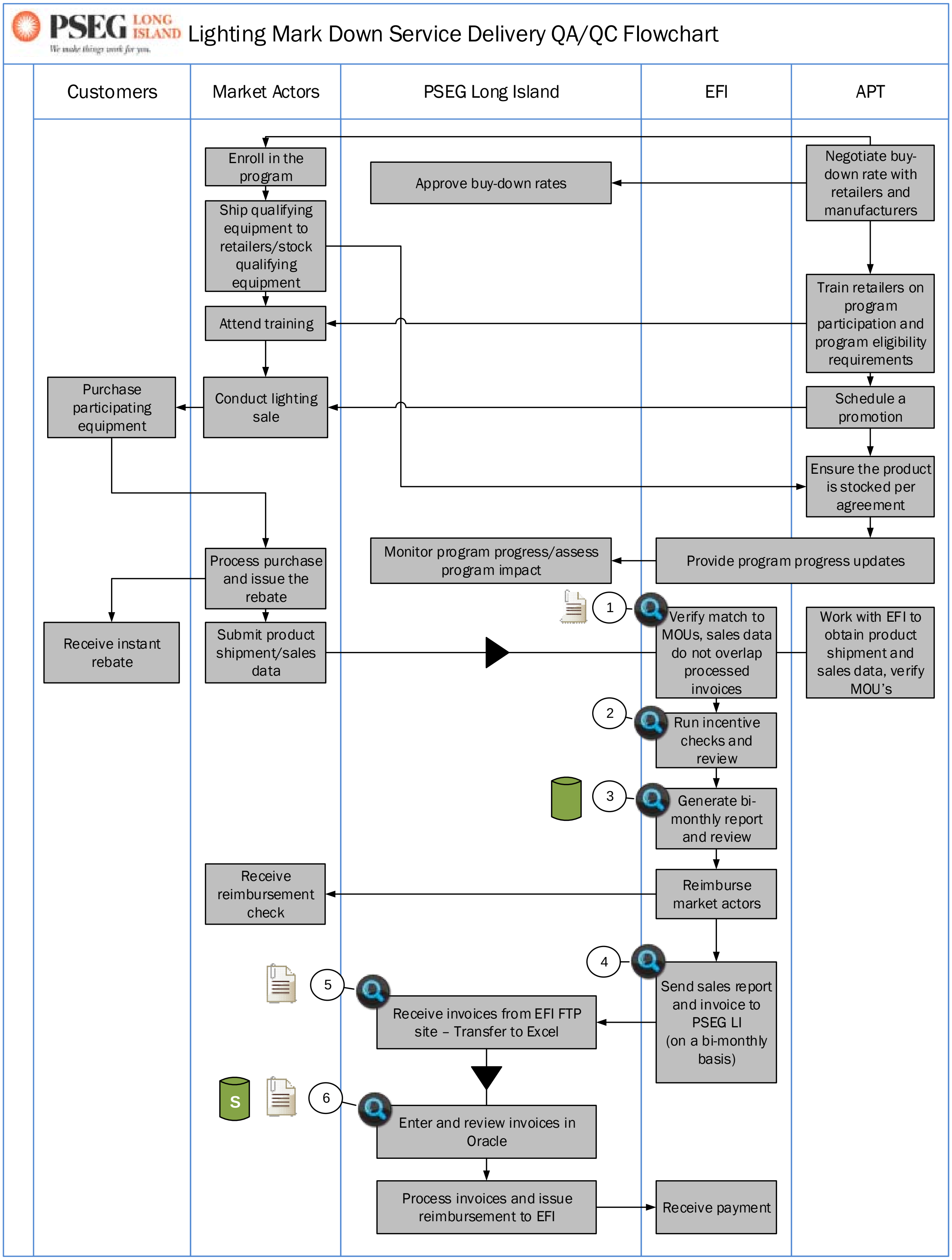
Results of the rebate processing review and approval are recorded as an activity in Siebel. The activity contains the name of the person who entered it, the result of the activity, and the time stamp.

(2) Rebate Processing Program Manager Review and Approval. Depending on the final rebate amount, there might be additional QA/QC steps involved. If the project incentive amount does not exceed $10,000, the rebate processing clerk issues an Accounts Payable memo, at which point the project is considered paid and closed. If the rebate amount is $10,000 or more, the project incentive needs to undergo an approval by the Rebate Processing Manager. Results of this quality check step and approval are recorded as an activity in Siebel. The activity contains the name of the person who entered it, the result of the activity, and the time stamp. It is our understanding that the protocols for what information to check are currently not documented.

(3) PSEG Long Island Manager Review and Approval. Projects with rebates of $100,000 or more, in addition to being reviewed and approved by the Rebate Processing Manager, need to undergo the approval of the PSEG Long Island Energy Efficiency Program Manager for payment. Results of this quality check step and approval are recorded as an activity in Siebel. The activity contains the name of the person who entered it, the result of the activity, and the time stamp. It is our understanding that the protocols for what information to check are currently not documented.

(4) AP Reconciliation Report. The final QA/QC step consists of running an accounts payable reconciliation report, which compares project information on the rebates paid to the rebates issued by the accounts payable department. This step is performed on a monthly basis by the rebate processing Program Manager. All discrepancies are directed to the accounts payable department for correction.

Figure 12-22. EEP Program Lighting Markdown QA/QC Flowchart



(1) Agreement with MOU Review and Duplicative Data Review (EFI). Upon receipt of invoices and/or point of sales (POS) data submitted by retailers or manufacturers (participants) in native format, EFI staff members ensure that the quantities, models and incentives match those specified in the participants' memoranda of understanding (MOUs) with the Long Island Power Authority. (This step is documented in *EFI Incentive Processing Quality Assurance Procedures.*) If incentive levels do not match the MOUs, EFI contacts the participating retailer or manufacturer to confirm that the products were discounted by the correct incentive levels. EFI also checks that invoices do not include sales for which they have already issued incentives. (This step is documented in *EFI Incentive Processing Quality Assurance Procedures.*) If EFI finds any duplicate data, EFI returns the invoice to the retailer or manufacturer and requires a revised invoice, or depending on the time of month, will compensate for the difference by underpaying the upcoming reimbursement. (This step is documented in *EFI Incentive Processing Quality Assurance Procedures.*)

Lighting, Appliance Rebate, and Pool Pump Channels

(2) Incentive Check Review (EFI). Once incentive checks are printed, the EFI Chief Operating Officer reviews these for accuracy while signing them. (This step is not documented.)

(3) Rebate Report Review (EFI). When EFI "closes-out" the program either monthly or more frequently, they generate a report of all approved applications. The electronic file is reviewed by an EFI manager to verify the applications' eligibility. (This step is not documented.)

(4) Participation Report Review (EFI). After checks have been sent, EFI generates an invoice that is reviewed by a manager before it is mailed to National Grid. With approval, the processed-rebate dataset[36] is also loaded onto the FTP site. (This step is not documented.)

(5) Program Manager Review (PSEG Long Island). The PSEG Program Manager (PM) downloads the data from the FTP site upon receiving the invoice. The PM transfers the dataset from EFI's text file format into an Excel worksheet. The PM then compares the invoice quantities to those in the dataset. Any discrepancies are resolved via email with EFI. Product totals are then entered into the EEP Goals Tracker (This step is documented in the Long Island Power Authority's *Processing Invoices—Energy Efficient Products*.)

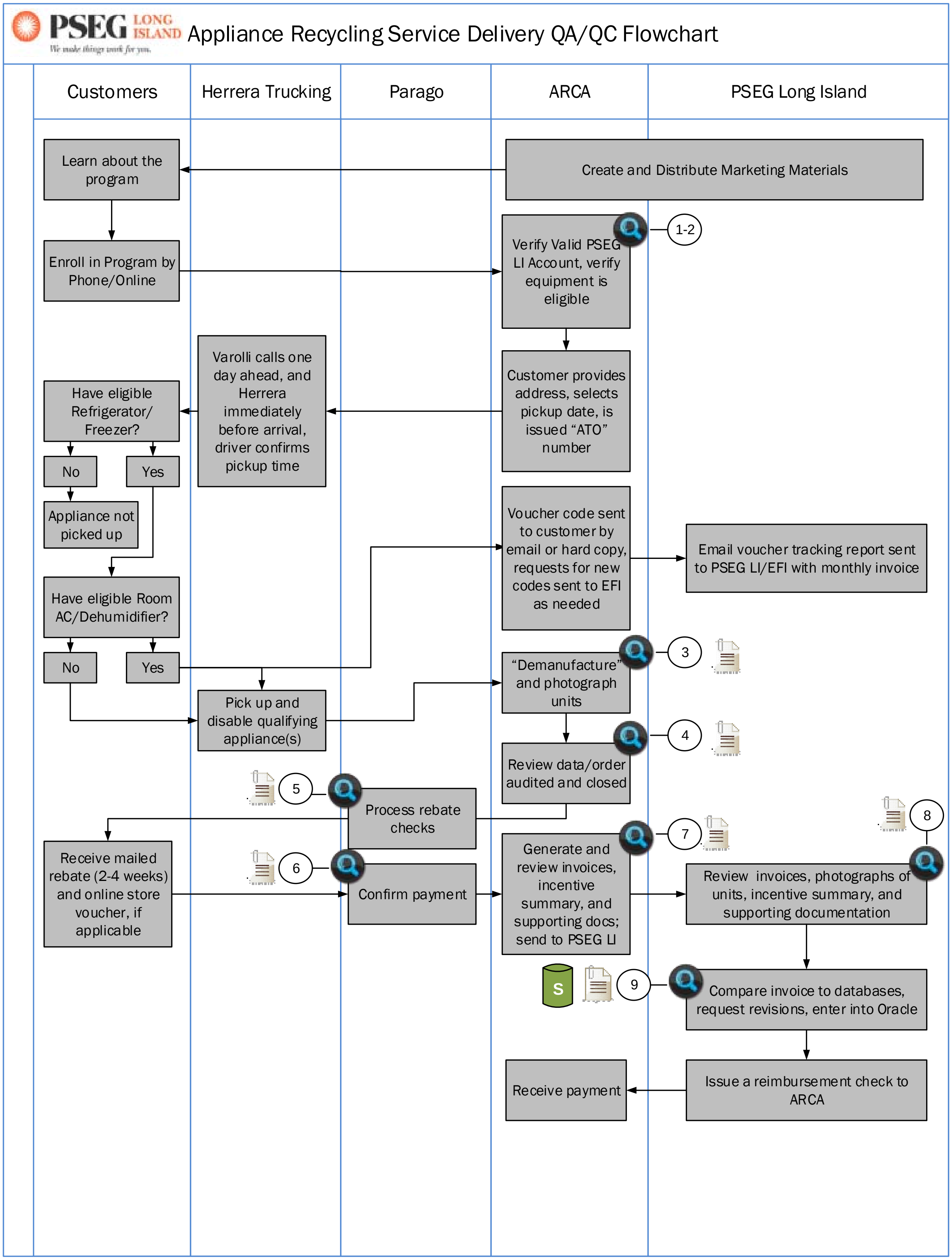
(6) Invoice Approval (PSEG Long Island). Once the PM approves the invoice it is entered into an Oracle database for payment processing. After the PSEG Long Island Manager of Residential Programs reviews and approves the invoice, EFI is sent the reimbursement check and the invoice is catalogued and filed. (This step is documented in the Long Island Power Authority's *Processing Invoices—Energy Efficient Products*.)

In summary, during the processing of participant date, there are between eight and nine different QA/QC checks. The participant data are transferred at three different points before they are is entered into Siebel:

- From paper applications/POS data to EFI's database
- From EFI's database to a report loaded onto the FTP site
- From the FTP site file to an Excel file

[36] Ultimately, this is the text file that is used by the Siebel team.

Figure 12-23. EEP Program Appliance Recycling QA/QC Flowchart



The processing of appliance recycling incentives are subject to nine QA/QC points. To date, we have not received ARCA's QA/QC documentation due to confidentiality concerns on the part of ARCA; however, ARCA representatives have indicated that all QA/QC steps are documented. The description of this process is as follows:

(1) Verification of Participant Eligibility (ARCA). To enroll in the Appliance Recycling Program, customers must verify their PSEG Long Island account number either online or verbally on the telephone. If the customer cannot provide the account number or it is invalid, ARCA contacts PSEG Long Island to provide or validate the information. If the customer is not confirmed as a PSEG Long Island customer, the application is rejected. (It is unclear where this step is documented.)

(2) Preliminary Verification of Appliance Eligibility (ARCA). ARCA's internal database logic flags ineligible units that do not meet the age, size, usage, and quantity qualifications. However, to ensure that their call center representatives are correctly entering the information, ARCA Managers occasional monitor calls. (It is unclear where this step is documented.)

(3) Reconciliation of Appliance Characteristics (ARCA). Upon arrival at the de-manufacturing facility, an ARCA representative photographs the units to document their receipt of the unit and that its characteristics match those recorded. The team also documents any additional information unique to the unit. (It is unclear where this step is documented.)

(4) Data Review (ARCA). It is unclear what type of verification is performed regarding the process of Herrera trucking entering data to ARCA's electronic database. After ARCA has received data, it is reviewed and orders are either audited further and corrected or closed.

(5) Incentive Check Report Review (ARCA). After this stage, ARCA generates an incentive check file. The report and incentive check file are both reviewed before the check file is sent to the subcontractor, Parago, for printing and mailing. (It is unclear where this step is documented.)

(6) Incentive Deposit Reconciliation (ARCA). ARCA makes two efforts to ensure that participants have deposited their incentive checks. If a check has not been deposited, ARCA contacts the customer. After failing at a second attempt to contact the customer, ARCA will transfer funds to the state as unclaimed property. (It is unclear where this step is documented although their compliance with this ensures they are adhering to state law around unclaimed property.)

(7) Participation Data Review (ARCA). Before sending the participant data and invoice to PSEG Long Island, ARCA reviews the materials.

(8) Program Manager Review (PSEG Long Island). After checks have been sent, PSEG Long Island receives the participant data and invoice from ARCA on the FTP site, and additionally a compact disc of the photographs taken of the units at the facility through the mail. The participant data arrive in Excel format.[37] The PM then compares the invoice quantities to those in the dataset. Any discrepancies are managed via email with ARCA. Product totals are then entered into the EEP Goals Tracker (This step is not documented.)

(9) Invoice Approval (PSEG Long Island). Once the PM approves the invoice it is entered into an Oracle database for payment processing. After the Manager of Residential Programs reviews and approves the invoice, ARCA is sent the reimbursement check and the invoice is catalogued and filed.

[37] Ultimately, this is the file that is used by the Siebel team.

(This step is documented in the Long Island Power Authority's *Processing Invoices—Energy Efficient Products*.)

Figure 12-24. EEP Program Appliance Rebate QA/QC Flowchart

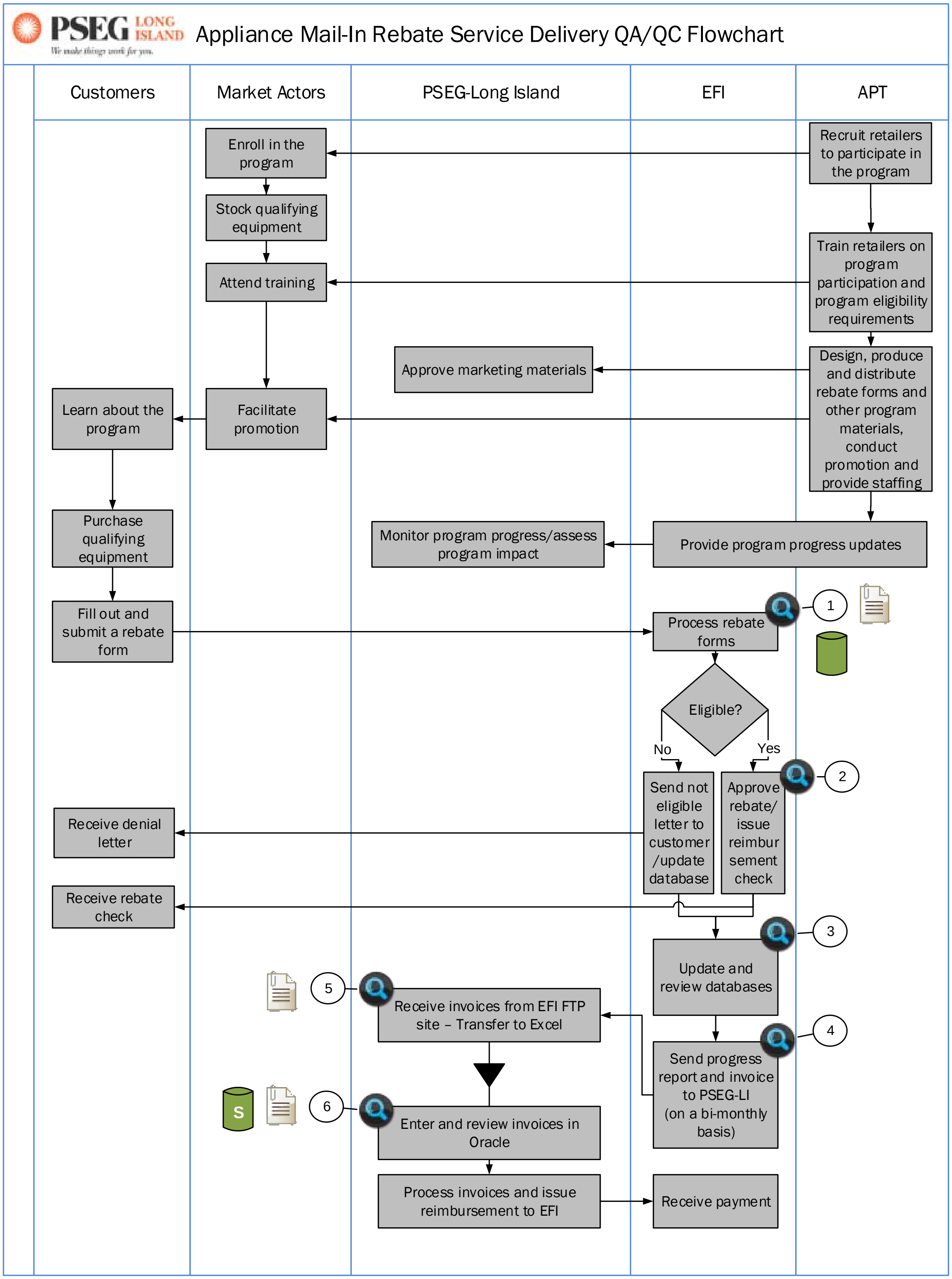
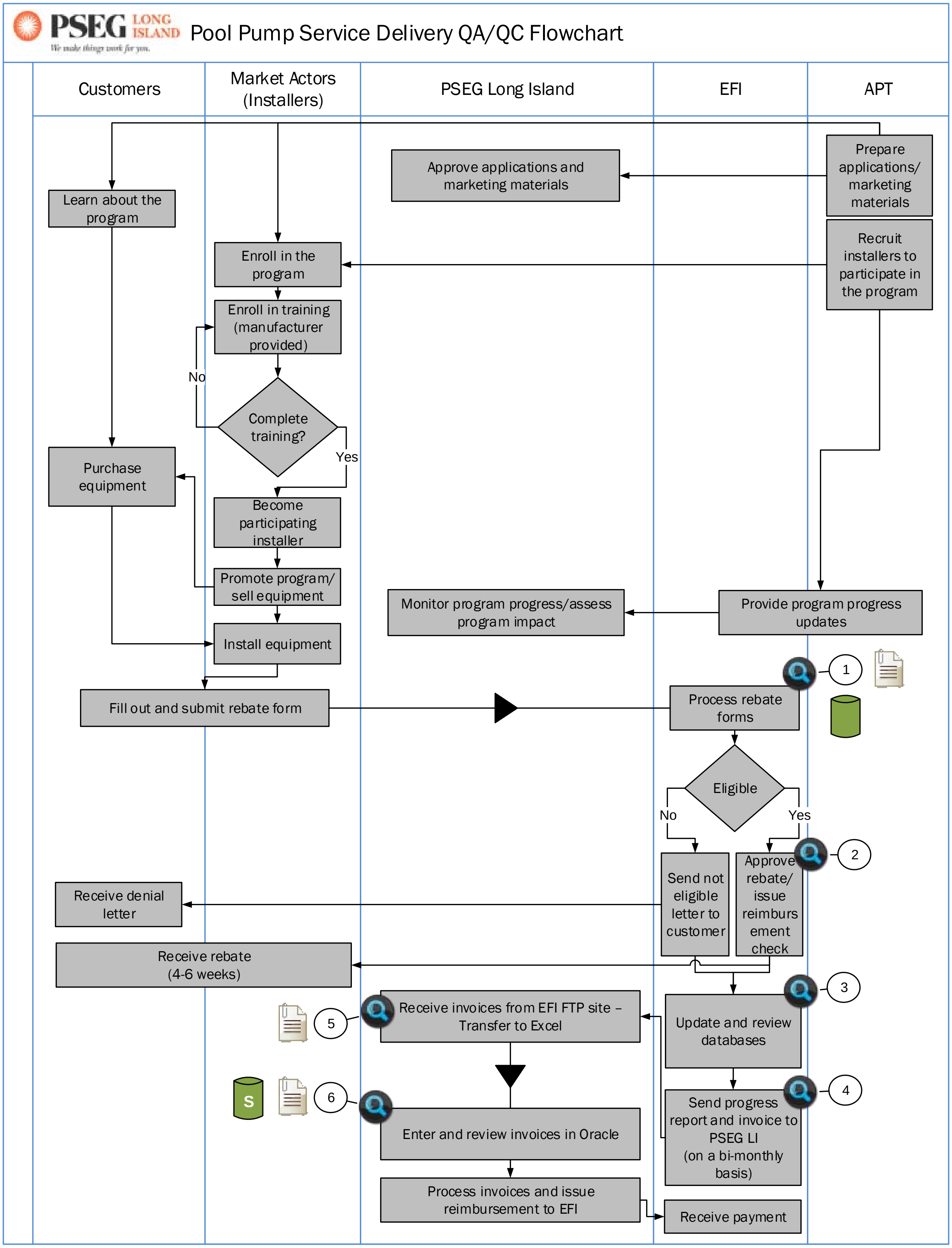


Figure 12-25. EEP Program Pool Pump QA/QC Flowchart



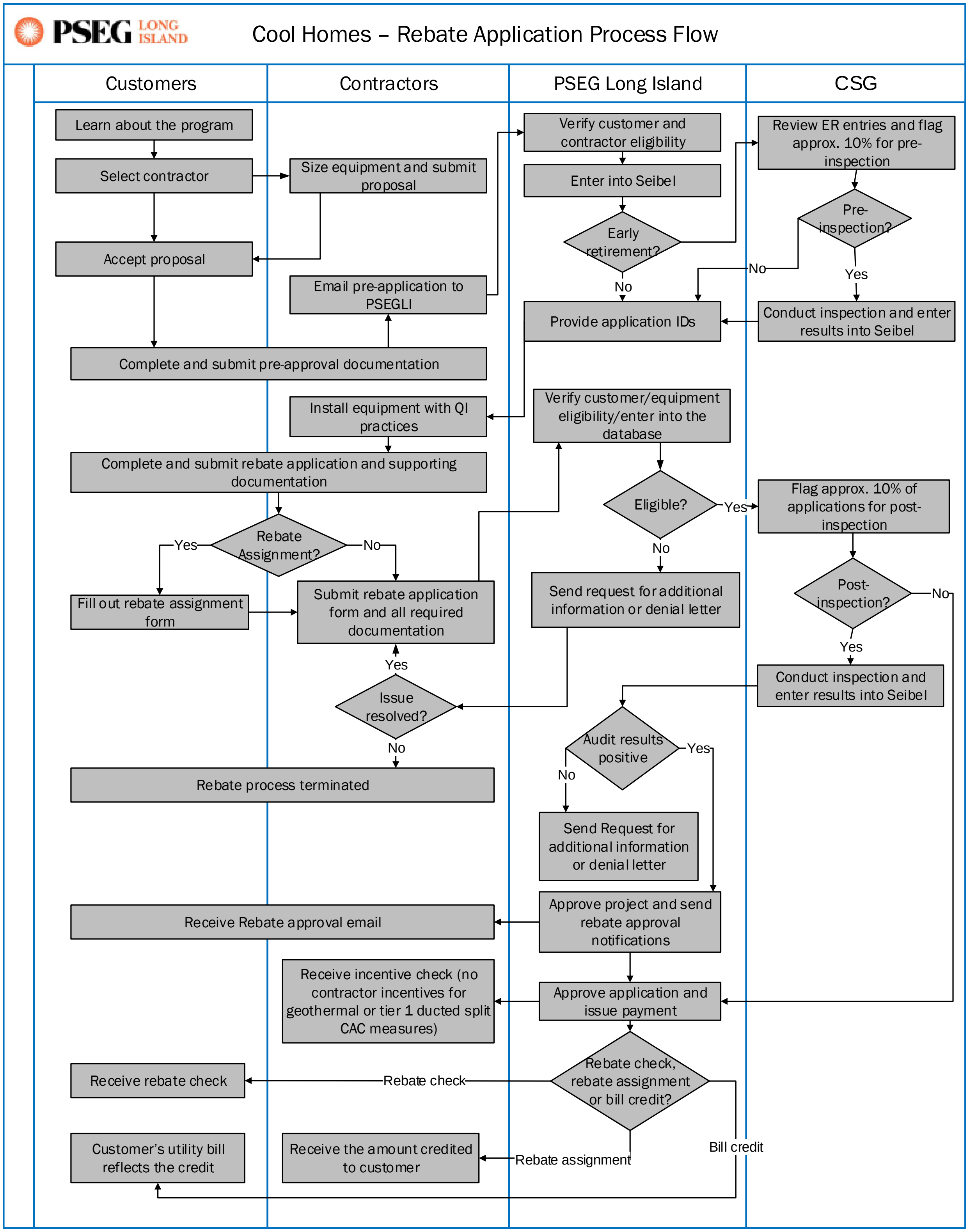
(1) Rebate Processing and Pool Pumps:

Review for Completeness of Materials (EFI). Upon receipt of applications, EFI staff members check that all materials (applications and receipts) have been received. If these materials are incomplete, the team contacts the customer and requests the missing materials. (This step is documented in EFI Incentive Processing Quality Assurance Procedures.)

Verification of Participant Eligibility (EFI). Before entering applications into EFI's program tracking database, the team ensures that the applicants have valid PSEG Long Island account numbers (either with the Long Island Power Authority's data files to which they have access or with the provided customer utility bill). If the account number information is missing or invalid, PSEG Long Island, using the customer database, is contacted to provide or validate the information. If the customer is not a PSEG Long Island customer, the application is rejected. (This step is documented in EFI Incentive Processing Quality Assurance Procedures.) In the case of pool pumps, the team must also ensure that the installer is a certified program installer. This is done manually with EFI cross checking a qualified contractor list provided by Applied Proactive Technologies, Inc. (APT) including those contractors that have completed certification.

Verification of Product Eligibility (EFI). EFI's database has built-in logic to ensure that applications that are entered do not exceed the number of allowed units per customer, are qualifying models, were installed in the PSEG Long Island service territory, and were purchased during eligible dates. (This step is documented in EFI Incentive Processing Quality Assurance Procedures.) If any applications include appliances purchased outside of the eligible dates, EFI contacts PSEG Long Island to determine if the exception can be allowed; if the exception is not permitted, the application will be denied.

Figure 12-26. Cool Homes QA/QC Flowchart



This contains an overview of quality control and quality assurance (QA/QC) procedures and protocols that are currently in place for PSEG Long Island's Cool Homes Program. This overview has been developed based on the review of program materials and interviews with the program staff.

PSEG Long Island's Cool Homes program has the following six quality assurance procedures at each step of program implementation.

(1) Completion of pre-approval documentation. Prior to beginning work on a project, all applicants must complete pre-approval documentation. The pre-approval documentation consists of the first two tabs of the Cool Home's rebate application which is an Excel workbook and can be found on PSEG Long Island's website. The pre-approval documentation consists of the application tab and the worksheet tab. The application form is typically completed in the Excel sheet by contractors, printed, signed by the customer and contractor, scanned, and emailed to PSEG Long Island. This documentation includes the customer name, address, and electric account number which is used to verify eligibility. The worksheet requests information about application type (replacement, new, or early retirement), existing equipment type (if applicable), new equipment type, SEER, EER, and HSPF/COP (if applicable). By entering this information the customer and contractor rebate is automatically populated, reducing error.

(2) Pre-approval documentation review. Upon receipt of an application, PSEG Long Island rebate processing staff review the application for completeness and accuracy. Cool Homes program staff verify both customer and equipment eligibility based on the Cool Homes Program requirements. This QA/QC step is performed automatically through data entry into Siebel. If the equipment does not meet standards of the Cool Homes program, the application process is halted and either a request for more information or a denial letter is sent to the contractor.

(3) Pre-inspection of early retirement. CSG conducts pre-inspections on approximately ten percent of projects to verify that existing equipment is eligible for early retirement. Prior to 2014, CSG utilized Air Conditioning Contractors of America (ACCA) sampling procedures in selecting projects for pre-inspection. However, due to changes in data processing in 2014, CSG now flags applications based on past activity and performance of the contractor, though with less prescribed criteria for selection. If a system fails an inspection, future applications from that contractor will be more frequently selected for inspection.

(4) Rebate application review. Upon receipt of a rebate application, PSEG Long Island rebate processing staff review the application for completeness and accuracy. Cool Homes program staff verify both customer and equipment eligibility based on the Cool Homes Program requirements. This QA/QC step is performed automatically through data entry into Siebel. The application must contain a valid AHRI number which links the equipment model and efficiency. If the equipment does not meet standards of the Cool Homes program, the application process is halted and either a request for more information or a denial letter is sent to the contractor.

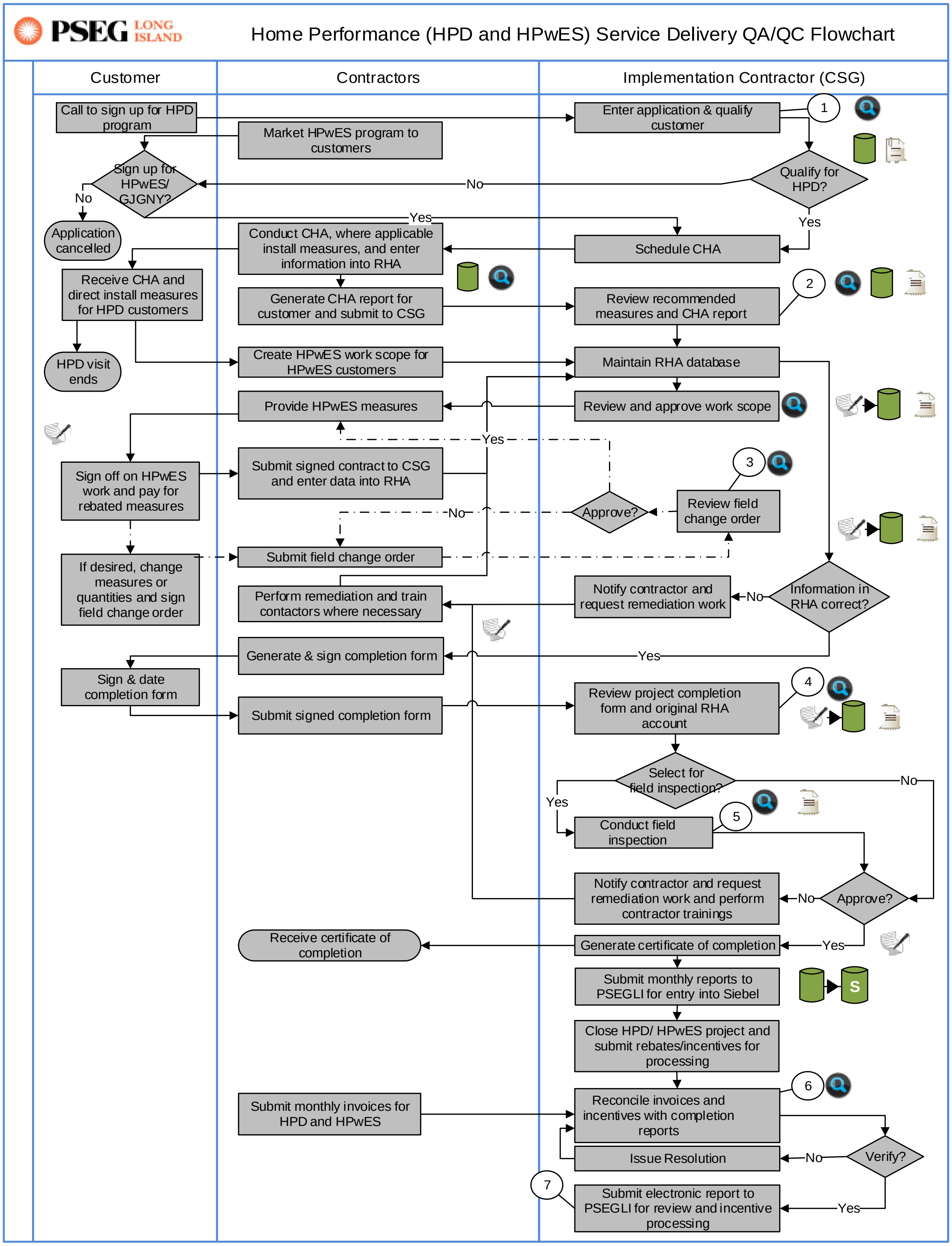
(5) Post-installation inspection. Similar to pre-inspection protocols, CSG conducts post-inspections on approximately ten percent of projects to verify that the information submitted matches the equipment installed. Prior to 2014, CSG utilized Air Conditioning Contractors of America (ACCA) sampling procedures in selecting projects for post-inspection. However, due to changes in data processing in 2014, CSG now flags applications based on past activity and performance of the contractor, though with less prescribed criteria for selection. If the equipment installed does not match the equipment on the rebate application, but the equipment does qualify for the program, or if minor adjustments need to be made, the contractor and customer are notified and may re-submit the application. If the equipment does not meet program requirements, PSEG notifies the contractor and customer of the application termination.

(6) Supervisor application review. In order for an application to be approved and forwarded to accounts payable, the supervisor must verify that the data was entered into the database properly This serves as an important QA step for all applications. The supervisor verifies data entry on key variables such as the ARI#, Model#, Serial#, PSEG Account #, and the type of incentive offering preferred by the customer (i.e., customer check, contractor check, or bill credit).

(7) Manager application review. There is an additional QA/QC procedure for projects receiving $10,000 or more in incentives. For these rare large projects in the Cool Homes Program, the rebate processing manager must check program information and provide the authorizing signature before the application is approved and forwarded to Accounts Payable. This management review step is common to PSEG Long Island's entire Efficiency Long Island Portfolio.

(8) AP Reconciliation Report. The final QA/QC step consists of running an accounts payable reconciliation report, where project information on the rebates paid is compared to the rebates issued by the accounts payable department. This step is performed on a monthly basis. All discrepancies are directed to the accounts payable department for correction.

Figure 12-27. HPwES and HPD Program QA/QC Flowchart



(1) Determination of Customer Eligibility. The first quality assurance step occurs for HPD when Long Island Power Authority customers contact program staff about the program. At this step, CSG staff determines customer eligibility. If the customer meets the program's qualifying criteria – they have CAC – CSG staff enters this information into Real Home Analyzer (RHA) and create a new site record for the customer. Staff also gathers contact information and household information from the customer at this time. Every customer inquiry goes through this process and the procedure is documented.

(*2) Assessment Review and Approval*. Upon completion of the Comprehensive Home Assessment (CHA), the contractor creates a CHA report and submits it to CSG for review. As part of this quality assurance step, two CSG staff members review the report for completeness and also ensure that it is technically correct (i.e., that the information within the report is logical). In addition, CSG staff will review any notes provided by the contractors. If any issues arise, CSG will contact the contractor and request additional information or revisions to the RHA entry for a particular project. This step is documented in the *Summary of CSG's Quality Assurance and Administrative Review Process & Field Inspection Procedures*.

(3) Change Order Review and Approval (HPwES Only). At any point between the job scope review and installation of measures, there could be a need to make adjustments to the contract due to a number of different reasons. In such an event, the contractor submits a change order form to CSG which carries customer's acceptance and signature. A CSG program administrator reviews all aspects of the change orders for eligibility and consistency with program requirements. Formal approval or disapproval of change orders are provided to the contractors. Contractors are required to provide information to the customer detailing any changes to incentive eligibility, or to the total incentive dollars due, at that time the change order is signed. Every change order goes through this process and the procedure is documented in Summary of CSG's Quality Assurance Administrative Review Process & Field Inspection Procedures. This information was also verified in an interview with a program staff.

(4) Project Completion Review and Approval (HPwES Only). After the installation of measures, the contractor submits a completion form to CSG. A completion form has a customer's signature acknowledging the project information (summary of eligible measures installed) reported in the document. Essentially, a customer signature signifies that eh work is complete and meets the customer's expectations. This document also includes all post completion test-out data, A CSG program administrator compares the information contained in this document with the digital information in CSG's system (database) and makes sure that all the measures are on the contract and all the measures are flagged as installed. Based upon this review, the program administrator approves or disapproves the project completion document. This step is document in the Summary of CSG's Quality Assurance and Administrative Review Process & Field Inspection Procedures, and was verified during an interview with a program staff.

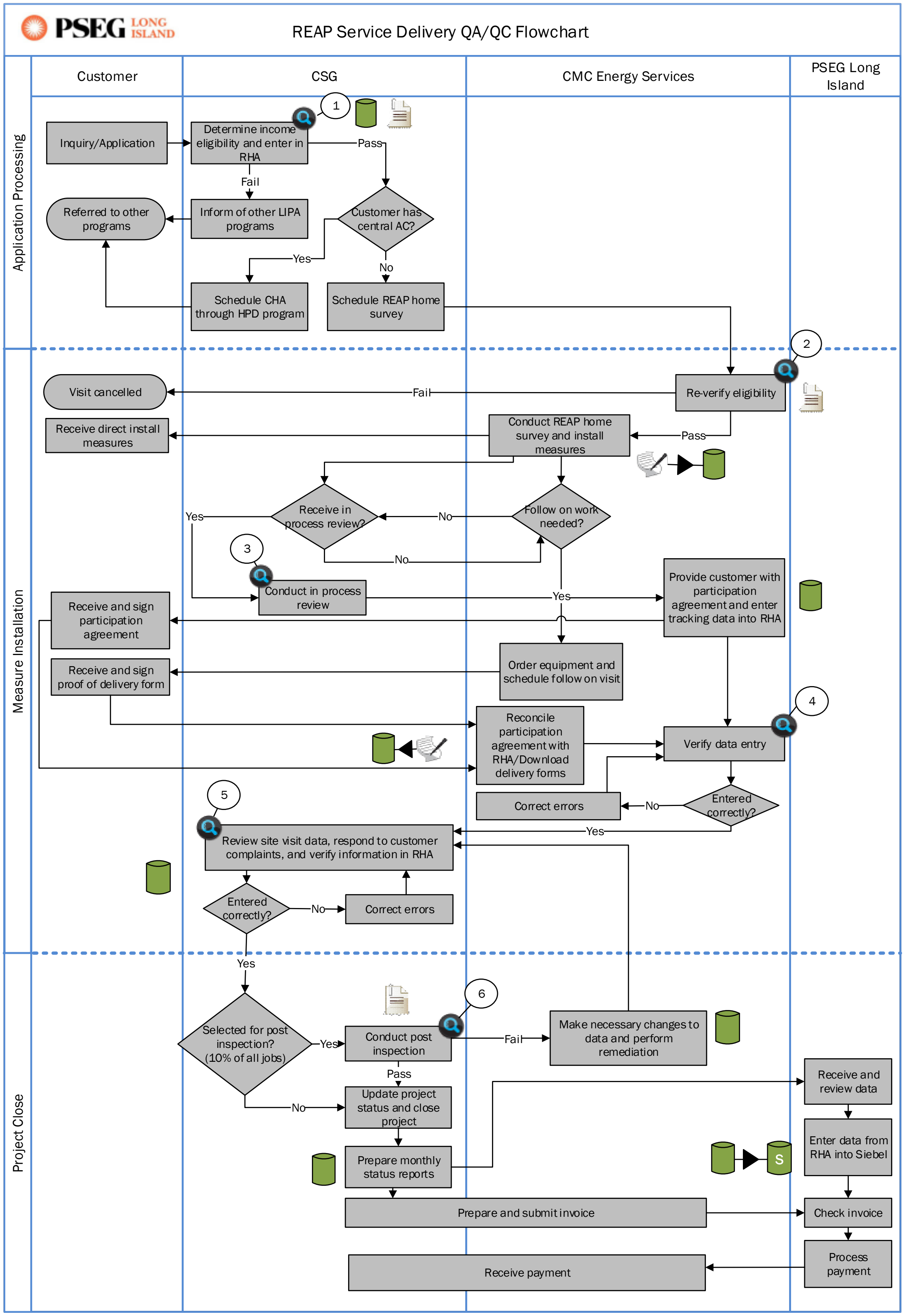
(5) Field Inspection. Once CSG receives the CHA report, staff determines whether they will conduct a field inspection. For HPD visits, this determination is done after CSG receives the CHA report. For HPwES follow-on visits (customers that elect to continue with HPwES work after their HPD visit), this is determined after the review of the completion document. For free-market HPwES only, there are two different points in the process, when a project could be selected for field inspection. The first instance is after CSG receives the CHA report, and the second instance is after the completion of the project completion document. In selecting projects for field inspection, CSG staff pays special attention to the following criteria: (1) whether the project was submitted by a new contractor, (2) whether the project was submitted by a contractor that has not met BPI standards in the past, and (3) whether the project was submitted by a contract who has participated at high levels in the past

month. This step is documented in the *Summary of CSG's Quality Assurance and Administrative Review Process & Field Inspection Procedures*.

(6) Invoice Review. After completion of any field inspections and a determination that the HPD project is complete, participating contractors submit invoices to CSG that are reviewed and matched against project completion reports. This quality assurance steps ensures that the number of jobs that a contractor invoices the program for were actually completed and documented in the program tracking data. We understand that this step is performed by CSG staff, but there is not additional documentation of this process.

(7) Program Manager Review and Approval. Upon receipt of the monthly invoices from CSG, PSEG Long Island staff conducts an extensive review of the original invoices and supporting documentation. After the program manager receives the invoice originals and back-up materials via mail, he or she reviews them to ensure that the customer signed off on the job and that the visit actually occurred. First, the program manager fills out the necessary information to pay the contractor (e.g., date received, submission date etc.) and submits the invoice to a clerk who uses the Oracle system to arrange for payment. The clerk then emails the program manager with information about the invoice and this information is provided to the manager of residential programs for a second review and approval in Oracle. Once approved, the clerk informs account payable that they can issue payment and mails and original copy of the invoice to that department. Our knowledge of this process is based on interviews with program staff.

Figure 12-28. REAP QA/QC Flowchart



Throughout the implementation process of the REAP program, quality assurance is performed at six points.

(1) Determination of Eligibility. The first quality assurance step is performed when PSEG Long Island customers call the program hotline (1-800-263-6786). CSG staff gathers data from the customer related to home heating fuel type, past participation, and household income. If the customer meets income criteria, CSG staff confirms the customer's PSEG Long Island account number via Siebel, as well as their contact information. Every customer inquiry goes through this process and the procedure is documented in detail in the PSEG Long Island REAP Scripts. The information collected is entered into the audit tab of the Real Home Analyzer (RHA) database that CSG maintains. This step occurs in real-time. As a result, there are no timing expectations associated with its completion.

(2) Confirmation of Eligibility. The second quality assurance step is performed during the home survey visit. Upon arrival at the customer's home, CMC staff confirms customer eligibility through verification of hard copy documentation. In particular, customers must provide one of the following documents: child support or court order, department of public welfare information, employer verification letter, pay stubs from the prior two months, social security disability form, supplemental security income award letter, social security retirement form, social security survivors benefit form, unemployment award letter, veteran's benefits award letter, previous year W-2 or 1040 SSE form, or workman's compensation award letter. Documentation for this procedure exists in the auditor binder: revision one, effective July 1, 2011, page 1.1. Confirmation of eligibility is documented in the RHA database after the visit is completed. Similar to the determination of eligibility, this step occurs in real-time and does not require documented timing expectations.

(3) In-Process Review. CSG identifies a sub-set of homes for "in-process review," which involves a CSG staff person following the contractors as they perform the initial site visit. This step occurs at the same time as the initial site visit, and should not affect project timing. The staff member performing the review visually inspects the work of contractors to make sure they have identified all of the measure installation opportunities, as well as any threats to the health or safety of the occupant. There is no defined procedure for selecting which homes receive the in-process review, and there is no set number of homes that must be visited each year. CSG prioritizes conducting more reviews based the failure rate of post-installation inspections. If CSG begins seeing a higher fail rate, or the contractor is new to the program, the frequency at which the in-process reviews occur will increase. Presently, CSG has reduced the number of reviews based on the high performance of CMC on post-installation inspections. The procedures for determining and conducting in-process reviews are not documented, and the RHA database does not track which projects receive this type of review.

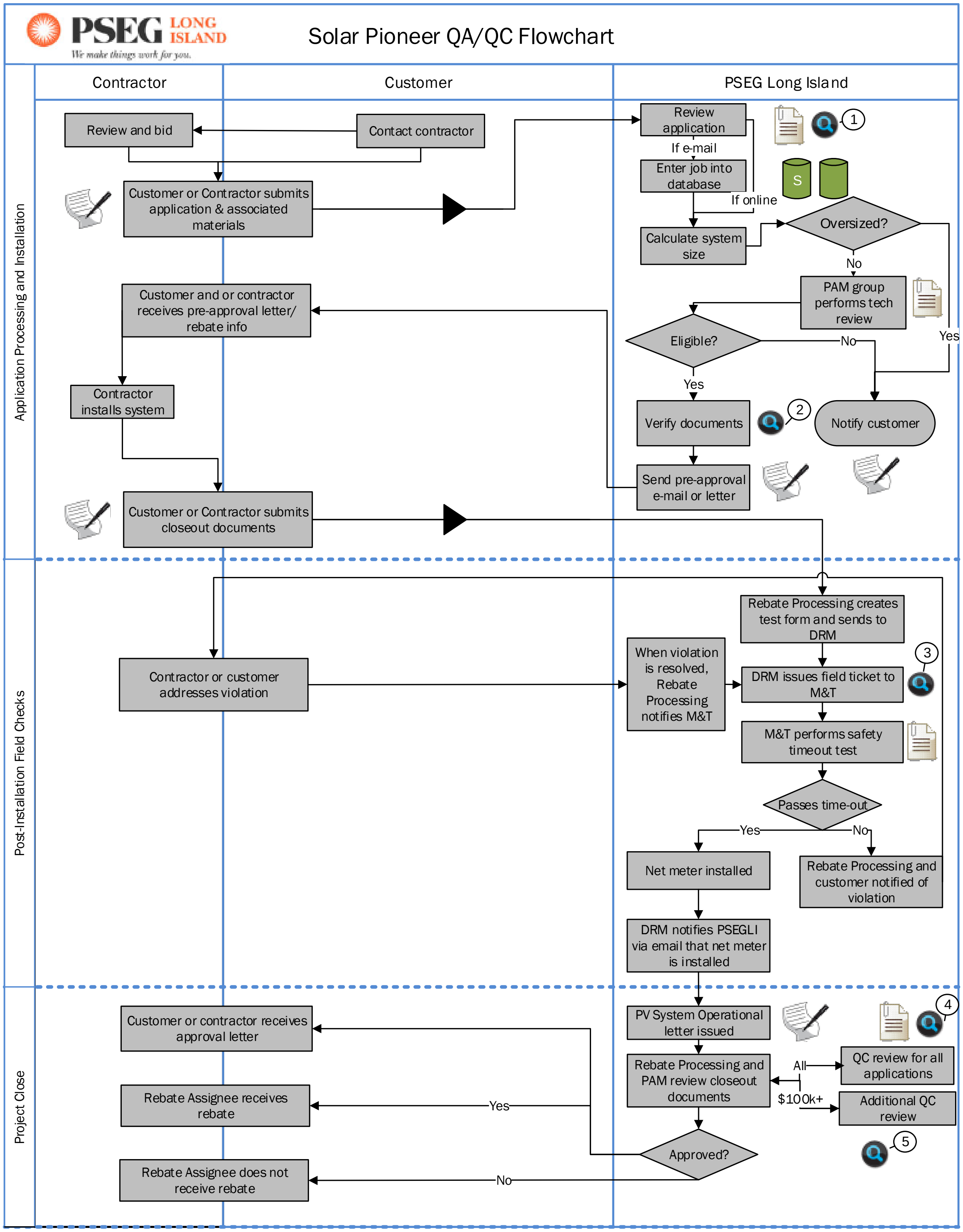
(4) CMC Data Entry Review. CMC staff reviews data entered into the RHA database after site visit completion. This represents the next quality assurance step. More specifically, staff reviews the RHA "jump screen," where an icon is displayed next to each section of the application with a colored light indicating where the system has flagged potential inconsistencies within the data (e.g., a green icon indicates that there are no inconsistencies and data is entered correctly). If there are issues identified on this screen, staff members will review those portions of the application data in greater detail to determine what the issue is. Based on this review, staff reviews database entries and makes appropriate changes as needed. Given that the paper documents completed on-site are not collected and stored for every project, staff does not check every field in the database against the hard copy forms. No formal timing expectations are included in this step. Overall, there is no defined procedure for reviewing entries, and there is no documentation for this QA/QC step.

(5) CSG Data Review. Upon receipt of project data from CMC, CSG staff reviews the project data for all submitted projects. As part of this review, CSG confirms that all measures are eligible under the program guidelines. The CSG program coordinator confirms that the participation agreement form is

signed by the customer, the health and safety form is complete for direct install projects, and the proof of delivery form is complete for projects with refrigerator replacement. Any errors are highlighted and CMC is notified to make the appropriate changes. There are no formal timelines documented for this step and interviews with program staff indicate that there are no concerns around the speed with which this review takes place. This procedure is not currently documented for REAP. However, the program manager indicated that the procedures used match those implemented for the Home Performance Direct and Home Performance with ENERGY STAR® programs also administered by CSG. Documentation of procedures for those programs is located in the *"Summary of CSG's Quality Assurance Administrative Review Process & Field Inspection Procedures for the Long Island Power Authority's Home Performance with ENERGY STAR® and Home Performance Direct Programs, 2012."*

(6) Post-Installation Inspection. CSG performs a series of targeted post-installation inspections after the initial site visit. CSG prioritizes projects where there is any question about the validity of the data provided by CMC, or if the subcontractor performing the inspection is new to the program. This procedure is not currently documented for REAP. However, the program manager indicated that the procedures used match those implemented for the Home Performance Direct and Home Performance with ENERGY STAR programs also administered by CSG. Documentation of procedures for those programs is located in the *"Summary of CSG's Quality Assurance Administrative Review Process & Field Inspection Procedures for the Long Island Power Authority's Home Performance with ENERGY STAR® and Home Performance Direct Programs, 2012."* Project data finalized as a result of the inspections are documented in the RHA and Siebel databases.

Figure 12-29. Solar Pioneer Program QA/QC Flowchart



Key – PAM: Power Asset Management, DRM: Distributed Resource Management, M&T: Meter & Test, ELI: Efficiency Long Island

PSEG Long Island's Solar PV program (consisting of both Solar Pioneer and Solar Entrepreneur) has the following five quality assurance procedures at each step of program implementation.

(1) Initial Application Review. Upon receipt of an application, PSEG Long Island Rebate Processing staff review the application for completeness and accuracy. PSEG Long Island Solar PV program staff verifies both customer and equipment eligibility based on the applicable program requirements (Solar Pioneer and Solar Entrepreneur) listed on the application. The clerk inputting the application uses a checklist to make sure that all the proper documents and information are included. The application can also be submitted on-line, which automatically creates an entry in the Siebel database, removing the need for a clerk to input the application information.

> <u>Equipment Eligibility</u> - The program requires that all inverters are on the NYS PSC certified equipment list and that all solar panels are UL approved. When reviewing the application, the rebate processing staff calculates the system size by evaluating it in PSEG Long Island's Solar Clean Power Estimator, which is available on PSEG Long Island's website. When a system meets the requirements listed above, the system's characteristics are sent to PSEG Long Island's Power Asset Management (PAM) to perform a technical review to ensure that it can be tied into PSEG Long Island's electrical distribution grid. Finally, the PSEG Long Island Rebate Processing staff ensure that all proposed systems meet a minimum efficiency level. The proposed system must have an expected output of at least 80% of the same system optimally oriented south with a 34 degree tilt.

> <u>Customer Eligibility</u> – The Rebate Processing staff confirms that the customer has an electric account with PSEG Long Island by verifying the customer name and account number supplied on the application. The Rebate Processing staff also verifies that the customer has not met the kW limit (i.e. 10 kW for residential, 50 kW for commercial), and that they are installing only up to 105% of their previous year's annual kWh usage.

If the application review or PAM review is missing information, the Rebate Processing staff notes this in Siebel, which will send an automatic email to the appropriate customer contact. When the status is changed to "Missing Info," the "Application on Hold" checkbox will be checked and the "Reason on Hold" field will be automatically populated. These steps, performed on all applications, are detailed in the "Request for Program Tracking Data (Solar Pioneer Program)" document and the "Siebel Training Doc – Solar Automation" document. Additionally, as part of his day to day responsibilities, the program manager visually reviews the application summaries and looks for anomalies. If an issue with the data surfaces, it is sent to the Siebel team for review and correction, if needed.

(2) Document Verification. After the Rebate Processing clerk and PAM perform their application reviews, the application and supporting documentation are reviewed by the Rebate Processing Manager. Assuming the application and supporting documentation are complete, the Rebate Processing Department sends a pre-approval letter to the customer and contractor (if applicable).

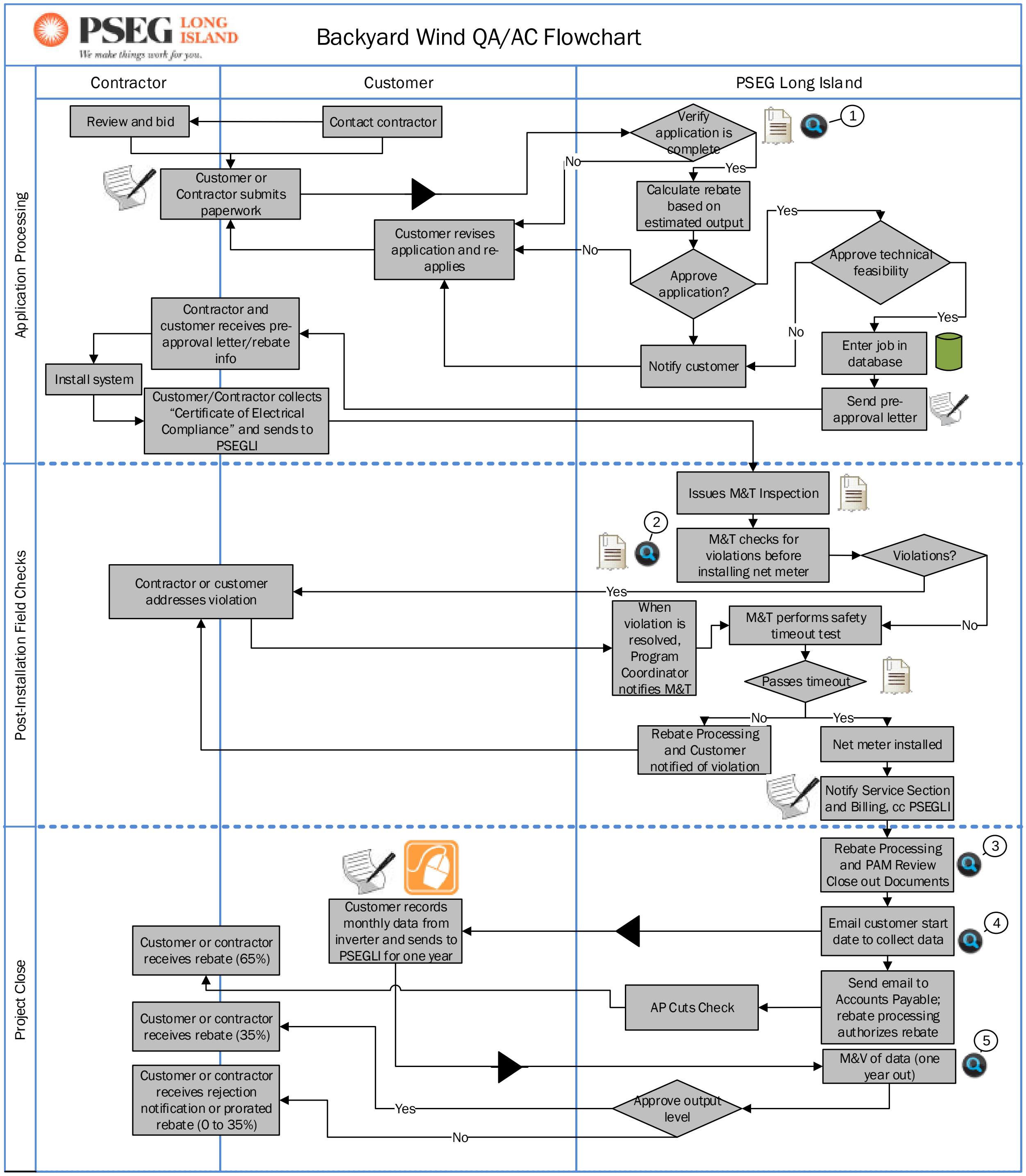
(3) Installation Verification. PSEG Long Island's Meter & Test (M&T) department performs an installation verification prior to installing the customer's net meter. They verify the make and model of the inverters installed and the quantity of solar modules. M&T also performs a safety timeout (Loss of Utility) test to ensure functionality of the system. The information collected and verified is entered on the "Inspection Form". If the equipment is verified and the system passes the timeout test then the net meter is installed; if not, M&T informs Rebate Processing and the customer of the violation.

(4) Review of Closeout Documents. After the net meter is installed, the Rebate Processing department reviews the project's closeout documents to verify that they contain the proper documentation and that the equipment on the application was actually installed. This information is

entered into Siebel. The application and rebate are then reviewed by the clerk, the Rebate Processing Manager, and PAM before the payment is sent and the application is closed. Results of the rebate processing review and approval are recorded as an activity in Siebel. The activity contains the name of the person who entered it, the result of the activity, and the time stamp.

(5) Program Manager Review and Approval. Projects receiving rebates of $100,000 or more receive an additional QA/QC procedure. For these rare large projects in the Solar PV Program, the manager must check program information and be the authorizing signature before the application is approved and forwarded to Accounts Payable. This management review step is common to all of PSEG Long Island's Efficiency Long Island Portfolio. Results of this quality check step and approval are recorded as an activity in Siebel. The activity contains the name of the person who entered it, the result of the activity, and the time stamp.

Figure 12-30. Backyard Wind Program QA/QC Flowchart



Key – PAM: Power Asset Management, DRM: Distributed Resource Management, M&T: Meter & Test, ELI: Efficiency Long Island

PSEG Long Island Backyard Wind program has the following five quality assurance procedures at each step of program implementation.

(1) Initial Application Review. Upon receipt of an application, the Long Island Power Authority Rebate Processing staff review the application for completeness and accuracy. PSEG Long Island Backyard Wind program staff verifies both customer and equipment eligibility based on the applicable program requirements listed on the application. The clerk inputting the application uses a checklist to make sure that all the proper documents and information have been submitted. This checklist is also available for the customer's reference on PSEG Long Island's website.

> Customer and Site Eligibility – The Rebate Processing staff confirms that the customer has an electric account with PSEG Long Island by verifying the customer name and account number supplied on the application. The Rebate Processing staff also verifies that the customer is installing only up to 105% of their previous year's annual kWh usage.
>
> Equipment Eligibility - The program requires that all inverters are on the NYS PSC certified equipment list and that all wind systems are UL approved. Applications must include an interconnection agreement form, a "one-line" diagram (listing the components) of the wind system, expected performance-based analysis and production graphs, a site survey, and a signed installer contract. When a system meets the requirements listed above, the Rebate Processing department sends the system's characteristics to PSEG Long Island's Power Asset Management (PAM) to perform a technical review to ensure that it can be tied into PSEG Long Island's electrical distribution grid and create a Parallel Generation Agreement (PGA). Rebate Processing then sends the PGA and pre-approval letter to the customer and contractor.

If the application review or PAM review is missing information, the program staff sends a "Missing Info" letter and email to the customer and contractor to collect this information.

(2) Net Metering Verification. After the contractor installs the system, PSEG Long Island's Meter and Test department installs the net meter. To install the net meter, the customer/contractor must first collect the "Certificate of Electrical Compliance" from an electrical inspector and send it to the Rebate Processing department. The Rebate Processing department then issues a net Meter and Test (M&T) form. PSEG Long Island's Meter & Test department performs an installation verification prior to installing the customer's net meter. They verify the make and model of the inverter and turbine generator installed. M&T also performs a safety timeout (Loss of Utility) test to ensure functionality of the system. The information collected and verified is entered on the "Inspection Form". If the equipment is verified and the system passes the timeout test then the net meter is installed; if not, M&T informs Rebate Processing and the customer of the violation.

(3) Review of Closeout Documents. After the net meter is installed, the Meter and Test department notifies the Service Section and Billing department. The Rebate Processing collects the PGA and invoices from the customer or contractor and reviews these closeout documents to verify that they contain the proper documentation and that the equipment on the application was actually installed. These documents include the customer's taxpayer identification number, if applicable, the before and after pictures of the site, relevant permits, and other required documentation identified on the application checklist. The application and rebate are then reviewed by clerk and Rebate Processing Manager before the payment is sent.

(4) Program Manager Review and Approval. Projects receiving rebates of $100,000 or more receive an additional QA/QC procedure. For these rare large projects, program the manager must check program information and be the authorizing signature before the application is approved and forwarded to Accounts Payable. This management review step is common to all of PSEG Long Island's Efficiency Long Island Portfolio.

(5) Measurement and Verification of Output. Upon successful review of the closeout documents, customers receive 65% of the approved rebate and the program claims 100% of demand savings and 65% of energy savings. The customer's monthly kWh data is recorded from the inverter and sent to the PSEG Long Island Backyard Wind program for 12 months following installation, usually by the contractor or manufacturer but sometimes by the customer. The program performs random field checks to verify the inverter readings, although this is formalized. At the end of the 12 month period, if the recorded kWh output level matches that of the calculated output, the customer receives the remaining 35% of the rebate amount. If the actual output is less than the calculated output, the program provides a prorated share of the 35%.

13. Detailed Methods

13.1 Overview of Data Collection

This report documents the findings from the 2013 evaluation of the Long Island Power Authority's portfolio of Efficiency Long Island and Renewable Energy programs. The Evaluation Team used a variety of data collection methods to compile the primary data required to support the effort, including in-depth interviews with program staff and trade allies, quantitative telephone surveys with program participants and non-participants, and on-site data collection visits. Table 13-1 lists the primary data collection efforts associated with the evaluation of each program.

Table 13-1. Primary Data-Collection Efforts in 2013 Evaluation

Program	In-Depth Interviews		Telephone Survey		On-Site Visits
	Program Managers	Retailers / Contractors/ Stakeholders	Participants	Non-Participants	
CEP – Custom	X				
CEP – SBDI	X				
CEP – Prescriptive / Existing Retrofit	X				
Energy Efficient Products	X	X		X	X
Cool Homes	X	X	X	X	X
HPD / HPwES	X				
REAP	X				
ENERGY STAR® New Homes	X	X			
Solar Pioneer	X				
Solar Entrepreneur	X				
Solar Thermal	X				
Backyard Wind	X				

Quantitative Telephone Surveys

We used quantitative telephone surveys to gather structured data from relevant populations to support the assessment of Efficiency Long Island programs. We completed all telephone surveys using Computer-Assisted Telephone Interviewing (CATI) software. Using CATI ensures data consistency and virtually eliminates the chance of an interviewer skipping a question or entering a response that is outside the range of valid responses. Our use of in-house resources and CATI software allowed us to apply the most rigorous Quality Assurance/Quality Control (QA/QC) protocols possible to all quantitative data sets prior to analysis.

In-Depth Interviews

In-depth interviews with key constituents played an important role in gathering the information needed to support this analysis. In-depth interviews are less structured than quantitative surveys, allowing for greater flexibility. This method allows respondents to talk in greater detail about their experience or perspective while still shaping the discussion so that we collect the important, relevant, and necessary information. The flexible format also allows us to uncover other information we might not have otherwise considered, adding richness to the data.

We conducted a number of interviews with program staff and trade allies, including contractors, HVAC distributors, and retailers, as summarized below.

On-Site Data Collection

For the EEP In-home Study, we recruited audit participants and completed visits to homes to collect information on lighting, secondary refrigerators, and pool pumps. During each home visit, the auditor recorded the quantity and type of lighting installed in each room inside the home as well as lighting installed on the exterior or in the garage. The auditor also recorded lighting found in storage but not currently in use. As part of the in-home lighting study, we also asked participants to complete a short paper survey addressing past and future lighting purchase behaviors and awareness of lighting market-related factors. Auditors also collected data on refrigerators, freezers, and pool pumps, where applicable.

As part of the Cool Homes market analysis research, we identified and recruited qualifying non-participants for site visits during the non-participant telephone survey. Technicians visited each of the non-participating homes to confirm that the systems qualified and to obtain the quantity and make and model of non-program CAC systems. From this field data, we determined SEER, EER, and capacity for these systems. We also leveraged data collected during the EEP in-home audits to determine the penetration of CAC equipment types on Long Island.

Program-Specific Sample Designs

This section provides a detailed description of the sample design for each quantitative data collection effort, including telephone surveys and on-site visits by program.

For 2013, we conducted surveys with program participants for only the Cool Homes program and with non-participants for the Cool Homes market assessment and the EEP In-home Study recruiting.

We calculated response and cooperation rates for all surveys using the standards and formulas set forth by the American Association for Public Opinion Research (AAPOR).[38]

- The response rate is the number of completed interviews divided by the total number of potentially eligible respondents in the sample. Response rates can vary substantially and often are different for different populations. The response rates for the surveys we conducted for this evaluation are similar to those of other surveys conducted in the energy evaluation industry.

[38] Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys, AAPOR, 2011. http://www.aapor.org/Standard_Definitions/3049.htm.

- The cooperation rate is the number of completed interviews divided by the total number of eligible sample units actually contacted. In essence, the cooperation rate gives the percentage of participants who agreed to complete an interview out of all of the participants who answered the telephone and heard our request for an interview.

13.2 Overview of Analytical Methods

Table 13-2. Primary Analytical Methods Used in 2013 Evaluation

Program	Qualitative Analysis of In-Depth Interviews/ Focus Group	Quantitative Analysis of Telephone and On-site Survey Data	Descriptive Statistics (Means, Frequencies, etc.)	Secondary Data Review	Billing Analysis	Engineering Review of Algorithms	Engineering Desk Review of Projects
	Process/ Impact	Process/ Impact	Process/ Impact	Process	Impact	Impact	Impact
CEP	X					X	X
EEP	X	X	X			X	
Cool Homes	X	X	X	X		X	
HPwES / HPD	X				X	X	
REAP	X				X	X	
New Homes	X					X	
Solar PV	X					X	
Solar Thermal	X					X	
Backyard Wind	X					X	

The remainder of this section describes key analytic approaches used to develop the findings presented throughout the report.

13.3 Commercial Efficiency Program

We performed two specific data collection activities within the Commercial Efficiency program:

1. In-depth interviews with program staff to understand programmatic changes and record program implementation processes
2. Engineering desk review to assess gross impacts

Next we describe each effort in greater detail.

Program Staff Interviews

As part of the 2013 Commercial Efficiency program evaluation, we conducted in-depth interviews between February 11 and March 25 2014 with a total of five program staff members at PSEG (previously with Long Island Power Authority) responsible for the implementation of the Commercial Efficiency Program. The interviews were designed to understand programmatic changes made in 2013 as well as planned changes for 2014. As part of the interviews, we asked a series of questions aiming at updating the program implementation and QA/QC models.

Engineering Desk Reviews

In 2013, the Evaluation Team performed two types of desk reviews: 1) review of Siebel data and calculation of savings using engineering algorithms, and 2) review of a sample of projects and calculation of savings for the sample using detailed information from each sampled project. For custom projects, we applied the most recent realization rates (from 2011 and 2012 M&V) to the 2013 projects.

We used Siebel data and engineering algorithms to calculate all prescriptive measures except for lighting and performance lighting. The Evaluation Team used engineering desk reviews of a sample of projects to determine ex post savings for four different components of the Commercial Efficiency Program: 1) Small Business Direct Install (SBDI), 2) Existing Retrofit Lighting, 3) Existing Retrofit Non-Lighting, and 4) Prescriptive Lighting and Performance Lighting projects. The engineering desk review of a sample of projects as opposed to the population is necessitated by inability to automatically extract project-specific information for a population of projects.[39]

All evaluations that include sampling have inherent levels of uncertainty in the estimates based solely on the fact that we are only assessing a portion of the population.[40] We can calculate this sampling error using the variability of savings seen from a probability-based sample design. In this type of design, each item in our sample frame has equal probability of being chosen for inclusion in our sample and being further assessed. However, certain sample designs require larger numbers to be included in the sample to reach the level of certainty desired. The Dalenius-Hodges technique is a statistical technique that provides optimal stratification of a population to enable reduction in sample size while maintaining statistical precision.

We used a stratified random sample design to draw samples for the Prescriptive Lighting and Performance Lighting, Existing Retrofit Lighting, and Existing Retrofit Non-Lighting projects. In the case of the SBDI program component, we used a simple random sample. In all other cases we used the Dalenius-Hodges technique to determine appropriate stratum for each sample frame, and the Neyman allocation method to obtain optimal samples by strata. We detail this process below. Following, we provide information on the samples that we drew for each of the Commercial Efficiency Program components.

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[39] Detailed data that is useful for an engineering analysis is stored in Siebel as attachments and savings are calculated outside of Siebel. The Siebel system contained a project gross and net total. We used this information at the project level to pull our sample by demand savings for each component.

[40] We note that all evaluations contain levels of uncertainty, some of which can be calculated (e.g., sampling error, measurement error for engineering instruments) and some which cannot (e.g., nonresponse in surveys).

Determination of Strata Boundaries

The Dalenius-Hodges method begins with the creation of numerous and narrow strata. Within each strata, the frequency of coupons within each strata, f(y), is calculated. Next, the square root of f(y), $\sqrt{f(y)}$, is calculated and the cumulative of $\sqrt{f(y)}$ is formed. The total of cumulative $\sqrt{f(y)}$ is then divided by the number of desired strata to determine the division points on the cumulative $\sqrt{f(y)}$ scale.

The above rule assumes equal widths d for the class intervals, and it must be modified when the class intervals have variable widths d_y. The approach recommended by Kish[41] is to multiply the f(y) by the width the interval, take the square root of this value, and cumulate the values $\sqrt{d_y f(y)}$. Finally, as in the above case, the total of cumulative $\sqrt{d_y f(y)}$ is then divided by the number of desired strata to determine the division points on the cumulative $\sqrt{d_y f(y)}$ scale.

Optimal Allocation

Once strata boundaries have been determined, an allocation scheme is used to estimate the population mean with the lowest variance for a fixed total sample size n under stratified random sampling. Such a scheme is the Neyman allocation as described in Cochran.[42]

$$n_h = n \frac{N_h s_h}{\sum N_h s_h} \qquad (1)$$

where N_h = the total number of units in stratum h

n_h = the number of units in the sample of stratum h

n = the total number of units in the sample across all strata

s_h = the variance within stratum h

This formula for optimal allocation may produce an n_h in some stratum that is larger than the corresponding N_h. This problem can arise in the plan for the verification of rebate program savings since the overall sampling fraction is large and some strata are much more variable than others. If the original allocation gives, for example, a n_1 that is greater than N_1, then equation 1 is revised as follows:

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[41] Kish, L. (1995). Survey Sampling. Wiley Classics Library Edition.

[42] Cochran, W. G. (1977). *Sampling Techniques.* Hoboken: John Wiley & Sons, Inc.

$$n_h = (n - N_1) \frac{N_h s_h}{\sum_{2}^{L} N_h s_h} \quad (2)$$

If the original allocation gives, for example, an n_1 that is greater than N_1 and an n_2 that is greater than N_2, then equation 2 is revised as follows:

$$n_h = (n - N_1 - N_2) \frac{N_h s_h}{\sum_{3}^{L} N_h s_h} \quad (3)$$

Using the approach just described, the sample design for all of our samples were expected to provide statistically valid impact results at least at the 90% confidence level +/- 10% for the projects overall based on demand.

Engineering Review Sample Design

As previously mentioned, we used a simple random sample design to draw a sample of the SBDI projects. Given the similarity of the SBDI projects in terms of savings, we did not see a need to employ the Dalenius-Hodges technique. The table below provides detail on the total population and sample size for the SBDI component of the Commercial Efficiency Program.

Table 13-3. Commercial Efficiency Program SBDI Engineering Review Sample Design

	Projects in Population*	Total Ex Ante Savings (kW)	Projects in Sample
Total	1,689	50	20

* Note that the final count of projects for SBDI is slightly higher. At the time when the sampling design took place, the reconciliation process for CEP was undergoing. As a result, not all projects were a part of the sample frame.

The sample design for the Prescriptive Lighting and Performance Lighting projects, Existing Retrofit Lighting, and Existing Retrofit Non-Lighting components is shown in Table 13-4. We used a stratified random sample design, split by kW demand savings to draw the samples for these three components.

Table 13-4. Commercial Efficiency Program Prescriptive Lighting and Existing Retrofit Engineering Review Sample Design

Stratum	Boundaries (kW)	Total Ex Ante Savings (kW)	Projects in Population*	Projects in Sample
Prescriptive Lighting				
1	1-15	180	54	4
2	16-102	441	10	6
Total		621	64	10
Existing Retrofit Non-Lighting Projects				
1	0-19	1,361	222	6
2	20-160	1,260	29	4
Total		2,621	251	10
Existing Retrofit Lighting Projects				
1	1-10	5,875	1840	5
2	11-40	6,892	343	3
3	41-647	6,888	75	7
Total		19,655	2,258	15

* Note that the final count of projects for these program components is slightly higher. At the time when the sampling design took place, the reconciliation process for CEP was undergoing. As a result, not all projects were a part of the sample frame.

For each desk review, we performed the following tasks:

- Compared hard copy information such as invoices to data shown in spreadsheets to ensure that there were no data entry type errors
- Calculated an ex post gross demand and energy savings using detailed information in the project files to ensure that savings were calculated correctly
- Adjusted the ex ante Siebel values so that the same factors were included in the ex ante values[43], and compared the ex ante gross values to our ex post gross values to calculate a site-specific gross realization rate
- Applied the sample design weighting factors to arrive at a gross realization rate for the component

For the desk reviews, we used the ratio adjustment method[44] to extrapolate results for each site back to the overall 2013 component population. Figure 13-1 shows the algorithm we used to extrapolate to the population.

[43] Long Island Power Authority includes line losses and coincident factor in their net values while our gross impacts include these two factors.

[44] Judith T. Lessler and William D. Kalsbeek. Nonsampling Error in Surveys. 1992. p. 269.

Figure 13-1. Ratio Adjustment Algorithm

$$I_{EP} = \frac{I_{EPS}}{I_{EAS}} * I_{EA}$$

Where

I_{EP} = the ex post population impact
I_{EA} = the ex ante population impact
IEPS = the ex post impact from the sample
IEAS = the ex ante impact from the sample
IEPS / IEAS = Realization Rate

There are background algorithms that are used as part of the ratio adjustment algorithm that we describe next. To obtain the phase-specific realization rate, we use the following algorithm:

$$Realization\ Rate = \sum_{i=1}^{n} \frac{Ex\ Post\ Savings_i * W_{si}}{Ex\ Ante\ Savings_i * W_{si}}$$

Where:

W_{si}=expansion weight for strata I (shown in tables above)

$Savings_i$ = project values for sampled projects

Once we obtain the realization rate, we calculate the standard error, error bound, and relative precision, as shown next.

$$e_i = Ex\ Post\ Savings_i - (Realization\ Rate * Ex\ Ante\ Savings_i)$$

$$Standard\ Error = \sqrt{\frac{W_{si}(W_{si} - 1) * e_i^2}{\sum_{i=1}^{n} Ex\ Ante\ Savings_i * W_{si}}}$$

$$Error\ Bound = 1.645 * Standard\ Error$$

$$Relative\ Precision = \frac{Error\ Bound}{Realization\ Rate}$$

To pull together the multiple samples and arrive at a single precision for the population, we use the following algorithm:

$$Relative\ Precision\ Across\ Multiple\ Samples = \frac{\sqrt{Error\ Bound_1 + Error\ Bound_2 + Error\ Bound_n}}{\sum_1^n Ex\ Post\ Savings_i}$$

13.3.1 Cool Homes

The Evaluation Team conducted in-depth interviews with program managers and reviewed program-tracking data. In addition, we are conducting a market characterization study using data collected from participant and non-participant surveys and site visits.

13.3.2 EEP

The Evaluation Team conducted in-depth interviews with program managers and reviewed program-tracking data. In addition, we are conducting two studies: a room air conditioner and dehumidifier stocking study and retailer interviews, and an in-home study of lighting, secondary refrigerators, and pool pumps. This research included retailer interviews, in-store product survey, and in-home audits.

13.3.3 REAP Estimation of Savings Using Billing Analysis

The Evaluation Team conducted an in-depth interview with the program manager, and reviewed program materials and the program-tracking data. In addition, we conducted a billing analysis to estimate program savings for REAP. The methods used in conducting the billing analysis are presented below.

Data Preparation and Cleaning

The Long Island Power Authority provided participation and measure data for all customers who participated in the REAP program from 2012-2013. The Long Island Power Authority also provided a billing history going back 30 months from February 2014 for the 2012 and 2013 participants whose account identifiers we could verify based on program data[45]. Prior to carrying out the statistical modeling, some matching, cleaning, data quality assurance, and transformations of the data were required. For analysis purposes, we focused primarily on the 2012 participant cohort, but retained 2013 participants as a comparison group, and cleaned 2013 participant and billing records to the same specifications as 2012 participants.

Cleaning Participation Data

Similar to the 2012 evaluation, we used Initial Site Visit records as the basis for our analysis sample, because these records had the Long Island Power Authority customer account number associated with each job identifier. We excluded 22 participant records tracked in participation data that did not have an account number associated with the site ID from the analysis. We drew our analysis sample from Initial Site Visit records available in early February 2014, which included complete 2012 and 2013 participant data.

We cleaned participant and measure data for both the 2012 and 2013 Program Years. The cleaning steps were consistent with what was performed as part of the 2012 evaluation. First, we identified and removed records without measure data, as well as records associated with master-metered accounts (based on the presence of duplicate account numbers associated with more than one participant household). For example, two or more enrollment identifiers, with similar street

[45] Some of this data had already been provided to us in last year's evaluation and some was provided this year.

addresses but different apartment numbers and resident names, could be linked to the same Long Island Power Authority customer account number. We also removed sites with multiple account numbers (which could have been due to presence of multi-meter accounts or changes in account ownership over time).

When cleaning the measure data, we identified and removed records with missing savings or zero quantities. In instances with positive kWh savings and zero quantities or positive quantities and missing or zero savings, or where installation dates were missing, we removed the entire household from further analysis. We aggregated the remaining records into the four end-use categories (lighting, air conditioning, refrigeration, and domestic hot water), which we then rolled up to a unique household level (defined as unique site ID).

Finally, we merged the measure data set for the 2012 participants into the project-level data set. We also merged in the measure data from 2013 to capture households with initial site visits in late 2012, which may have had measures installed in early 2013. We retained for further analysis only those participants whose clean measure data matched cleaned 2012 participant data. After cleaning the measure data, we calculated annual expected savings for each participant based on the sum of gross deemed kWh savings for all of the measures that each participant installed within the REAP program. We used these expected savings as the basis for realization rates. Further, we dropped 2012 records for projects that were continuations of 2011 projects, as they were included in the last year's analysis.

For 2013 participant data, we retained all households regardless of improvements they made or savings associated with those improvements. We aggregated the data for 2013 participants by account number and dropped records with duplicate or incomplete/corrupted account numbers. We used the first installation date as the cut-off for retaining 2013 participant billing records, as this group serves as the comparison group for analysis.

Matching Participant Information with Long Island Power Authority Account Information

REAP tracks Long Island Power Authority customer account information with participant records. As a result, we used the customer account numbers provided with participation data to match billing histories to program participants.

Cleaning Billing Data

After merging 2012 and 2013 participants' billing data, we took a two-step approach to cleaning customer billing data. This approach is consistent with the approach used in the 2012 evaluation of the program. First, we removed individual billing periods—i.e., meter reads—that are duplicative and have zero billing days. Second, we cleaned the data for customer accounts with anomalous or insufficient data for billing analysis. We describe each billing data cleaning step below.

- Remove Duplicate Billing Records: Because the 2013 billing data that we received only contained the most recent usage data, we needed to also merge in billing data prior to 2013 in order to obtain longer pre-periods for analysis. Some of the billing records were duplicative across the two files. We removed these duplicates so as to not double count the usage.
- Cleaning Individual Billing Periods: We removed billing periods with a duration of zero days (i.e., same start and end date). Usage records for these billing periods either recorded zero kWh or positive kWh; many were the first read in the available billing

history, or a Turn-On read. We also dropped billing periods lasting longer than 90 days, since we need to assign each billing period to a specific month for analysis purposes, and longer read periods would introduce greater error into the model. For participants who participated in 2013 only, we dropped all billing periods occurring after their first installation date, as these 2013 participants were prepared to serve as the comparison group.

- **Extremely High or Low Average Daily Consumption:** We removed customers with entire pre- or post-periods having very high or very low usage. This is to ensure that participants spent equivalent amounts of time in their homes in the months before and after program participation. We dropped households with average daily consumption at or below 2 kWh/day on average (across their billing history in both the pre and post period). We also dropped customers with extremely high usage (over 300 kWh per day). These households are likely to contain odd usage patterns that we can't easily control for and could bias our results.

- **Inadequate Billing History before Program Participation:** The primary savings measures in the REAP program (lighting and refrigerators) are expected to generate energy savings throughout the year. To be able to assess changes in consumption due to program measures before and after installation, we required participants to have a billing history covering at least six billing records or 180 days before the first day of program participation for both the 2012 and 2013 program participants.

- **Inadequate Billing History after Program Participation:** We also required 2012 participants to have a minimum number of billing days after program participation. We dropped 2012 participants who did not have, at a minimum, six billing records or 180 days of billing data after each participant's last installation date. This post period drop only applies to the 2012 participants.

- **Inadequate Billing History in the Cooling Season before and after Program Participation:** We also required 2012 participants to have a minimum of 60 days in the summer (cooling season). This is because we expect the measure installation to be generally weather sensitive both in terms of temperature and also in terms of daylight hours. Making sure that we have enough billing data in the months of May, June, July, and August allows for more rigorous savings estimates.

Assigning Time Periods to Billing Data

The billing data was provided in billing cycle format, which means that customers have different read days and different read cycle lengths depending on their meter read cycle. For the analysis to be comparable across customers, it is necessary to assign each billing period to a specific calendar month, so that we can compare energy usage between customers, across time periods. We first assigned a month to each period based on the midpoint of the billing period—so that the month would refer to the month in which the majority of energy use occurred (e.g., if the read period started on June 20 and ended on July 19, we assigned that period to July). In cases where two shorter read periods occurred within the same billing period, we combined kWh usage for both periods and recalculated average daily consumption across the combined period.

Incorporating Weather Data

We obtained daily weather data from the National Climatic Data Center (NCDC) for the Islip weather station on Long Island.

The daily data is based on hourly averages from each day. We calculated cooling degree-days for each day (in the analysis and historical period) based on average daily temperature and dew point using the same formula as Long Island Power Authority forecasting.[46] We calculated heating degree-days from the average daily temperature using a balance temperature of 65 degrees. We merged daily weather data into the billing data set so that each billing period captures the heating degree-days and cooling degree-days for each day within that billing period (including start and end dates). For analysis purposes, we then calculated average daily heating degree-days (HDD) and average daily cooling degree-days (CDD), based on the number of days within each billing period.

Statistical Method Used

The Evaluation Team used a two-way fixed-effects panel model. This type of model allows all household factors that do not vary over time to be absorbed (and therefore controlled for) by individual constant terms in the equation. This could include things such as square footage, appliance stock, habitual behaviors, household size, and many other factors. While these factors may change over the evaluation period, the effects are likely to be infrequent and would likely not have an effect on the sample. The critical things to include in these models are the time-varying factors, including weather.

The two-way fixed effects model also controls for time by creating (either explicitly or implicitly) dummy variables for each year-month period. This allows monthly changes in base usage that could be seen in all customers (participants and the comparison group) to be captured as a fixed effect, giving the model a better opportunity to pick up the changes in base usage that are the result of participation. This is important since the primary measures in this program, lighting and refrigeration, are largely base-use and are not very weather-sensitive.

The evaluation design included a comparison group of customers who participated in the program in Program Year 2013. This allows us to compare the post-participation billing records of the treatment group (2012 participants) to both its own pre-participation records and to the pre-participation billing records of the comparison group (2013 participants). Those two periods (pre-participation for participant group and pre-participation for the comparison group) are contemporaneous. The advantage of using a comparison group of later participants is that they are likely to have similar propensities to participate, a characteristic that would be difficult to determine when selecting a comparison group from another population of individuals using another method.

Note that the billing analysis, using a good comparison group, incorporates the effects of both free ridership and spillover, thus resulting in the program net savings estimates. For example, the energy use patterns of the comparison group during 2012-2013 (up to the point of their participation) reflects equipment installations and behavioral changes that treatment group participants (2012 participants) might have performed in the absence of the program. In addition, any measures

[46] *A "degree-day" is a unit of measure for recording how hot or how cold it has been over a 24-hour period. The number of degree-days applied to any particular day of the week is determined by calculating the mean temperature for the day and then comparing the mean temperature to a base value of 65 degrees F. (The "mean" temperature is calculated by adding together the high for the day and the low for the day, and then dividing the result by 2.) If the mean temperature for the day is, say, 5 degrees higher than 65, then there have been 5 cooling degree-days. On the other hand, if the weather has been cool, and the mean temperature is, say, 55 degrees, then there have been 10 heating degree-days (65 minus 55 equals 10).* Quoted from http://www.srh.noaa.gov/ffc/html/degdays.shtml.

installed during the evaluation period beyond program measures (spillover) would be picked up by an increased coefficient for the participation variables.

The billing analysis we conducted estimates program savings overall and by two end-uses. We fit a number of possible models, and selected the one with the best overall fit, based on R^2 and AIC. The following equation represents the final model:

$$ADC_{it} = a + a_i + a_m + B_1X_1 + B_2X_2 + B_3X_3 + B_4X_4 + B_5X_5 + B_6X_6 + B_7X_6 + \varepsilon_{it}$$

where:

ADC_{it}	=	Average daily energy consumption per day for home i during month t
a	=	Overall intercept
a_i	=	Household-specific intercept (absorbed)
a_m	=	Month intercept for each month-year combination (absorbed)
B_1	=	the average effect of lighting installation on usage
B_2	=	the average effect of refrigerator installation on usage
B_3	=	the average effect of HVAC installation on usage
B_4	=	the average effect of domestic hot water (DHW) installation on usage
B_5	=	the average effect of cooling-degree days on usage[47]
B_6	=	the average effect of heating degree-days (base 65) on usage
B_7	=	the average effect of lighting installation on usage that occurs with each increment of heating degree-days
X_1	=	Program installation of lighting measures for home i during month t
X_2	=	Program installation of refrigerator for home i during month t
X_3	=	Program installation of HVAC measures for home i during month t
X_4	=	Program installation of DHW measures for home i during month t
X_5	=	Cooling degree-days for home i during month t
X_6	=	Heating degree-days (base 65) for home i during month t
ε_{it}	=	Error term

In this model, the end-use installation variables used in the billing analysis take on a value of 1 during the period *after* a home received its final measure installation (i.e., excluding the month of the installation). In cases where a participant received multiple installations, the period between the first and last installation was excluded from the analysis. The installation variable(s) were set to 0 for all months before the start of program participation.

To increase model fit, we also included in the model an interaction between the lighting measure and HDD. This helps to account for potential differences in lighting usage as a result of weather and should also pick up the potential effect of seasonal differences in the number of lighting hours per day on lighting usage.

[47] Cooling degree-days are based on the temperature humidity index (THI), base 65 as follows:

CDD (based on THI) = Mean Hourly THI for the day, base 65 THI;
THI = (.55 x Temp) + (.2 x Dew Point) + 17.5
CDD = max (THI - 65, 0)

Electric Savings Results

Before doing any modeling, we determined the overall average baseline kWh consumption for the treatment and comparison groups, and the average daily kWh and CDDs and HDDs for pre- and post-participation time periods for the treatment group. These figures provide context for the more detailed analyses. Table 13-5 shows the comparison of the pre and post kWh and weather variables for the treatment group. It shows that consumption dropped in the post-participation period compared to the pre-participation period. This drop could reflect program impacts, but may also be associated with weather. The post-participation period included a milder winter and a hotter summer. Because it is unclear exactly how these two offsetting factors may have influenced energy consumption, billing analysis is necessary to isolate program-related changes from other factors, such as the separate effects of CDD and HDD on consumption.

Table 13-5. REAP Analysis – Average Values of Key Variables by Time Period for 2012 Treatment Group

Variable	Statistic	Period		Significantly Different
		Pre	Post	
Daily kWh	Mean	20.26	19.68	Yes
	SD	16.60	16.78	
CDD	Mean	160.15	152.48	Yes
	SD	219.28	208.47	
HDD	Mean	606.61	646.13	Yes
	SD	603.45	616.70	

Also of interest is the difference between the treatment and the comparison group during the baseline period (i.e., the pre-participation period for the treatment group and the same months of 2010 and 2011 for the comparison group, which is roughly the same period for the two groups). Table 13-6 reveals lower baseline consumption for the treatment group versus the comparison group for 2010 and 2011.

Table 13-6. REAP Analysis – Baseline kWh by Sample Group in Analysis

Year	Statistic	Treatment Group	Comparison Group	Significantly Different
2010	Mean	20.04	17.45	Yes
	SD	16.10	11.96	
2011	Mean	20.55	17.27	Yes
	SD	16.89	12.08	
2010 & 2011	Mean	20.41	17.33	Yes
	SD	16.68	12.04	

Using a good comparison group is important since if we can assume that the treatment and comparison groups have a similar propensity to participate, then including the comparison group allows us to calculate net savings (i.e. savings that incorporate the effects of both free ridership and spillover). However, since there is a statistically significant difference in baseline usage between the treatment and comparison group, the assumption that these groups have a similar likelihood to participate in the program is questionable. There are two ways to address this issue. One way is to simply not include the comparison group in the billing analysis and thus calculate only gross savings.

A second strategy, and the one chosen for this analysis, is to rely on the two-way fixed effects model to absorb any unobservable household factors (constant over time) that may impact usage. By accounting for any unobservable time-invariant factors between households, our model effectively controls for any baseline differences between treatment and comparison group households. We also modeled baseline effects, but they did not improve the model, likely because of the fixed-effects approach.

Table 13-7 shows the final model results. The model shows a reduction in electricity use after program participants installed measures and after controlling for weather, time, and the household characteristics (reflected in the constant term). As shown in Table 13-7, the program effects coefficients are negative for all measures except for Domestic Hot Water, making it likely that each of the other end-use measures reduced consumption overall. Notably, savings from the two measures that were most commonly installed (lighting and refrigerators) are significant at the 0.05 alpha level. The coefficients for HVAC and Domestic Hot Water fail to reach statistical significance, which is likely due to the very small number of participants installing these measures (i.e. small sample sizes). In total, these results indicate that there is a very high probability that the lighting and refrigerator measures create savings.

Table 13-7. REAP Billing Analysis – Final Model

Predictor	Coefficient	Robust Std. Err	t	P>|t|	95% Confidence Interval	
					Lower Bound	Upper Bound
Lighting	-0.505	0.22	-2.32	0.020	-0.931	-0.079
Refrigerators	-1.099	0.19	-5.72	0.000	-1.476	-0.722
HVAC	-1.232	0.70	-1.76	0.079	-2.606	0.142
Domestic Hot Water	0.259	0.55	0.47	0.639	-0.824	1.342
Lighting*HDD	-0.002	0.00	-6.26	0.000	-0.002	-0.001
CDD	0.015	0.00	19.21	0.000	0.014	0.017
HDD	-0.003	0.00	-8.03	0.000	-0.003	-0.002
Constant	22.605	1.53	14.79	0.000	19.608	25.602
Adj R2	0.6728					

Evaluating the model, we calculated estimated average daily electricity use and percent electricity savings. As shown in Table 13-8, the average daily electricity use across studied participating homes dropped approximately 1.98 kWh per day after measures were installed, representing a 9.15% decrease in electricity usage overall.

Table 13-8 also shows the measure-level savings estimates for lighting and refrigeration, the major program measures. Lighting savings contributed 1.54 kWh of savings per day (weighted) to the overall drop of 1.98 kWh per day for the average household. Refrigerators contributed another 0.42 kWh per day to the overall savings of 1.98 kWh (weighted). Together, lighting and refrigeration account for over 90% of the program savings identified in the model.

Weighted savings and relative precision estimates are shown only for lighting and refrigeration because they are the only measures with large enough sample sizes to provide a reasonable level of confidence in the measure-level savings results. Measure-level savings estimates for the other measures were unreliable since there were only 78 HVAC participants and 90 Domestic Hot Water participants in the final analysis sample.

All of the estimates in Table 13-8 are shown for historical weather conditions, representing "normal" calculated from weather data for Long Island over 2004-2013. This is appropriate for developing observed savings estimates that can be compared to the weather-normalized savings estimates used in program planning.

Table 13-8. REAP Analysis – Relative Precision of Observed Savings from Billing Analysis

End-Use	Weighted Average Daily Household Savings*	90% Confidence Interval		% Savings	Relative Precision of Estimated Savings at 90% CI**
		Lower Bound	Upper Bound		
Overall	1.98	1.69	2.26	9.15%	14%
Lighting	1.54	1.25	1.83	7.13%	19%
Refrigerators	0.42	0.30	0.54	1.92%	29%

*The line loss factor is not applied to the program-planning savings

**Note that since the analysis included a population of participants, the concept of relative precision (which is associated with a sample) does not apply. However, we chose to report these measures of uncertainty to be consistent with conventional statistical reporting practices. Moreover, while sampling error does not apply here, these sampling statistics do provide some information about variability within a population for key variables.

Billing Analysis Compared to Expected Savings

Table 13-9 compares the observed (ex post) savings from the billing analysis to the expected (ex ante) savings for these participants based on the Long Island Power Authority's program-planning estimates. The results of the comparisons are the associated realization rates. The overall realization rate for the program is 48%. The realization rate for lighting measures is slightly higher at 50%, while the realization rate for refrigeration is slightly lower at 45%.

Measure-level savings values in this table are not weighted across all households. Instead, they are presented as averages for participants who installed the particular measure. This was done to give a clear sense of what the observed savings per customer were in a manner easily comparable to the first year savings values commonly seen in the program plan.

Table 13-9. Savings from REAP Billing Analysis Compared to Savings Expected from Program-Planning Estimates

End-Use	N (Participants in Billing Analysis)**	Observed Savings		Program-Planning Savings*		Realization Rate
		Household Daily Savings for those with the Measure	Household Annual Savings for those with the Measure	Household Daily Savings for those with the Measure	Household Annual Savings for those with the Measure	
Overall Program	2,639	1.98	722	4.10	1,498	48%
Lighting	2,581	1.55	567	3.12	1,138	50%
Refrigerators	1,012	1.10	401	2.45	895	45%

*The line loss factor is not applied to the program-planning savings

**There was a total of 3,714 unique accounts from PY 2012. Of that, 1,075 program participants were excluded from the billing analysis due to missing or incomplete measure data, or insufficient billing data in the pre- or post-participation periods.

13.3.4 Home Performance Estimation of Savings Using Billing Analysis

In this section, we present the method and results of a billing analysis to estimate program savings for HPwES and HPD.

Data Preparation and Cleaning

The Long Island Power Authority provided participation and measure data for all customers who participated in the HPD and HPwES programs from 2012-2013. In addition, the Long Island Power Authority provided a billing history covering 30 months up to January 2014 for 2012 and 2013 participants whose account identifiers we could verify based on program data. Prior to carrying out the statistical modeling, some matching, cleaning, data QA, and transformations of the data were required. For analysis purposes, we focus primarily on the 2012 participants, but retained 2013 participants as a potential comparison group. We have cleaned 2013 participant and billing records to the same specifications as 2012 participants.

Cleaning Participation Data

We used Initial Site Visit records as the basis for our analysis sample, because these records had the Long Island Power Authority customer account number associated with each job identifier or site ID. If participant records tracked in participation data did not have an account number associated with the site ID, we excluded them from analysis. We drew our 2012 analysis sample from Initial Site Visit records available in early February 2013, which included complete 2012 participant data. We drew our 2013 analysis sample from Initial Site Visit records available in early February 2014, which included complete 2013 participant data.

With regard to measure-level data, we first checked to make sure that all sites had measure data. There were no records without measure data. We did identify and remove a few site IDs without electric measures.

We looked for records with missing savings or zero quantities; however, no site IDs had to be removed for this reason. In instances with negative kWh savings, we left household data alone because total savings was not missing or exactly zero. We aggregated the remaining records into the four end-use categories, which we then rolled up to a unique household level (defined as unique site ID).

Finally, we merged the measure data set for 2012 and 2013 participants into the project-level data set. We used the first installation date as the cut-off for distinguishing between 2012 and 2013 participants (2012 participants in this analysis include any customers with a first installation date in 2012)

Matching Participant Information with Long Island Power Authority Account Information

HPD and HPwES track Long Island Power Authority customer account information with participant records. As a result, we used the customer account numbers provided with participation data to match billing histories to program participants. We dropped customers (site IDs) with missing account numbers or multiple account numbers per site ID.

Cleaning Billing Data

We took a two-step approach to cleaning customer billing data. First, we removed individual billing periods—i.e., meter reads—that contained duplicate, overlapping, or otherwise uncertain information. Second, we cleaned the data for customer accounts with anomalous or insufficient data for billing analysis. We describe each billing data cleaning criteria below.

- Cleaning individual billing periods: We removed billing periods with a duration of zero days (i.e., same start and end data). Records for these billing periods either recorded zero kWh or positive kWh; many were the first read in the available billing history, or a Turn-On read. We also dropped billing periods lasting longer than 90 days, since we need to assign each billing period to a specific month for analysis purposes, and longer read periods would introduce greater error into the model.

- Inadequate billing history before program participation: HPD and HPwES program measures are expected to generate energy savings in heating season, cooling season, and the shoulder months. To be able to assess changes in consumption due to program measures before and after installation, we required participants to have a billing history covering heating and cooling months both before and after program participation. We dropped participants who did not have, at a minimum, 60 days of billing data from peak heating months, and 60 days of data from peak cooling months before each participant's first installation date. We defined peak heating and cooling months based on weather patterns in the 10 years prior to the participation year, and gave participants full credit for each billing day occurring within those months as well as partial credit for billing data in cooling months.[48] We also dropped participants with less than six observations (billing records) in the pre-period.

- Inadequate billing history after program participation: We also required 2012 participants to have a minimum number of billing days in heating and cooling months after program participation. We dropped 2012 participants who did not have, at a minimum, 60 days of billing data from peak heating months, and 60 days of data from peak cooling months after each participant's last installation date. We also dropped 2012 participants with less than six observations (billing records) in the post-period.

[48] Long Island MacArthur Airport (Islip) in Suffolk County served as the primary weather station for all weather data. When Islip data was missing for a long period of time, we averaged weather from the two nearest stations, Republic and Brookhaven. We used average daily temperature and dew point from the Northeast Regional Climate Center (NRCC) for 2000-2012 as the basis for historical and program-period weather calculations. Heating and cooling months were defined by average daily heating degree-days or cooling degree-days in each month—peak cooling months are July and August, and peak heating months are December, January, and February. We also considered billing days occurring in June, September, November, and March for participants who had less than 60 days of data in peak months.

Assigning Time Periods to Billing Data

The billing data was provided in billing cycle format, which means that customers have different read days and different read cycle lengths depending on their meter read cycle. For the analysis to be comparable across customers, it is necessary to assign each billing period to a specific calendar month, so that we can compare energy usage between customers, across time periods. We first assigned a month to each period based on the midpoint of the billing period—so that the month would refer to the month in which the majority of energy use occurred (e.g., if the read period started on June 20 and ended on July 19, we assigned that period to July). In cases where two shorter read periods occurred within the same billing period, we combined kWh usage for both periods and recalculated average daily consumption across the combined period.

Incorporating Weather Data

As in previous years' HPD and HPwES billing analysis, we used daily weather data for the Long Island MacArthur (Islip) Airport in Suffolk County. We obtained this data from the Northeast Regional Climate Center (NRCC). We chose Islip Airport as the basis for weather analysis based on its central location in Long Island Power Authority service territory.

The daily data are based on hourly averages from each day. We calculated cooling degree-days for each day (in the analysis and historical period) based on average daily temperature and dew point using the same formula as Long Island Power Authority forecasting.[49] We calculated heating degree-days from the average daily temperature using a balance temperature of 65 degrees. We merged daily weather data into the billing data set so that each billing period captures the heating degree-days and cooling degrees for each day within that billing period (including start and end dates). For analysis purposes, we then calculated average daily heating degree-days (HDD) and average daily cooling degree-days (CDD), based on the number of days within each billing period.

Final Data Set

Ultimately, our Home Performance data set includes 2,027 2012 participants. About 77% of the 2012 participant population was available for analysis after data preparation and cleaning.

Table 13-10 presents the results of cleaning participation data, integrating clean billing data, and checking for sufficient billing data for each customer.

[49] A "degree-day" is a unit of measure for recording how hot or how cold it has been over a 24-hour period. The number of degree-days applied to any particular day of the week is determined by calculating the mean temperature for the day and then comparing the mean temperature to a base value of 65 degrees F. (The "mean" temperature is calculated by adding together the high for the day and the low for the day, and then dividing the result by 2.) If the mean temperature for the day is, say, 5 degrees higher than 65, then there have been 5 cooling degree-days. On the other hand, if the weather has been cool, and the mean temperature is, say, 55 degrees, then there have 10 heating degree-days (65 minus 55 equals 10). Quoted from http://www.srh.noaa.gov/ffc/html/degdays.shtml.

Table 13-10. HPD/HPwES Participation and Billing Data Cleaning Steps

		Unique Customer Count	
Starting Program Year	Action	2012 Count	
Unique Site ID in Program Year Data		2643	
Drop participants with 2011 records	n dropped	233	
	n remaining	2410	
Program Year for Billing Analysis		2012 Only	2012-2013
Re-Assign 2012-2013 Participants to 2012	n dropped	0	0
	n remaining	2350	60
Drop all non-electric savings	n dropped	4	0
	n remaining	2346	60
Account number missing	n dropped	1	0
	n remaining	2345	60
Drop sites with multiple account numbers and accounts with multiple site IDs that cannot be rationalized	n dropped	13	0
	n remaining	2332	60
Participant does not have billing data from 2013 or 2014 evaluation extracts	n dropped	12	0
	n remaining	2320	60
Less Than 6 Pre Billing Periods	n dropped	154	6
	n remaining	2166	54
Less Than 6 Post Billing Periods	n dropped	98	31
	n remaining	2068	23
Less Than 60 billing days in pre-period summer	n dropped	31	0
	n remaining	2037	23
Less Than 60 billing days in post-period summer	n dropped	4	1
	n remaining	2033	22
Less Than 60 billing days in pre-period winter	n dropped	18	1
	n remaining	2015	21
Less Than 60 billing days in post-period winter	n dropped	9	0
	n remaining	2006	21
Less Customers with unusual measures (Central Air Conditioners, refrigerators, dishwashers)	n dropped	22	2
	n remaining	1984	19
Percent of participants remaining		84%	32%

Statistical Method Used

We conducted a billing analysis to determine ex post net program savings. We evaluated a number of possible models, and chose to use a Linear Fixed Effects Regression (LFER), conditional demand analysis (CDA) model. The final model utilized "dummy" variables for the two primary measures of interest: lighting and weatherization. The lighting variables included an interaction with the average number of hours per day that indoor lighting was needed during each billing period. This was based on sunrise and sunset times for the Long Island latitude. The weatherization variables included interaction with cooling degree-days, heating degree-days, and the presence of electric space heating. In a previous Home Performance billing analysis, we used the next year's participants as a "control" for the treatment group to estimate net savings. In last year's report, we were unable to use a similar control group model because 2011 participants were predominantly electric space heating customers while 2012 participants were not. In the current report, we have been able to return to the original model design and use 2013 participants as the comparison group for evaluation of savings from 2012 participants. Neither the 2012 participant group nor the 2013 participant group contained many electric space heating customers, so they were a good match. The result is that this analysis does employ a comparison group, and therefore realization rates reflect net ex post savings.

The final billing analysis model was run for all 2012 and 2013 Home Performance participants combined, with 2013 participants serving only as a comparison group for the time period before they became participants. The variables included in the model differentiate savings for lighting measures and weatherization measures. There were so few participants with other energy efficiency measures (refrigerators, electric water heaters, and central air conditioners) that they were removed from the analysis. There was an insufficient sample size for these other measures to determine their individual savings, and leaving them in the mix could potentially bias the savings estimates for lighting and weatherization. While the number of electric space heating (ESH) participants during 2012 was greatly reduced from 2011, there were still a sufficient number to warrant modeling winter weatherization savings separately for ESH customers. In 2011, ex ante savings from measures installed in electric space heat homes comprised 67% of overall program savings, while in 2012 ex ante savings from measures installed in electric space heat homes comprised only 17% of savings.

The single model described below can be used to evaluate overall program savings for all participants as well as for ESH participants or non-ESH participants. It can also be used to estimate savings from a few measure categories.[50] The final fixed effects model used for the billing analysis has the following structure:

$$y_{it} = \alpha_i + \beta_1 X_{1it} + \beta_2 X_{2it} + \beta_3 X_{3it} + \beta_4 X_{4it} + \beta_5 X_{5it} + \beta_6 X_{6it} + \beta_7 X_{7it} + \beta_8 X_{8it} + \beta_9 X_{9it} + \varepsilon_{it}$$

where:

y_{it}	=	Average energy consumption per day for home *i* during month *t (ADC)*
α_i	=	Constant term for home *i*
$\beta_1 - \beta_9$	=	Coefficients for explanatory variables
X_1	=	Ave daily heating degree-days (HDD) for home *i* during month *t*
X_2	=	Interaction of ESH dummy with X_1
X_3	=	Ave daily cooling degree-days (CDD)[51] for home *i* during month *t*

[50] Savings from measure categories that are not modeled individually are picked up in the general "post-participation" variables, and thereby contribute to overall program savings estimates.

[51] Cooling degree-days are based on the temperature humidity index (THI), base 65 as follows:
CDD (based on THI) = Mean Hourly THI for the day, base 65 THI;
THI = (.55 x Temp) + (.2 x Dew Point) + 17.5
CDD = max (THI - 65, 0)

X_4	=	Weatherization (WEA) measure installed dummy for home *i* during month *t*
X_5	=	Interaction of WEA dummy with HDD
X_6	=	Interaction of WEA dummy with CDD
X_7	=	Interaction of ESH with X_5
X_8	=	Average hours that lighting is needed per day during month *t* (LIT-HRS)
X_9	=	Lighting (LIT) measure installed dummy for home *i* during month *t*
X_{10}	=	Interaction of LIT dummy with LIT-HRS
ε	=	Error term

In this model, the end-use installation variables used in the billing analysis take on a value of 1 during the period *after* a home received its final measure installation (i.e., excluding the month of the installation). In cases where a participant received multiple installations, the period between the first and last installation was excluded from the analysis. The installation variables were set to 0 for all months before the start of program participation. For 2013 participants that serve as the comparison group, their usage data is only included for time periods before they started participation, so all installation variables for them are 0 within this model.

Electric Savings Results

Table 13-11 below shows the model results. The model shows a reduction in electricity use after program participants installed measures, and after controlling for weather and the household characteristics (reflected in the constant term). When evaluated together using the means of 2012 program participation indictors, the program effects terms (for the post-period and measures) are jointly negative, indicating that program participants did reduce energy consumption in the post-period (after controlling for weather).

Table 13-11. Home Performance Billing Analysis – Final Model

Predictor	Coefficient	Robust Std. Err.	T	P>|t|	90% Confidence Interval	
					Lower	Upper
CDD	2.51	0.08	33.42	0.00	2.39	2.64
HDD	0.22	0.03	8.25	0.00	0.18	0.27
LIT HRS	0.42	0.35	1.19	0.23	-0.16	1.00
LIT dummy	0.86	0.62	1.38	0.17	-0.16	1.89
LIT x LIT HRS	-0.38	0.14	-2.67	0.01	-0.62	-0.15
WEA dummy	1.44	0.57	2.55	0.01	0.51	2.37
WEA x CDD	-0.58	0.07	-7.98	0.00	-0.70	-0.46
WEA x HDD	-0.02	0.02	-0.70	0.48	-0.06	0.02
ESH x HDD	2.21	0.10	22.9	0.00	2.05	2.37
ESH x WEA x HDD	-0.16	0.06	-2.74	0.01	-0.26	-0.06
Constant	12.64	0.49	25.99	0.00	11.68	13.59

The model results can be used to estimate net savings for several types of customers and measures, as shown in Table 13-12 below. The average daily electricity use across studied participating homes dropped approximately 1.08 kWh per day after measures were installed, representing a 3.2% decrease in electricity usage overall. There is a 90% probability, or confidence, that overall program savings are within plus or minus 42% of this estimate, meaning that savings could range from 0.63 kWh per day to 1.54 kWh per day.

The table also shows the average measure-level annual savings estimates for lighting and weatherization measures across the entire participant group. Lighting savings contributed 0.38 kWh of savings per day to the overall drop of 1.08 kWh per day for the average household, with a relative precision level of 84% (at the 90% confidence level). Weatherization savings contributed 0.70 kWh per day with a relative precision level of 69% at the 90% confidence level.

All of the estimates in Table 13-12 are shown for historical weather conditions, using a normal calculated from weather data for 2004-2013. This is appropriate for developing observed savings estimates that can be compared to the weather-normalized savings estimates used in program planning.

Table 13-12. Home Performance Analysis – Relative Precision of Observed Savings from Billing Analysis[52]

Category	Weighted Average Household Daily Savings	90% Confidence Interval		% Savings
		Lower	Upper	
All Program Participants	1.08	0.63	1.54	3.2%
Lighting, All Part.	*0.38*	*0.06*	*0.70*	*1.1%*
Weatherization, All Part.	*0.70*	*0.22*	*1.18*	*2.1%*

The Evaluation Team compared these observed savings estimates to expected savings from the program-tracking database to determine the realization rate. The realization rate (RR) indicates what percentage of the expected savings was observed in the data.

Table 13-13 below shows that the 2012 Home Performance programs realized 35% of their expected net savings. The realization rate is higher for electric space heat customers at 67%, and lower for other heat customers at 42%.

[52] These values exclude line losses.

Table 13-13. Savings from Home Performance Billing Analysis Compared to Savings Expected from Program-Planning Estimates

End-Use	N (Participants in billing analysis)[53]	Observed Savings		Program Planning Savings[54]		Realization Rate
		Household Daily KWH Savings for those with the Measure	Household Annual KWH Savings for those with the Measure	Household Daily KWH Savings for those with the Measure	Household Annual KWH Savings for those with the Measure	
Overall Savings	2003	1.08	395	3.11	1136	35%
Lighting Savings	1290	0.59	217	3.62	1323	16%
Weatherization Savings, All Fuels	1808	0.77	283	0.86	315	90%
Weatherization Savings, Electric Space Heat Only	91	2.91	1064	5.63	2058	52%

A review of realization results for the individual measures provides an explanation of why the overall realization rate for the program was 35%. The high realization rate for weatherization measures (90%) was offset by a very low realization rate for lighting (16%)

Since most of the homes receiving weatherization measures were not electric space heating homes, a large share of observed savings come from a reduced need for air conditioning. Within the overall weatherization group, there are a few homes (91 out of 1808) that are electric space heating. The ESH homes show much higher observed savings, 1064 kWh per year instead of 283, and these primarily occur in winter. Even though their observed savings are higher, the ESH homes receiving weatherization measures are expected to save over 2000 kWh per year, so the realization rate for this group is 52%. In fact, if the ESH customers were removed from the overall weatherization savings, we would find that the observed cooling-related savings for weatherization measures are actually slightly greater than what is expected. That is, the realization rate for cooling savings from weatherization measures would be greater than 100%.

13.3.5 Cost-Effectiveness Method

The Evaluation Team developed an Excel-based tool to assess cost-effectiveness at the program and portfolio level using information derived from the Long Island Power Authority's 2013 Year End Expenditure Report and the evaluation results. We used three metrics to assess the cost-effectiveness of the Long Island Power Authority's Efficiency Long Island and Renewable Energy programs: the Program Administrator (PA) test, the Total Resource Cost (TRC) test, and the levelized cost of capacity and energy. The Long Island Power Authority considers the Efficiency Long Island and Renewable Energy Portfolios as alternative supply-side resources. To allow for direct comparison with the Long Island Power Authority's assessment of all supply-side options, we apply the PA test as

[53] Total 2011 participants in the billing analysis = 986. Program participants were excluded from the billing analysis due to missing or incomplete measure data, or insufficient billing data in the pre- or post-participation periods.

[54] Excludes line losses.

the primary method of determining cost-effectiveness, and used assumptions similar to those used by the Long Island Power Authority's resource planning team. Each of the three methods is described below.

Calculation of Program Administrator Costs

The Program Administrator Cost Test measures the net costs of an energy efficiency program as a resource option based on the costs incurred by the Program Administrator (PA). These costs include all program costs and any rebate and incentive costs, but exclude any measurement and evaluation costs unless those costs are necessary to administering the program. The PA Cost Test excludes any net costs incurred by the participant, such as the actual measure cost, and includes the benefits accrued over the life of the measure, including electric energy and capacity savings for an electric utility.

The PA Cost Test calculates a Benefit/Cost ratio by taking the net present value (NPV) of benefits and dividing them by the first year program costs as shown in Equation 1. NPV discounts for the time value of money using a discount rate. In other words, savings that accrue in the future are less valuable than immediate savings. Taking a NPV normalizes for the present value of future savings. This evaluation used a nominal discount rate of 5.643%.[55]

$$PA\ Cost = \frac{NPV\ of\ Benefits\ [\,MCE*NRG*EUL+mAD*DR]}{2013\ Costs\ [PA]} \qquad \text{(Eq. 1)}$$

A Benefit/Cost ratio greater than 1 indicates a cost-effective investment of funds from a Program Administrator perspective.

Table 13-14 presents the sources for inputs used to calculate cost-effectiveness using the PA Cost Test.

[55] All cost-effectiveness analyses used a nominal discount rate of 5.643% to be consistent with supply-side alternatives.

Table 13-14. PA Cost Test Algorithm Inputs

Name	Variable	Units	Source	Input Type	Notes
MCE	Annual Marginal Utility Avoided Cost of Energy (includes costs for RGGI, NOx and SO2 compliance)	$/kWh	Long Island Power Authority	Benefit	
NRG	Energy Reductions by Measure	kWh	Net Ex Post kWh, includes transmission losses	Benefit	First year annual value[56]
EUL	Effective Useful Life by Measure	Years	Long Island Power Authority (From AEG) Averaged by end-use	Benefit	
mAD	Marginal Utility Avoided Cost of Demand	$/kW	Long Island Power Authority	Benefit	
DR	Demand Reductions by Measure	kW	Net Ex Post kWh, includes transmission losses	Benefit	First year value – coincident peak estimate
PA	Program Administrator Cost	$ or % of incentives	Long Island Power Authority (December 2013 Expenditure Report)	Cost	
DR	Discount Rate	%	Long Island Power Authority (Nominal discount rate of 5.643% used in calculations of supply side alternatives)	Discount Rate	Interest Rate

Calculation of Total Resource Costs

The Total Resource Cost (TRC) Test measures the total costs of a program based on both the participants' and the utility's costs. The TRC Test considers the same program costs as the PA Cost Test with the addition of incremental cost to the participant of purchasing the program measure. Further, the TRC Test does not consider the costs of incentives and rebates, as these are viewed as transfers at the societal level. Specifically, the program administrator costs no longer include the incentive costs when used within the calculation of the TRC. A Benefit/Cost ratio greater than 1 indicates a cost-effective investment of funds from the perspective of the utility and its ratepayers.

[56] For the Energy-Efficient Products (EEP), Home Performance with ENERGY STAR®, and Home Performance Direct programs, the energy and demand savings of CFLs were discounted to account for the change in baseline efficiency levels over the life of the bulb. Beginning in 2012, higher-wattage bulbs are being phased out due to the Energy Independence and Security Act (EISA). Based on the expected installation rates, the timeline of the phase outs, and the useful life of the CFLs, we estimate a lifetime savings of 79.47% of first year annual value for CFLs installed in 2013.

Calculation of Levelized Costs

A levelized cost analysis is a way to quickly compare the cost of energy efficiency programs relative to the demand and energy saved from the programs. Levelized costs are expressed as $/kW or $/kWh, meaning that the result can readily be compared to the cost of alternative supply additions or the cost of generating electricity. If the cost of the efficiency investment is less than the cost of capacity additions or generated electricity, efficiency is considered a wise investment.

The Evaluation Team determined levelized cost estimates at the program and portfolio level. The sources for this analysis are the same as the PA Cost Test calculations. To determine the levelized costs of the program, we determined the demand and energy savings over the life of the measure installed in a single year, discounted back to the same year of investment. The Long Island Power Authority's investment (incentives and overhead) was divided by the present value of the savings to yield the lifetime levelized cost. Equation 2 shows the methodology used to calculate the levelized cost values. For a description of these costs, see Table 13-14.

$$Levelized\ Costs\ = \frac{2013\ Total\ Utility\ Expenditures}{NPV\ (Lifecycle\ kW\ or\ kWh\ Savings\ from\ 2013\ Installs)} \qquad \text{(Eq. 2)}$$

13.3.6 Economic Impact Method

As part of the 2013 Efficiency Long Island and Renewable Energy Portfolios Evaluation, the Evaluation Team conducted an economic impact analysis to quantify the benefits of the Long Island Power Authority's 2013 program spending on economic output and employment on Long Island. The economic impact analysis quantifies the 10-year impact of the Long Island Power Authority's 2013 Efficiency Long Island Portfolio and 2013 Renewable Energy Portfolio on the economy of Nassau and Suffolk counties. In particular, it quantifies each portfolio's economic impact in terms of the following impact metrics:

- Overall economic output (value-added portion of sales)
- Employment or jobs created
- Labor income/wages from these jobs

These impacts can be broken into three dimensions—direct, indirect, and induced impact, summarized as:

- Direct Impacts: These impacts are equal to the localized portion of direct spending of the Long Island Power Authority programs. For example, direct impacts would include money (and associated increases in employment) supplied to contractors to install energy efficiency measures in homes and businesses, such as the HVAC contractor installing energy-efficient central A/C systems on a project incented by the Long Island Power Authority's Cool Homes program.
- Indirect Impacts: These impacts are determined by the amount of the direct impacts spent within Long Island on supplies, services, labor, and taxes. For example, indirect impacts would include money (and associated employment) transferred to local businesses by contractors for supplies needed to install energy efficiency measures, such as if a local wholesaler of HVAC equipment had increased sales and added additional workers to help meet the growing demand for the company's products.

- **Induced Impacts:** These impacts are associated with the effects of the direct and indirect impacts on household and business proprietors' income. For example, money expended on Long Island by households or business proprietors benefitting from energy efficiency savings and direct and indirect program spending, such as if the employee of an HVAC contractor used their income (increased by work through the Long Island Power Authority's Cool Homes program) to purchase a car, which stimulates business at the local car dealership.

Along each dimension, we quantify economic impact in terms of economic output and employment outcomes.

Next, we describe the methodology and key assumptions used in this economic impact analysis.

Evaluated Program Effects

Program actions create effects that are the mechanisms through which the Long Island Power Authority programs may benefit participants and the regional economy—essentially via changes in cash flow. Based on a review of publicly available economic impact analyses of efficiency and renewable energy programs, and discussions with the Long Island Power Authority, we identified two main program effects (and associated costs) to quantify in the 2013 analysis. These high-priority program effects are participant bill savings and program and measure spending (on administration and management, and equipment and installation), shown in the Societal Benefits column in Table 13-15. To determine the overall impact of net participant bill savings and program spending on the regional economy, we also quantify the monetary costs associated with these efforts—namely incremental participant costs and the efficiency and renewable charge (that funds programs). These costs are shown in the Societal Costs column of Table 13-15.

Table 13-15. Evaluated Program Effects

Category	Societal Benefits *(Realized Benefit or Avoided Cost)*	Societal Costs *(Realized Cost or Opportunity Cost)*
Participant Savings	**Program Participant Bill Savings** Increased household and business savings over 10 years, with potential increase in regional spending	**Incremental Participant Spending**[57] Participant co-payments that are incrementally higher than what they may have been in the absence of Long Island Power Authority programs, due to purchase of higher-efficiency equipment
Program & Measure Spending	**Program Spending** Increased sales of goods & services and increased employment, due to Long Island Power Authority's spending on equipment, contractors, customer services, administration, and management **Incremental Participant Spending**[78] Increased spending on goods & services due to purchase of higher-efficiency equipment and contractor services	**Efficiency and Renewables Charge** Decreased disposable income for ratepayers in 2013 due to small efficiency and renewables charge(s) and riders leveraged to fund Long Island Power Authority programs

Our analysis of high-priority program impacts will estimate economic gains associated with portfolio-level spending and net participant savings. The impacts we estimate will be "net" in the sense that they account for the complete flow of funds associated with the benefits we are estimating: program spending enters the model as inflows and outflows, as does incremental participant spending. Because only avoided costs are used to estimate bill savings, the total monetary value of bill savings in each year is equal to the net societal benefit of installation of high-efficiency measures in 2013. Though participant savings will be "net" and the flow of funds will be "net" in the sense that we account for both societal benefits and costs, the economic impact will be gross, as it will not "net out" what economic output, employment, and wages would have been *without* any program spending.

Model-Based Approach

The economic impact analysis is based on an Input-Output model. We used IMPLAN (Impact Analysis for Planning) software to analyze the economic impact of the Long Island Power Authority's programs. With information on program spending and costs, and the IMPLAN software, the Evaluation Team built a static model for the effects of program spending based on a matrix of underlying relationships among various sectors, including households, industries, and government. Assumptions about these relationships are an underlying component of the IMPLAN software, based on localized economic and employment data from sources such as the Bureau of Economic Analysis' Regional Economic Accounts and the Bureau of Labor Statistics' Census of Employment and Wages. These assumptions are also specific to the local economy (i.e., Nassau and Suffolk Counties),

[57] Incremental participant spending is measured as both a benefit and a cost, to reflect the flow of funds in the local economy; while program participants experience this spending as a negative cash flow, contractors, retailers, manufacturers, and other service providers experience an equivalent positive cash flow.

containing information on how spending is "multiplied" to multiple local sectors, as well as what portion of spending may extend beyond the local economy.[58]

To prepare the model, the Evaluation Team aggregated spending and cost data at a sector level for each year, and entered this information into the software. There are 440 IMPLAN sectors, which generally correspond to NAICS codes, plus a household sector to represent residential customers. The model accounts for spending going to a specific sector (e.g., contractors), as well as expenditures from a specific sector (e.g., household spending on incremental measure costs). For example, the stream of residential *household* benefits accounts for *participant* bill savings, *participant* incremental measure cost, the efficiency and renewable charge (proportional to energy sales), and rebate payments from the program to participants, where participant bill savings persist for as long as the expected measure life of installed measures. Similarly, the stream of commercial benefits accounts for *participant* bill savings, *participant* incremental measure cost, the efficiency and renewable charge (proportional to energy sales), as well as any program spending related to that sector.

Data Inputs and Assumptions

In this section, we briefly describe the data that we used as inputs in our model. The data inputs are broken into the four different spending and savings components outlined in Table 13-15.

We performed all steps for the Efficiency Long Island Portfolio and Renewable Energy Portfolio separately, though the steps were identical. Therefore, we provide a single methodology that reflects analysis steps taken for both portfolios.

Program Participant Bill Savings

To calculate the monetary value of participant bill savings over a 10-year period due to measure installation in 2013, we incorporated the following data inputs:

- **Evaluated net ex post annual kW and kWh savings for each program:** At a measure, measure-category, or program level, depending on the level used in the cost-effectiveness screening tool.
- **Effective useful measure life for each program:** To estimate savings by sector for each of the next 10 years, we applied program-level effective useful measure life value (EUL) to net savings for each program, utilizing the same assumptions as the Long Island Power Authority's cost-effectiveness tests.
- **Load shapes:** We used measure-level load shapes to distribute net ex post kWh savings to load periods (e.g., summer on-peak) so that we could apply avoided energy cost per kWh values appropriately, in each year.

[58] It is worth noting that IMPLAN makes a number of simplifying assumptions, such as fixed prices, no substitution effects, no supply constraints, and no changes in competitiveness or other demographic factors. However, such assumptions are not worrisome in assessing short-term impacts, in which the focus is on attaining a snapshot of a regional economy. In fact, this methodology is deemed to be an effective tool for the evaluation of impacts that do not shift economic equilibrium conditions, and has been used successfully in economic impact evaluation of a number of different energy efficiency and renewable energy programs.

- **Avoided costs:** To calculate the monetary value of bill savings for the next 10 years, we used the same avoided capacity and energy cost forecast that is used for the cost benefit screening tool. Multiplying net ex post savings (kW and kWh) by avoided costs (capacity and energy, respectively) gives the total monetary savings that will be realized among Long Island Power Authority customers.
- Using net ex post savings, load shapes, avoided costs, and measure life assumptions, we calculated the nominal monetary value of bill savings for each program, at the program or measure-category level. We distributed all annual bill savings achieved by residential programs to the residential sector. We distributed bill savings achieved by C&I programs to C&I participant sectors in two steps: first, we assigned participants to IMPLAN sectors based on the SIC codes of C&I participants whose SIC code could be found in CAS data.[59] For Efficiency programs, we then calculated the proportion of gross kWh savings by sector, by program, and applied these proportions to the annual monetary bill savings values. For Renewable Energy programs, we calculated the proportion of gross kW savings by sector, by program, and applied these proportions to the annual monetary bill savings values.

__Program Spending__

Program spending on measures and installation—The Long Island Power Authority provided program-level actual 2013 expenditures for three spending categories: rebates, incentives, and customer services. To assign expenditures to an IMPLAN sector, we took a slightly different approach for each category.

- **Rebates:** Spending on rebates is assigned to participating customer sectors—either the household sector or the commercial and industrial sector. For C&I, we linked participant accounts to SIC codes (available in the 2013 CAS data). We then matched SIC codes to IMPLAN sectors.
- **Incentives and Customer Services:** For most programs, incentives are defined as spending that goes directly to the specialty trade contractors, and customer service expenditures are defined as spending on installation services in participant homes or businesses, which may include spending on "direct transfers" to participants (e.g., direct install). Because spending in each of these categories could be distributed to multiple sectors for a given program, we leveraged additional information, such as the 2013 budget and discussions with program staff, to determine what comprised incentives and customer services for each program, and how to distribute these expenditures (e.g., by identifying sectors in the budget, and distributing actual expenditures proportional to the budget).

Program administration and management expenditures—The Long Island Power Authority provided actual expenditures on program delivery and administration spending, broken out by the following categories:

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[59] We used 2012 CAS data, which contains 2- and 4-digit SIC codes, which can be mapped to IMPLAN sectors. For participants without an SIC code or whose account number was not present in 2012 data, we assigned IMPLAN sectors in proportion to gross kWh achieved by all participants with known SIC codes.

- **Contractors, Marketing, Advertising, Evaluation:** These expenditures were available at a program level. We identified appropriate sectors based on detailed information in the budget, and where applicable, applied the budgetary proportions (of sector spending) to each program-level spending category. For a few expenditures, we developed sector assumptions (both sector assignment and proportion) based on discussions with Long Island Power Authority program staff.

- **Professional Services, General and Administrative, Salaries:** These expenditures were available at the portfolio level. We first developed assumptions about the sectors of each expenditure line item (e.g., IT consulting) based on a breakdown of subcategories provided by the Long Island Power Authority, which we assigned to an IMPLAN sector. We then assigned expenditures to a portfolio (e.g., Efficiency or Renewable Energy). Though some line items were specific to Efficiency or Renewable Energy, in most cases we assigned expenditures to either the Efficiency or Renewable Energy Portfolio in proportion to each portfolio's expenditures on all other program-level costs.[60]

Incremental Participant Spending

The Evaluation Team modeled the additional measure spending that occurs due to programs (i.e., total participant spending on measures and installation that is attributable to programs) using three sources of information:

- **Incremental measure cost assumptions:** We use the same per-unit incremental cost assumptions as developed by AEG for program planning and used for the 2013 cost benefit screening tool. Incremental costs are available at a measure level (per unit) for the majority of programs.

- **Ex post measure counts:** Final measure counts from the 2013 evaluation, which are needed if incremental costs are per-unit.

- **Free ridership and spillover rates:** After estimating the total incremental measure expenditures associated with each measure (or program, if incremental costs are at the program level), we estimated the incremental spending that occurred due to the Long Island Power Authority's programs by using free ridership and spillover rates (using evaluated NTGRs).

To model positive cash flows of participant spending to the local economy, we assigned an IMPLAN sector to each measure in the benefit cost screening tool.

To model negative cash flows of participant spending to appropriate sectors, we assigned all residential program incremental spending to the household sector. In addition, program-induced, non-labor-related cash flows to the household sector were modeled as household income change. Here we assumed that the distribution of cash flows is proportional to the distribution of households into different income brackets.[61] For Commercial programs, we distributed spending across commercial sectors by first assigning a sector to participants based on their SIC code (using the same assignments as for participant bill savings), and then calculating the percentage of total rebate dollars each sector accounts for (with the assumption that incremental measure costs will be roughly

[60] Sum of rebates, incentives, customer services, contractors, marketing, advertising, and evaluation.

[61] Source: U.S. Census Bureau's American Community Survey (2011).

proportional to available rebates). Program-induced non-sale-related cash flows—specifically rebates, savings, incremental cost, and Efficiency Long Island charge—were modeled as change in proprietor income.

Efficiency and Renewables Charges

To adequately represent local cash flows resulting from offering Efficiency & Renewable Energy programs, the model includes efficiency and renewables charge revenues that were used to fund the 2013 programs. We assume that this revenue is equivalent to total program spending. To distribute revenue across portfolios, we used the sum of program spending by portfolio, described above. To distribute revenue across sectors, the Long Island Power Authority provided a breakdown of 2013 sales (in MWh) for residential and C&I customers. The Evaluation Team applied these proportions to the total efficiency and renewables charge revenue estimate. The estimated proportion of charges from residential customers was applied to the household sector. We then broke down the C&I portion by IMPLAN sector based on the distribution of annual kWh by IMPLAN sector (again, based on SIC code) reflected in 2013 CAS data.

A. Ex Ante and Ex Post Net-to-Gross Values by Program and Measure

Below are the ex ante and ex post values used in the results shown in this report.

Program	Measure	Ex Post minus Ex Ante	Ex Post Values			Ex Ante – Calculated Program Values (All values calculated from gross and net values provided by the program)			
		NTGR Differences	FR	SO	NTGR	FR	SO	NTGR	Notes
Cool Homes	Central AC (kW)	-17.00%	See Report, table 4-3 for data		73%	10%	0%	90.00%	According to spreadsheet provided by LIPA on 3/25/14, Central AC NTGR varies from 0.85 (Tier 1) to 0.9 (Tier 2 and 3).
Cool Homes	Central AC (kWh)	-29.00%	See Report, table 4-3 for data		61%	10%	0%	90.00%	According to spreadsheet provided by LIPA on 3/25/14, Central AC NTGR varies from 0.85 (Tier 1) to 0.9 (Tier 2 and 3).
Cool Homes	Furnace Fan (kW)	6.00%	10%	0%	90%	16%	0%	84.00%	According to spreadsheet provided by LIPA on 3/25/14, furnace fan NTGR is 0.9.
Cool Homes	Furnace Fan (kWh)	0.00%	10%	0%	90%	10%	0%	90.00%	

Program	Measure	Ex Post minus Ex Ante	Ex Post Values			Ex Ante – Calculated Program Values (All values calculated from gross and net values provided by the program)			
		NTGR Differences	FR	SO	NTGR	FR	SO	NTGR	Notes
Cool Homes	Geothermal Heat Pump (kW)	6.00%	2%	0%	98%	8%	0%	92.00%	According to spreadsheet provided by LIPA on 3/25/14, Geothermal heat pump NTGR is 1.0.
Cool Homes	Geothermal Heat Pump (kWh)	0.00%	2%	0%	98%	2%	0%	98.00%	According to spreadsheet provided by LIPA on 3/25/14, Geothermal heat pump NTGR is 1.0.
Cool Homes	Unitary Heat Pump (kW)	8.00%	2%	0%	98%	10%	0%	90.00%	
Cool Homes	Unitary Heat Pump (kWh)	8.00%	2%	0%	98%	10%	0%	90.00%	

Program	Measure	Ex Post minus Ex Ante	Ex Post Values			Ex Ante – Calculated Program Values (All values calculated from gross and net values provided by the program)			
		NTGR Differences	FR	SO	NTGR	FR	SO	NTGR	Notes
Cool Homes	Ductless Mini Split AC (kW)	11.00%	8%	0%	98%	13%	0%	87.00%	According to spreadsheet provided by LIPA on 3/25/14, ductless mini split AC NTGR varies from 0.85 (Tier 1) to 0.90 (Tier 2 and 3).
Cool Homes	Ductless Mini Split AC (kWh)	11.00%	2%	0%	98%	13%	0%	87.00%	According to spreadsheet provided by LIPA on 3/25/14, ductless mini split AC NTGR varies from 0.85 (Tier 1) to 0.90 (Tier 2 and 3).
HPD	All Measures Except Lighting (kW)	2.60%	0%	2.60%	102.60%	0%	0%	100.00%	
HPD	All Measures Except Lighting (kWh)	6.62%	0%	6.62%	106.62%	0%	0%	100.00%	
HPD	Lighting (kW)	-48.40%	51%	1.60%	51.60%	0%	0%	100.00%	
HPD	Lighting (kWh)	-44.38%	49%	6.62%	55.62%	0%	0%	100.00%	
HPwES	All	1.91%	28%	1.91%	73.91%	28%	0%	72.00%	

Program	Measure	Ex Post minus Ex Ante	Ex Post Values			Ex Ante – Calculated Program Values (All values calculated from gross and net values provided by the program)			
		NTGR Differences	FR	SO	NTGR	FR	SO	NTGR	Notes
	measures (kW)								
HPwES	All measures (kWh)	2.80%	28%	2.80%	74.80%	28%	0%	72.00%	
EEP	ENERGY STAR Refrigerator	0.00%	20%	10%	90%	20%	10%	90.00%	
EEP	ENERGY STAR Dehumidifier	-52.00%	67%	0%	33%	30%	15%	85.00%	
EEP	Room A/C <=6kBtuh	0.00%	30%	25%	95%	30%	25%	95.00%	
EEP	Room A/C >6kBtuh <8kBtuh	0.00%	30%	25%	95%	30%	25%	95.00%	
EEP	Room A/C >=8kBtuh	0.00%	30%	25%	95%	30%	25%	95.00%	
EEP	ENERGY STAR Common CFLs	0.00%	30%	4%	74%	30%	4%	74.00%	
EEP	ENERGY STAR Specialty CFLs	0.00%	25%	20%	95%	25%	20%	95.00%	

Program	Measure	Ex Post minus Ex Ante	Ex Post Values			Ex Ante – Calculated Program Values (All values calculated from gross and net values provided by the program)			
		NTGR Differences	FR	SO	NTGR	FR	SO	NTGR	Notes
EEP	SSL	0.00%	5%	25%	120%	5%	25%	120.00%	
EEP	ENERGY STAR Fixtures	0.00%	1.7%	3.2%	101.5%	1.7%	3.2%	101.50%	
EEP	Refrigerator recycle	-9.00%	52%	0%	48%	43%	0%	57.00%	
EEP	Pool pumps-two spd	0.00%	20%	10%	90%	20%	10%	90.00%	
EEP	Pool pumps-var spd	0.00%	20%	10%	90%	20%	10%	90.00%	
EEP	TVs - 30% above ES	0.00%	20%	10%	90%	20%	10%	90.00%	
EEP	Smart power strips	0.00%	0%	0%	100%	0%	0%	100.00%	
EEP	Room A/C recycle	-9.00%	52%	0%	48%	43%	0%	57.00%	
EEP	Dehumidifi-er recycle	-9.00%	52%	0%	48%	43%	0%	57.00%	
EEP	Ceiling fans	0.00%	30%	0%	70%	30%	0%	70.00%	
EEP	Super-Efficient Dryer Pilot	0.00%	0%	0%	100%	0%	0%	100.00%	

Program	Measure	Ex Post minus Ex Ante	Ex Post Values			Ex Ante – Calculated Program Values (All values calculated from gross and net values provided by the program)			
		NTGR Differences	FR	SO	NTGR	FR	SO	NTGR	Notes
	(Heat Pumps)								
EEP	Super-Efficient Dryer Pilot (Electric)	0.00%	20%	10%	90%	20%	10%	90%	
CEP Prescriptive	Lighting (kW)	Varies	30%	1.87%	71.87%	0%	0%	50-120%	There are inconsistencies in NTGR between numbers in spreadsheet provided by LIPA on 3/25/14 and calculated NTGR using numbers provided by the program.
CEP Prescriptive	Lighting (kWh)	Varies	30%	1.55%	71.55%	0%	0%	96-106%	There are inconsistencies in NTGR between numbers in spreadsheet provided by LIPA on 3/25/14 and calculated NTGR using numbers provided by the program.

Program	Measure	Ex Post minus Ex Ante	Ex Post Values			Ex Ante – Calculated Program Values (All values calculated from gross and net values provided by the program)			
		NTGR Differences	FR	SO	NTGR	FR	SO	NTGR	Notes
CEP Prescriptive	Non-Lighting (kW)	Varies	30%	1.87%	71.87%	0%	0%	64-106%	NTGRs for HVAC and Building Envelope measure are not consistent between numbers in spreadsheet provided by LIPA on 3/25/14 and calculated NTGR using numbers provided by the program.
CEP Prescriptive	Non-Lighting (kWh)	Varies	30%	1.55%	71.55%	0%	0%	64-100%	
CEP Existing Retrofit	Lighting (kW)	Varies	30%	1.87%	71.87%	0%	0%	73-110%	There are inconsistencies in NTGR between numbers in spreadsheet provided by LIPA on 3/25/14 and calculated NTGR using numbers provided by the program.
CEP Existing Retrofit	Lighting (kWh)	Varies	30%	1.55%	71.55%	0%	0%	97-106%	
CEP Existing Retrofit	Non-Lighting (kW)	Varies	30%	1.87%	71.87%	0%	0%	70-100+%	There are inconsistencies in NTGR between numbers in spreadsheet provided by LIPA on 3/25/14 and calculated NTGR using numbers
CEP Existing Retrofit	Non-Lighting (kWh)	Varies	30%	1.55%	71.55%	0%	0%	95-100+%	

Program	Measure	Ex Post minus Ex Ante	Ex Post Values			Ex Ante – Calculated Program Values (All values calculated from gross and net values provided by the program)			
		NTGR Differences	FR	SO	NTGR	FR	SO	NTGR	Notes
									provided by the program.
SBDI	All measures (kW)	-12.99%	13%	0.01%	87.01%	0%	0%	100.00%	
SBDI	All measures (kWh)	-12.73%	13%	0.27%	87.27%	0%	0%	100.00%	
REAP	All Measures	0.00%	0%	0%	100%	0%	0%	100.00%	Assumed 1.0 as Low Income program.
ESLH	All	0.00%	0%	0%	100%	0%	0%	100.00%	
Solar Pioneer	All	0.00%	0%	0%	100%	0%	0%	100.00%	
Solar Entrepreneur	All	0.00%	0%	0%	100%	0%	0%	100.00%	
Backyard Wind	All	0.00%	0%	0%	100%	0%	0%	100.00%	
Solar Hot Water	All	0.00%	0%	0%	100%	0%	0%	100.00%	

B. 2013 Additional Research

In 2013, Opinion Dynamics completed additional research aimed at assessing the Authority's impact on energy efficiency building codes on Long Island as part of the ENERGY STAR® Labelled Homes program. Opinion Dynamic's report presenting the preliminary findings from this research is attached below.

Residential New Construction Codes: Preliminary Findings from Stakeholder Interviews – Submitted September 27, 2013

Residential New
Construction Codes