LIPA Efficiency Long Island and Renewable Energy Portfolio 2012 Program Guidance Document

Final

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LONG ISLAND POWER AUTHORITY

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June 2013

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1. INTRODUCTION

The 2012 Program Guidance Document provides a program-by-program review of gross and net impacts, as well as a description of the methods employed in our analyses to obtain the impacts. Opinion Dynamics created the document for use by program staff to provide data-driven planning actions moving forward and full transparency for the methods used to calculate savings. Additionally, at the direction of LIPA, we researched data creation and management as well as quality assurance/quality control procedures, and provide feedback for each program.

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. Because the Evaluation Team developed ex ante estimates at the measure level first to derive program-level estimates, and due to some gaps in the available program-tracking data, in some cases our estimates of ex ante savings do not match the program-level ex ante savings presented in LIPA's monthly tracking reports. In this document, we provide a comparison 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. Additionally, we provide a comparison 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 PY2012 programs, and provides measure-specific recommendations for updating the gross energy and demand savings calculations.

- Section 12 provides the results of process assessment and targeted market research efforts completed in 2012. These efforts focus on the Small Business Direct Install (SBDI), Energy-Efficient Products (EEP), Cool Homes, and ENERGY STAR® Labeled Homes (ESLH) programs.

- Section 13 provides a summary of additional research and evaluation activities being carried out in 2013. LIPA will use the information and recommendations generated through these research activities to inform their program-planning efforts going forward, and as such they are not included in this evaluation of PY2012.

- Section 14 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.

- The appendices present supporting documents for the evaluation.

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 LIPA'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 (NTGR).

- 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 LIPA's goals.

- Ex Post Net Savings: The savings realized by the program after independent evaluation determined gross impacts and applied ex post NTGR values. The Evaluation Team uses the ex post net impacts in the cost-effectiveness calculation.

- Line Loss Factors: All gross impacts include line losses of 6.6% on energy consumption, whereby a multiple of 1.0707 = (1/(1-0.066) has been applied to the reported numbers, and a line loss of 9.2% on peak demand, which is a multiple of 1.1013 = (1/(1-0.092).

Within the Economic Analysis, three terms are used.

- Direct Impacts: These impacts are equal to the localized portion of direct spending of the LIPA 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 LIPA'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 his or her income (increased by work through LIPA's 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 Section 14.

Gross Impact Methods

We conducted multiple analyses to assess the evaluated gross energy and demand savings associated with the LIPA 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 program, and Residential Energy Affordability Partnership (REAP) program. Analysis of custom projects implemented through the Commercial Efficiency Program (CEP) occurred through on-site measurement and verification of a sample of sites, and evaluation of the solar PV program used actual metered data from a sample of installations.

Net Impact Methods

The Evaluation Team used net impact estimates as inputs to three separate analyses required by LIPA 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 LIPA's decision to invest in the ELI 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 LIPA's programs. LIPA 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 ELI 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 LIPA'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 naturally occurring energy efficiency, 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.

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 and Table 1-2 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. ELI Portfolio Impacts for Goal Comparison

Program	Ex Ante		Evaluated		Realization Rate	
	MW	MWh	MW	MWh	MW	MWh
CEP Mid-Market	7.32	28,115	7.30	27,939	100%	99%
Solution Provider	16.06	66,946	15.43	66,168	96%	99%
Direct Install	5.21	21,811	5.24	21,939	100%	101%
Total Commercial	*28.60*	*116,872*	*27.96*	*116,046*	*98%*	*99%*
Energy-Efficient Products	15.13	109,167	16.25	117,297	107%	107%
Cool Homes	4.45	3,896	4.42	3,922	99%	101%
Residential Energy Affordability Partnership	0.72	5,739	0.32	2,345	45%	41%
Home Performance with ENERGY STAR	0.47	716	0.45	735	96%	103%
Home Performance Direct	0.84	2,550	0.84	2,300	100%	90%
Residential New Homes	1.44	1,839	1.05	1,513	73%	82%
Total Residential	*23.05*	*123,907*	*23.33*	*128,110*	*101%*	*103%*
ELI Total	**51.65**	**240,779**	**51.30**	**244,157**	**99%**	**101%**

Table 1-2. Renewable Energy Portfolio Impacts for Goal Comparison

Program	Ex Ante		Evaluated		Realization Rate	
	MW	MWh	MW	MWh	MW	MWh
Solar Pioneer	4.24	14,055	5.31	12,733	125%	91%
Solar Thermal	0.01	9	0.01	9	100%	100%
Backyard Wind	0.01	138	0.02	113	253%	82%
Renewable Energy Total	**4.25**	**14,202**	**5.34**	**12,855**	**125%**	**91%**

1.4 Summary of Cost-Effectiveness Results

Based on an analysis of program- and portfolio-level impacts and costs, the savings generated by the ELI 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 LIPA'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 LIPA's resource planning team.

The PA test Benefit/Cost ratio is 2.9 for the ELI portfolio and 1.6 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 1.9 and 0.6 for the ELI and Renewable Energy portfolios, respectively.

Table 1-3. Cost-Effectiveness for the ELI and Renewable Energy Portfolios

Program	Total Resource Cost			Program Administrator		
	NPV Benefits	Costs	Benefit /Cost Ratio	NPV Benefits	Costs	Benefit /Cost Ratio
CEP Mid-Market	$31,794,704	$19,473,019	1.6	$31,794,704	$14,724,508	2.2
Solution Provider	$71,331,255	$30,534,659	2.3	$71,331,255	$23,436,123	3.0
SBDI	$33,548,250	$8,976,073	3.7	$33,548,250	$6,513,140	5.2
Subtotal Commercial Efficiency Program	**$136,674,209**	**$58,983,751**	**2.3**	**$136,674,209**	**$44,673,772**	**3.1**
Energy-Efficient Products	$56,649,601	$29,088,599	1.9	$56,649,601	$13,621,284	4.2
Cool Homes	$15,431,902	$16,559,782	0.9	$15,431,902	$5,044,860	3.1
REAP	$1,367,400	$3,211,694	0.4	$1,299,745	$3,211,694	0.4
Home Performance with ENERGY STAR	$5,350,159	$5,341,716	1.0	$1,424,085	$4,422,998	0.3
Home Performance Direct	$2,157,068	$1,975,005	1.1	$1,930,485	$1,975,005	1.0
Existing Homes Subtotal	*$24,306,529*	*$27,088,197*	*0.9*	*$20,086,217*	*$14,654,556*	*1.4*
Residential New Homes	$6,268,216	$3,313,137	1.9	$4,380,586	$1,872,265	2.3
Subtotal Residential	**$87,224,347**	**$59,489,933**	**1.5**	**$87,224,347**	**$30,148,105**	**2.7**
Subtotal ELI	**$223,898,556**	**$118,473,684**	**1.9**	**$217,790,613**	**$74,821,877**	**2.9**
Solar PV	$34,377,999	$54,250,730	0.6	$34,377,999	$20,855,832	1.6
Solar Hot Water	$30,247	$179,652	0.2	$30,247	$157,476	0.2
Backyard Wind	$161,128	$684,982	0.4	$161,128	$394,715	0.4
Subtotal Renewable	**$34,569,373**	**$55,115,365**	**0.6**	**$34,569,373**	**$21,408,024**	**1.6**
Total	**$258,467,929**	**$173,589,049**	**1.5**	**$252,359,987**	**$96,229,901**	**2.6**

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, 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.

The levelized costs of capacity and energy for the ELI portfolio savings is $199.39 per kW and $0.046 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 exceeds the cost of alternative supply options for energy, but is below this level for capacity. However, when taking both portfolios together, LIPA's efficiency and renewable options compare favorably to the cost of alternative supply.

Table 1-4. Levelized Costs for the ELI and Renewable Energy Portfolios

Program	Total Program Costs	Levelized Costs	
		$/kWh	$/kW-yr
CEP Mid-Market	$14,724,508	0.066	249.95
Solution Provider	$23,436,123	0.044	182.97
SBDI	$6,513,140	0.033	137.99
Subtotal Commercial Efficiency Program	**$44,673,772**	**0.047**	**190.76**
Energy-Efficient Products	$13,621,284	0.023	162.65
Cool Homes	$5,044,860	0.160	128.10
REAP	$3,211,694	0.217	1,593.50
Home Performance with ENERGY STAR	$4,422,998	0.830	1,329.70
Home Performance Direct	$1,975,005	0.242	427.58
Existing Homes Subtotal	*$14,654,556*	*0.220*	*312.51*
Residential New Homes	$1,872,265	0.124	179.66
Subtotal Residential	**$30,148,105**	**0.044**	**213.73**
Subtotal ELI	**$74,821,877**	**0.046**	**199.39**
Solar PV	$20,855,832	0.124	296.76
Solar Hot Water	$157,476	1.536	2,244.28
Backyard Wind	$394,715	0.263	1,795.81
Subtotal Renewable	**$21,408,024**	**0.126**	**303.37**
Total	**$96,229,901**	**0.053**	**215.85**

LIPA's expenditures varied for each program. Figure 1-1 and Figure 1-2 show the respective breakouts of LIPA's spending related to the ELI and Renewable Energy portfolios by type of expenditure.

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

Figure 1-1. 2012 LIPA Expenditures for the ELI Portfolio

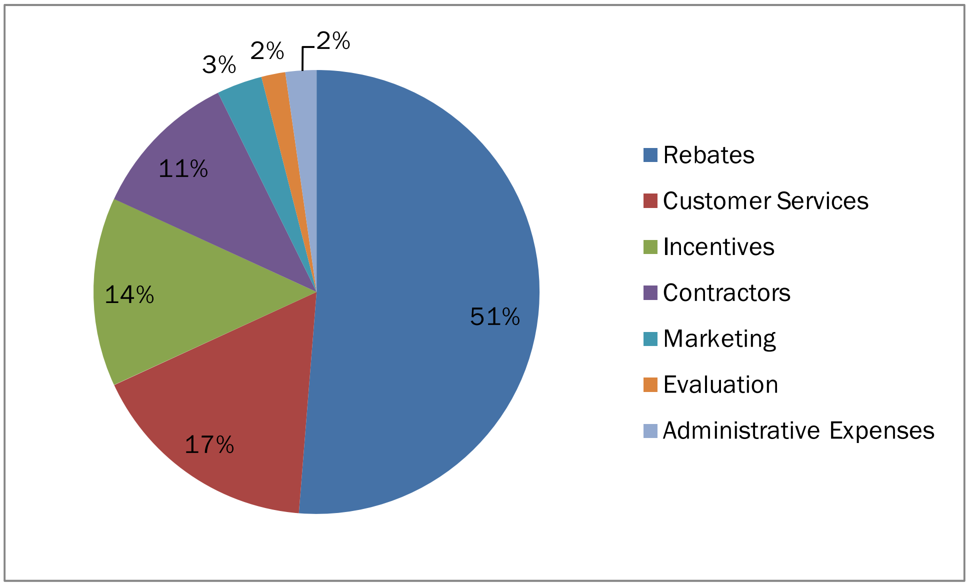
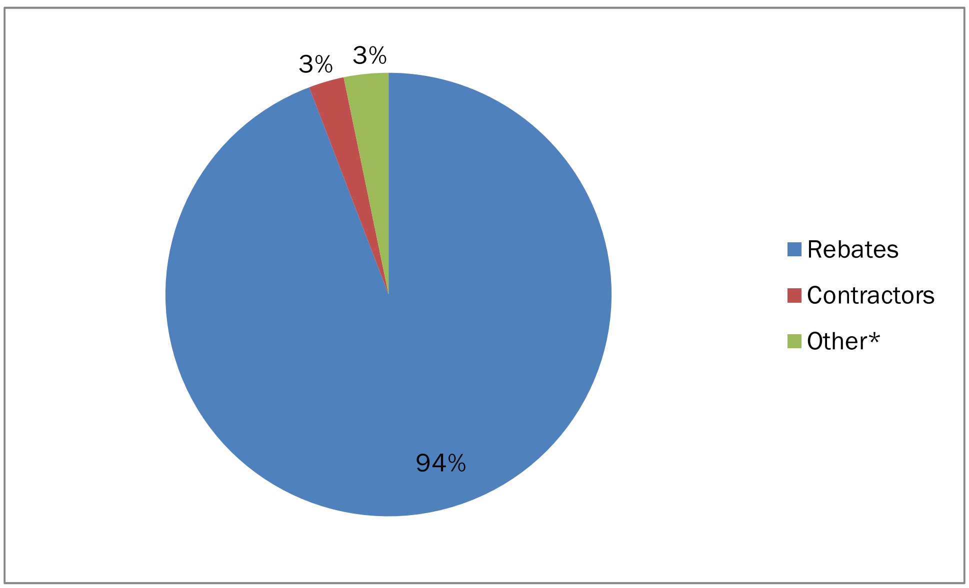


Figure 1-2. 2012 LIPA Expenditures for the Renewable Energy Portfolio



*Other includes marketing 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 LIPA's 2012 ELI and Renewable Energy portfolios over the next 10 years. Table 1-5 and Table 1-6 present the direct impacts and the combined indirect and induced impacts for 2012 and for the 10-year period of 2012 to 2021. 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 LIPA's supply-side planning and the cost-effectiveness analysis.

Over 10 years, the 2012 investments in the ELI program are expected to return $141.5 million in total economic benefits to the regional economy (in 2012 dollars), with an employment benefit of 1,086 new full-time equivalent employees (FTEs)[2] over that time period.

Table 1-5. Economic Impact of PY2012 ELI Program Investments

	2012 Economic Impact	2012-2021 Economic Impact (NPV[3])
Economic Impact		
Total Economic Output (millions)	$81.6	$141.5
Direct Effect	$79.2	$79.2
Indirect & Induced Effect	$2.4	$62.3
Employment (FTE)	609	1,086
Impact per $1M Investment		
2012 Program Investment (millions)	$74.8	$74.8
Total Economic Output in M per $1M Investment	$1.1	$1.9
Employment (FTE) per $1M Investment	8.1	14.5

Over 10 years, the 2012 investments in the Renewable Energy program are expected to return $12.8 million in total economic benefits to the regional economy (in 2012 dollars), with an employment benefit of 101 new FTEs over that time period.

[2] 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.

[3] Using nominal discount rate of 5.643%, based on LIPA energy-supply cost assumptions.

Table 1-6. Economic Impact of PY2012 Renewable Energy Program Investments

	2012 Economic Impact	2012-2021 Economic Impact (NPV[4])
Economic Impact		
Total Economic Output (millions)	$5.0	$12.8
Direct Effect	$18.2	$18.2
Indirect & Induced Effect	($13.2)	($5.4)
Employment (FTE)	37	101
Impact per $1M Investment		
2012 Program Investment (millions)	$21.4	$21.4
Total Economic Output in M per $1M Investment	$0.2	$0.3
Employment (FTE) per $1M Investment	1.7	4.7

LIPA's investments in the ELI portfolio resulted in a larger total economic output in 2012 ($81.6 million) than in 2011 ($61.6 million) due to LIPA's increased expenditures. However, the total economic output and employment created per $1 million of investment declined over that period. Several factors contribute to the difference in economic impacts, including:

- Changes in LIPA's avoided cost assumptions, which lowered participants' estimated bill savings
- Changes to the mix of investments in commercial and residential programs and their related energy and demand savings
- Changes to the implementation of programs in the ELI portfolio, including rebate and incentive levels
- Changes to the Long Island economy and how economic impacts diffuse through different sectors

The economic impact of the Renewable Energy portfolio in 2012 was lower than in 2011. In addition to the factors listed above, the difference between the two years' results is also driven by the lack of American Recovery and Reinvestment Act (ARRA) funding for the solar PV program. In 2011, LIPA received $8.3 million of ARRA grants that positively contributed to the direct impact of the program but without the corresponding renewables charge to ratepayers. Note that the indirect and induced effect of the Renewable Energy program was negative for 2012 and for the following 10-year period, but these effects will eventually become positive as the benefits of the installed systems continue through their 20- to 25-year expected life.

Note that because the direct impacts of the ELI and Renewable Energy portfolios are only realized in 2012, the economic impact of LIPA's 2012 investments after the first year only include participants' bill savings from the implemented measures. This means that the changes in LIPA's assumptions of the avoided cost of energy and capacity greatly affect the estimated future economic impact of the portfolios.

[4] Using nominal discount rate of 5.643%, based on LIPA energy-supply cost assumptions.

2. Commercial Efficiency Program (CEP)

LIPA's Commercial Efficiency Program (CEP) is multi-faceted and comprehensive in how it provides incentives to commercial customers with facilities in LIPA's service territory. CEP caters to all business customers in LIPA'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 2012, CEP continued delivering their program through the following four avenues:

- **Prescriptive**: Offers predefined replacement and retrofit measures that are rebated at set incentive amounts.
- **Retrofit Existing**: Offers retrofit measures using the specific measures installed in the existing site as the determination of savings. These measures are rebated at set incentive amounts.
- **Direct Install**: Offers only lighting measures through a turnkey approach. Typically offered to small businesses located in load-constrained circuits.
- **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 LIPA to better meet customers' needs and engage customers with the program.

The customer may be serviced by 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, Retrofit Existing, or Custom components. Customers must work with Lime Energy to participate through the Direct Install component. However, customers involved with SBDI can also work with CEP Mid-Market or Solutions Provider if they prefer.

In addition to these core components, LIPA's CEP also offers no-cost energy audits, cost-shared technical assistance studies, building commissioning co-funding, and Leadership in Energy and Environmental Design (LEED) certification incentives.

In 2012, CEP further continued to enhance its design, delivery, marketing and outreach, and project management structures. Some of the highlights include:

- **Enhanced measure and incentive offerings.** During 2012, CEP expanded the variety of its measure offerings by adding LED lighting, lighting controls, refrigeration, and HVAC measures, among other measures. For some of 2012, the program successfully ran a stimulus incentive offering for T12 lighting retrofits.
- **Increased marketing and outreach.** The reach, frequency, and variety of marketing and outreach activities attempted by the program increased in 2012, and included outreach to both trade allies and potential customers. Some of the strategies included on-the-ground outreach (e.g., through senior territory managers), weekly open house meetings, quarterly trade ally breakfast sessions, outreach through Major Account Executive, and more traditional sources of marketing such as website marketing, brochures, case studies, and targeted mailings.

- **Increased trade ally outreach.** CEP staff continued working on further developing the relationships with trade allies and engaging them with the program. The core efforts included direct outreach to trade allies by program staff and field representatives; coordination with LIPA's Trade Ally Partners Program as well as other programs (e.g., Cool Homes program); periodic meeting and training sessions; and trade ally bonus incentives.

- **Streamlined application processes.** In 2012, CEP changed its applications to be more customer-friendly and to contain a greater level of detail about the required documentation and application process. The program moved from paper-based application forms to interactive Excel forms to make the application process easier for both consumers and implementation partners.

- **Streamlined data tracking and project management processes.** In 2012, CEP staff continued to work on streamlining project tracking and ensuring quality data inputs in the Siebel program-tracking database. The core achievements in this area include finalizing guidelines and naming conventions for the project documentation that should be uploaded into Siebel as part of the project package, and developing and implementing the import tool that allows for automated data imports from the application form into Siebel.

Section 12 contains a more detailed description of the changes and enhancements made to the CEP over the course of 2012.

Overall Impacts for CEP

Table 2-1 provides a comparison of evaluated net savings to ex ante savings for the Commercial Efficiency Program impacts by implementation entity.

Table 2-1. CEP Impacts for Goal Comparison

Program Component	Category	Ex Ante		Evaluated		Realization Rate	
		kW	kWh	kW	kWh	kW	kWh
CEP Mid-Market	Prescriptive	345	1,647,868	339	1,566,925	98%	95%
	Custom	84	644,833	67	615,230	80%	95%
	Retrofit Existing	6,892	25,821,919	6,894	25,756,673	100%	100%
	CEP Subtotal	*7,321*	*28,114,620*	*7,299*	*27,938,827*	*100%*	*99%*
Solution Provider	Prescriptive	2,594	14,236,190	2,522	14,207,938	97%	100%
	Custom	2,800	14,119,884	2,236	13,471,657	80%	95%
	Retrofit Existing	10,670	38,589,874	10,670	38,488,547	100%	100%
	Solution Provider Subtotal	*16,064*	*66,945,948*	*15,428*	*66,168,142*	*96%*	*99%*
Small Business Direct Install		5,213	21,811,489	5,238	21,939,293	100%	101%
Commercial Program Total		**28,598**	**116,872,057**	**27,965**	**116,046,263**	**98%**	**99%**

Ex post net savings differ from evaluated net savings in that ex post savings are developed using ex post NTGRs, where evaluated net savings are based on program planning NTGR values. Program-planning NTGRs differed from evaluated values by program component. The Evaluation Team performed new research on CEP participant spillover and updated the previous NTGR using this data. The derivation of ex post NTGRs is described in detail below and in Section 14.1.2 of this report.

Table 2-2 provides a comparison of ex ante and ex post savings by CEP program component and project category. The Evaluation Team developed ex post net impact estimates for use in the benefit-cost and economic impact assessments.

Table 2-2. CEP 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	345	1,647,868	270	1,239,464	78%	75%
	Custom	84	644,833	53	489,107	64%	76%
	Retrofit Existing	6,892	25,821,919	5,370	19,897,361	78%	77%
	CEP Subtotal	*7,321*	*28,114,620*	*5,694*	*21,625,933*	*78%*	*77%*
Solution Provider	Prescriptive	2,594	14,236,190	2,259	11,205,864	78%	75%
	Custom	2,800	14,119,884	1,785	10,709,968	64%	76%
	Retrofit Existing	10,670	38,589,874	8,321	29,749,416	78%	77%
	Solution Provider Subtotal	*16,064*	*66,945,948*	*12,365*	*51,665,248*	*77%*	*77%*
Small Business Direct Install		5,213	21,811,489	4,557	19,087,185	87%	88%
Commercial Program Total		**28,598**	**116,872,057**	**22,616**	**92,378,366**	**79%**	**79%**

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

Prescriptive Component of Commercial Efficiency Program (CEP)

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 (CEP) by the CEP and Solution Provider implementation entities. We performed our analysis by program component (Prescriptive, Custom, and Retrofit Existing) 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 purposes of engineering analysis, we grouped prescriptive measures into seven end-use categories: variable-frequency drives (VFDs), compressed air, HVAC, HVAC controls, kitchen equipment, building envelope (i.e., Cool Roofs), 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 2012. 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 1.2. We pulled out the lighting and performance lighting this year for a separate analysis that allowed the team to look closely at the details within projects.

Table 2-3 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 2-3. 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	20,049	2,185	7,951,750	2,083	7,842,096	95%	99%
HVAC	289	446	1,180,887	737	1,252,952	165%	106%
Compressed Air	83	313	2,395,500	127	1,884,258	40%	79%
Refrigeration	5,893	216	2,901,619	216	2,901,619	100%	100%
Building Envelope	32	215	385,136	215	385,136	100%	100%
Motors and VFDs	93	59	1,090,406	152	859,668	258%	79%
Vending Machines	10	0	12,009	0	16,732	100%	139%
Total	26,449	3,434	15,917,307	3,529	15,142,462	103%	95%

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 more thorough project-specific information on installed lighting systems than in our past analyses. 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 5% and 1% lower than ex ante.
    - The evaluators used deemed savings per measure type to calculate evaluated demand and energy savings. Deemed savings values were largely based on 2011 program assumptions where available. These values were different from LIPA's 2012 assumptions for four of the measure types in the program.
    - For occupancy sensors, the program often used energy savings factors higher than the recommended value of 0.3, in six separate instances.
    - The tracked savings were entered incorrectly in the database for two of the projects in the sample.
- For ***HVAC*** measures, evaluators applied a similar analysis strategy as in 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. Evaluated savings were determined by comparing the installed equipment to a code-standard baseline. Our analysis used normalized savings values (i.e., kW/ton or kWh/ton) and used similar algorithms and assumptions as used by CEP. We multiplied these values by the installed tons for each measure provided by LIPA to arrive at our estimated savings. The team did not know the specifics around how the CEP calculated program savings, so we cannot state why our values are different.

  - The database did not contain cooling capacity information for some measures. The evaluators estimated these values based on measure type and tracking data from previous evaluations.

- For *Motor and Variable-Frequency Drive (VFD)* projects, the database featured extensive per-install information. With this useful information, evaluators conducted an accurate analysis, which led to realization rates of 258% (demand) and 78% (energy). Our analysis used the same normalized savings values (i.e., kW/hp or kWh/hp) that LIPA recommends in their program documentation. We multiplied these values by the installed horsepower for each measure provided by LIPA to arrive at our evaluated savings. We discussed the differences between our analysis and LIPA's values with LIPA, and were unable to come to a firm conclusion as to why we have a major difference.

  - The tracked savings were entered incorrectly in the database for numerous projects in the sample.

- *Refrigeration* measures are new to the CEP program, and due to lack of installed kW information on these units, have been assigned a realization rate of 100% for this year. As the program's tracking system evolves for these measures, evaluators will perform a more thorough engineering analysis in the future.

- The database contained more install-specific information for *Compressed Air* projects, leading to lower evaluated savings as compared to ex ante, by 60% (demand) and 21% (energy).

  - The air receiver measure drives the finding. This measure provided about two-thirds of the demand savings and one-third of energy savings from compressed air projects. Our analysis for compressed air used similar methods to estimate savings as are used throughout the Northeast while CEP assigns a saving percentage.

  - We do not know the specifics around how CEP calculated the program percentage, so cannot state why our values are different. We will propose a savings algorithm based on CFM and other parameters for compressed air projects in the near future, in the form of TRMs.

- For *Building Envelope and Vending Machine* measures, the evaluators used install-specific information when available to most accurately characterize the incentivized equipment. Building envelope measures have been assigned a realization rate of 100% for this year's analysis, as there was insufficient information to complete a thorough analysis and the tracking system used the standard New York State TRM approach.

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 2-4. The ex post NTGR value is 0.02 higher than last year due to savings found within our participant spillover analysis.

Table 2-4. NTGR for Prescriptive Component of CEP

End Use	Ex Ante NTGR[a]	Ex Post NTGR[b]
Lighting	0.92	0.72
Performance Lighting	0.92	0.72
Motors and VFDs	0.41 or 0.84	0.72
Compressed Air	0.66 to 0.89	0.72
HVAC	0.90	0.72
HVAC Controls	0.60 or 0.95	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 LIPA 2009 and 2010 documentation.

[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 2-5 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 in Section 0, the Evaluation Team developed ex post net impact estimates for use in the benefit-cost and economic impact assessments.

Table 2-5. Prescriptive Component of CEP for Cost-Effectiveness

Category	Number of Units	Ex Ante		Ex Post		Cost-Effectiveness Realization Rate	
		kW	kWh	kW	kWh	kW	kWh
Lighting	20,049	2,185	7,951,750	1,627	6,098,935	74%	77%
HVAC	289	446	1,180,887	589	996,097	132%	84%
Compressed Air	83	313	2,395,500	104	1,511,731	33%	63%
Refrigeration	5,893	216	2,901,619	118	2,076,175	55%	72%
Building Envelope	32	215	385,136	193	275,575	90%	72%
Motors and VFD	93	59	1,090,406	266	1,500,226	453%	138%
Vending Machines	10	0	12,009	-	12,093	100%	101%
Total	26,449	3,434	15,917,307	2,897	12,470,830	84%	78%

Reasons for Differences

The Evaluation Team developed an updated NTG factor for the CEP and Solution Provider program elements in 2011 and performed primary research in 2012 to specifically look for participant spillover. Spillover adds another approximately 0.02[5] 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

[5] 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.

contrast, the program calculates ex ante net savings by assigning multiple deemed net-to-gross ratios based on measure type. These deemed NTGRs varied from 0.41 to 0.95. We did not have sufficient sample size for calculation of measure-specific NTGRs and applied the single value for all prescriptive measures. This value of 0.72 was slightly higher than for motors and lower for other measures.

Retrofit Existing Component of Commercial Efficiency Program (CEP)

Table 2-6 presents evaluated net energy and demand savings associated with the Retrofit Existing 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.

Table 2-6. Retrofit Existing Component of CEP for Goal Comparison

Program Component	Category	Ex Ante			Evaluated		Realization Rate	
		Units	kW	kWh	kW	kWh	kW	kWh
Retrofit Existing	CEP	122,003	6,892	25,821,919	6,894	25,756,673	1.00	1.00
	Solution Provider	320,191	10,670	38,589,874	10,670	38,488,547	1.00	1.00
	Total	442,194	17,562	64,411,793	17,564	64,245,220	1.00	1.00

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.

For the ***Lighting*** analysis, a few individual realization rates for the sample projects varied slightly from 1.00, although the overall analysis found realization rates of 100% for both kW and kWh. The two primary reasons for differences were:

- There were four projects (out of the total of 40 projects in our sample) where the hours of use were different than expected. We back-calculated the values found in the ex ante values and compared them to the values we used (based on the TRM hours of use by building type). Three of the projects were non-refrigerated warehouses where our analysis applied 2,602 hours of use while the ex ante values were ~2,900. For the last project (a food store), we applied a value of 4,055 while the ex ante value was ~7,300.

- Our calculations assumed 30% for sensor savings in conformity with the LIPA Technical Reference Manual. However, the ex ante sensor savings (back-calculated based on the information we received) varied from 20% to 40%. Of the 12 projects with sensor savings, 7 used 40%, 3 used 30%, 1 used 25%, and 1 used 20%.

For ***HVAC*** analysis, there were only a few one-off type of errors that made virtually no difference to the realization rate (100.1% for peak kW and 100.3% for kWh). The few differences we found were:

- The efficiency information of existing units was not available for one project in the database.

- One project incorrectly multiplied savings by 0.96.

Table 2-7 shows a comparison of ex ante to ex post net energy and demand savings associated with the Retrofit Existing 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 2-7. Retrofit Existing Component of CEP for Cost-Effectiveness

Program Component	Category	Ex Ante			Ex Post		Realization Rate	
		Units	kW	kWh	kW	kWh	kW	kWh
Retrofit Existing	CEP	122,003	6,892	25,821,919	5,370	19,897,361	0.78	0.77
	Solution Provider	320,191	10,670	38,589,874	8,321	29,749,416	0.78	0.77
	Total	442,194	17,562	64,411,793	13,691	49,646,777	0.78	0.77

Reasons for Differences in Net Impacts

Similar to the Prescriptive program component, we estimated a single NTGR for the population of measures across the CEP program in 2011 and then added to that information with primary research in 2012 on participant spillover. The planning assumption NTGRs are 0.92 for lighting and 0.90 for HVAC. The evaluated NTGR is 0.72, thus reducing ex post net savings values (spillover provides 0.02[6] of the NTGR).

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

Table 2-8 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 2-8. SBDI Component of CEP Impacts for Goal Comparison

	Ex Ante		Evaluated		Realization Rate	
	kW	kWh	kW	kWh	kW	kWh
All Measures	5,213	21,811,489	5,238	21,939,293	100%	101%

Reasons for Differences in Impacts

Our analysis showed a very slight difference between the ex ante value and the ex post value. There was one project that appeared to have been incorrectly entered (we found more savings than the ex ante value), but as seen by the realization rates, this made little overall difference.

Table 2-9 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

[6] Ibid.

the addition of a negligible level of spillover.[7] This NTGR value, 0.87, was lower than the program planning value of 1.0, reducing all values in Table 2-9. 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 2-9. SBDI Component of CEP Impacts for Cost-Effectiveness

Category	Ex Ante		Ex Post		Realization Rate	
	kW	kWh	kW	kWh	kW	kWh
All Measures	5,213	21,811,489	4,557	19,087,185	87%	88%

Custom Program

We based energy impacts from the Custom program on the evaluation of 29 sites via engineering measurement and verification (M&V).

Custom projects varied from the installation of efficient lighting fixtures with occupancy sensors to a demand-controlled ventilation system in an underground parking garage. To perform custom project analysis, we first determine site-specific realization rates for a stratified random sample of projects. The Evaluation Team stratified the population of completed projects according to their ex ante demand savings values. The analysis essentially compares the program-estimated savings values to the evaluated values obtained from site M&V for the various projects in our sample. We applied a weighted realization rate from the sample back to the overall program population to obtain program component level impacts. See the definitions in Section 1.1 for the difference between the ex ante and evaluated values.

As discussed in Section 14, our analysis of custom measures produced results with a slightly higher relative precision (90 percent confidence, +/- 13% error for demand and 90 percent confidence, +/- 15% error for energy) than is desired (90 percent confidence, +/- 10% error). The high relative precision is, in part, a result of the sample design for the on-site M&V for custom measures. Based on choices made in conjunction with LIPA early in the evaluation process, the Evaluation Team designed the sample to include the optimum number of sites to reach 90/10 precision for demand and performed additional site assessment to increase the likelihood of meeting our sampling error targets. Despite these efforts, the analysis of demand savings associated with sampled sites produced higher than anticipated variation between evaluated and ex ante savings and thus yielded program level results with slightly higher sampling error. Our analysis of energy savings also saw higher variation than previously found resulting in higher sampling error. In general, we found that LIPA's ex ante savings estimates for weather dependent measures saw the greatest variation from evaluated results, as the site specific realization rates for demand were typically under 0.4 for this type of measure. Similarly, we found a wide variation in the site specific realization rates for energy savings for these measures, ranging from 0.1 to 1.03 for evaluated sites.

[7] 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 2-10. Custom Program Component for Goal Comparison

Program Component	Category	Ex Ante		Evaluated		Realization Rate	
		kW	kWh	kW	kWh	kW	kWh
Custom	CEP Mid-Market	84	644,833	67	615,230	0.80	0.95
	Solutions Provider	2,800	14,119,884	2,236	13,471,657	0.80	0.95
	Total	2,884	14,764,717	2,303	14,086,887	0.80	0.95

For the sample of 15 custom projects evaluated during the summer of 2012, realization rates varied from 0% to 205% for peak kW, and 11% to 144% for kWh. Appendix B provides the site specific evaluation reports for each sampled project. Though the custom projects are diverse in nature, we found some predominant reasons for discrepancy during custom ex ante savings estimation that were responsible for both high and low realization rates:

- The custom screening tool does not account for business type when calculating peak kW savings. Equipment operation during the peak period often varies among different building types but is currently not accounted for in LIPA's peak savings algorithm. For example, evaluators determined differences in lighting coincidence factor between an elementary school and an office during the peak period. These differences often led to lower evaluated peak demand savings than those claimed in the tracking system.

- Conversely, the evaluated peak demand savings were sometimes higher than claimed. For example, businesses or equipment that feature 24/7 operation, such as refrigerated cases at a supermarket, feature a higher coincidence factor than currently applied in the screening tool.

- Occupancy-based lighting control projects may require additional research or field work for the program to more accurately estimate savings moving forward. For example, the screening tool assigns an identical peak coincidence factor for occupancy-controlled lighting fixtures regardless of the space type. Evaluators determined a lower coincidence factor for low-traffic storage spaces than high-traffic areas such as classrooms or offices.

- Custom HVAC projects are often complex and typically require advanced modeling techniques to assess measure interactivity and project savings. Evaluators found HVAC projects within the sample for which the savings were determined using basic spreadsheet calculation. Evaluators determined that tracking savings for these projects often overestimated the facility cooling load and therefore overestimated project kWh and peak kW savings.

- Tighter Quality Control may be needed. Evaluators noticed a mix-up within the tracking system between two individual projects at the same facility, leading to higher claimed savings than evaluated.

Table 2-11 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 0, the Evaluation Team developed ex post net impact estimates for use in the benefit-cost and economic impact assessments.

Table 2-11. 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	84	644,833	53	489,107	0.64	0.76
	Solutions Provider	2,800	14,119,884	1,785	10,709,968	0.64	0.76
	Total	2,884	14,764,717	1,839	11,199,075	0.64	0.76

Reasons for Differences in Net Impacts

Similar to the Prescriptive Program component, we estimated a single NTGR for the population of measures across the Commercial program in 2011 and then added to that information with primary research in 2012 on participant spillover. Spillover adds another approximately 0.02[8] 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 slightly by end use, but averaged 0.93.

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:

$$NTGR = 1 - \textit{Free Ridership} + \textit{Spillover}$$

LIPA uses deemed NTGRs for CEP that vary from 0.41 to 0.95 depending on the measure for CEP and uses an NTGR of 1 for the SBDI program. The 2011 program evaluation found a 0.70 NTGR for CEP and a 0.87 for SBDI in the last evaluation cycle. The evaluated NTGRs from last year did not include spillover.

As described in the individual sections above, the Evaluation Team developed an updated NTGR for the CEP and Solution Provider program elements in 2011 and performed primary research in 2012 to specifically look for participant spillover. Spillover adds another approximately 0.02[9] to the previous NTGR of 0.70 and a negligible amount to the previous 0.87 NTGR for SBDI.

[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.

[9] Ibid.

Free Ridership

The 2012 evaluation effort was focused on quantifying spillover. We did not ask customers questions related to free ridership; instead, we used the NTGRs from the 2011 evaluation (0.70 for CEP and 0.87 for SBDI) as the free ridership rates for 2012. We did not have sufficient sample size for calculation of measure-specific NTGRs and applied the single value for all CEP and SBDI measures.

Participant Spillover

Participant spillover refers to energy efficiency installations that took place without direct program assistance but were influenced by participants' prior experience with the program. An example of participant spillover is a customer who installed a rebated piece of equipment in one facility and, as a result of the positive experience with the program, installed additional equipment at other facilities without a program incentive.

In 2011, the Evaluation Team found indications of the presence of spillover; however it was not quantified at that time. This year the Evaluation Team sought to quantify spillover by interviewing past participants in the CEP and SBDI programs to collect technical information on projects they may have done outside of the program. Our methodology including sample sizes can be found in the methods chapter of this report.

Total Participant Spillover Savings

The total calculated spillover savings by measure type for CEP and SBDI are shown below in Table 2-12 and Table 2-13, respectively.

Table 2-12. Total Spillover Savings per Measure for CEP Participants

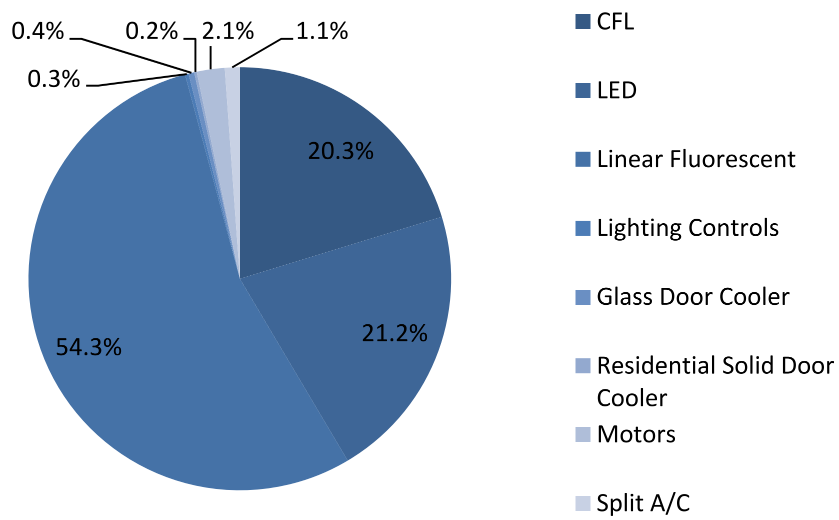
Measure	kWh	kW
CFLs	32,105	13.23
LEDs	45,219	9.81
Linear Fluorescent T8s	107,653	31.93
Linear Fluorescent T5s	1,649	0.37
Occupancy Sensors	664	0.19
Glass Door Cooler	1,035	0.13
Split A/C	2,721	4.07
Motors	3,377	0.58
Total	**194,423**	**60.32**
Total Verified Savings for Surveyed Sample	**12,528,760**	**3,221.00**
% Spillover	**1.55%**	**1.87%**

Table 2-13. Total Spillover Savings per Measure for SBDI Participants

Measure	kWh	kW
LEDs	4,924	0.00
Residential Solid Door Cooler	425	0.05
Total	**5,349**	**0.05**
Total Verified Savings for Surveyed Sample	**2,009,381**	**502**
% Spillover	**0.27%**	**0.01%**

Figure 2-1 below shows the contribution of various measures to the spillover savings that was found through the customer interviews. The vast majority of the savings (96.1%) came from lighting measures.

Figure 2-1. Contribution of Measures to Spillover



Non-participant Spillover

Non-participant spillover occurs when people who have not previously participated in the program undertake an energy-efficient improvement that was influenced directly or indirectly by the program, but for which the customer did not receive direct assistance. Non-participant spillover is difficult to evaluate because individuals may not even know that the program influenced them. For example, if a customer bought a more efficient piece of equipment because it was what the distributor had in stock, he or she may not realize that the program had actually changed the distributor's stocking behavior thereby making that product available. The Evaluation Team has proposed a number of activities aimed at quantifying the market effects of the program and the spillover associated with programmatic activities. Phase one of those activities includes reviewing program documentation and hosting a focus group with market actors. A second phase of research will include a survey of customers who started the application process but did not complete their projects through the program. These activities will be conducted throughout 2013.

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 LIPA residential customers. In 2012, the program provided rebates or discounts on ENERGY STAR® compact fluorescent lamps (CFLs), solid state lighting (LEDs), advanced power strips, televisions, dehumidifiers, refrigerators, and room air conditioners. 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 LIPA 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 EEP program's design and implementation remained the same in 2012, though some specific program areas were modified. The appliance recycling program was expanded to include the pickup of room air conditioners and dehumidifiers if a larger appliance (such as a refrigerator or freezer) was picked up at the same time. Additionally, a "Most Efficient" ENERGY STAR category was added to the refrigerator rebate program component, offering a higher incentive for refrigerators that are 30% more efficient than new, non-ENERGY STAR-certified models. To help promote specialty CFLs and LEDs, the program offered a new mall promotion for lighting products, including the sale of a kit containing CFLs, CFL fixtures, LEDs, and an LED nightlight. Finally, LIPA ran a pilot program that provided discounts for advanced power strips through their online catalogue.

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	2,190,347	10,352	93,498,513	2,180,723	11,202	101,192,798	108%	108%
Room AC	26,617	1,607	781,367	26,617	1,661	807,550	103%	103%
Appliance recycling	9,745	1,384	7,988,836	9,745	1,346	7,970,585	97%	100%
Dehumidifiers	7,320	577	971,977	7,321	842	1,423,891	146%	146%
Refrigerators	24,007	574	2,795,103	24,007	573	2,785,297	100%	100%
Pool pumps	748	345	640,677	748	345	640,698	100%	100%
Televisions	18,489	275	2,440,786	18,489	275	2,440,868	100%	100%
Ceiling fans & advanced power strips	620	14	49,860	620	10	34,974	70%	70%
Totals	**2,277,893**	**15,129**	**109,167,119**	**2,268,270**	**16,254**	**117,296,661**	**107%**	**107%**

[a] Ex post impacts reflect 9,624 fewer lighting units than ex ante, and one additional dehumidifier.

Reasons for Differences in Impacts

Lighting: We found a realization rate of 108% for both kWh and peak kW for lighting installs in 2012. High realization rates are attributed to the following reasons:

- Delta watts, hours of use, and coincidence factor. Beginning in 2012, the program updated three critical input values that are used in the calculation of per-install lighting savings. These values were updated based on recommendations in past program evaluations. Therefore, EEP is currently seeing more favorable realization rates for lighting installs than in previous evaluations.

- In-service rates. The LIPA residential baseline study[10] found that 83% of CFLs distributed are currently installed, with 17% in storage. These values were assumed to be applicable for the 2012 bulbs (i.e., the long-term in-service rate of 83% was applied to 2012 program bulbs). In addition, a study in California estimated a trajectory of future installation for stored program bulbs, and found 98% of program bulbs are expected to be installed within two years following the program. The study further concluded that 9% of bulbs are installed less than a year after purchase, and an additional 6% are installed less than two years after purchase. Therefore, 9% of ex post CFL savings from 2011 and 6% of ex post CFL savings from 2010 have been added to the 2012 totals for kWh and peak kW. The ex ante savings 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: The gross ex ante savings values used for the ENERGY STAR Dehumidifier measure were found to be slightly lower than gross ex post savings. The EEP program provided detailed documentation on 2012 dehumidifier installs by capacity, allowing a more accurate evaluation

[10] *2010 LIPA Residential Baseline Study*. Opinion Dynamics Corporation. June 2011.

analysis. Moving forward, we recommend that the deemed savings values be consistent with the energy savings values recommended by ENERGY STAR. The recycling of dehumidifiers, a new measure in 2012, features little information on industry-standard savings values. Ex ante savings for this measure have been deemed reasonable in this evaluation, but evaluators recommend that periodic research be conducted to remain apprised of future ENERGY STAR recommendations.

Refrigerators: Ex ante savings estimates closely match the values recommended by ENERGY STAR for refrigerator replacement (both “Standard” and “Most Efficient”) and refrigerator recycle. We recommend that the program continue its current activity and remain up-to-date with ENERGY STAR savings recommendations moving forward.

Televisions: Ex ante savings estimates are identical to average values recommended by ENERGY STAR. We recommend that the program remains up-to-date with ENERGY STAR savings recommendations moving forward.

Room air conditioners (RACs): Ex ante savings estimates are slightly lower than the values recommended by ENERGY STAR for the three size-tiers of room air conditioners, especially for the largest-size RACs. The recycling of room air conditioners, a new measure in 2012, features lower ex post savings than ex ante, as we used the ENERGY STAR average savings value in the ex post analysis. We recommend that the program also applies the ENERGY STAR’s average savings value for RAC recycled units.[11]

Pool pumps: We found that the savings values were reasonable. Similar to last year, we recommend further research to measure the pre- and post-conditions to fine-tune the ex ante savings values if the measure becomes a more prevalent program offering.

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 shows the ex ante and ex post NTGRs by measure.

[11] http://www.energystar.gov/ia/products/recycle/documents/RoomAirConditionerTurn-InAndRecyclingPrograms.pdf.

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%
TVs – 30% above ES	20.0%	10.0%	90.0%	20.0%	10.0%	90.0%

Applying the NTGRs in Table 3-2 to evaluated gross savings provides ex post net savings. Table 3-3 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	2,190,347	10,352	93,498,513	2,180,723	11,288	101,970,059	109%	109%
Dehumidifiers	7,320	577	971,977	7,321	327	552,805	57%	57%
Refrigerators	24,007	574	2,795,103	24,007	573	2,785,297	100%	100%
Room AC	26,617	1,607	781,367	26,617	1,661	807,550	103%	103%
Televisions	18,489	275	2,440,786	18,489	275	2,440,868	100%	100%
Appliance recycling	9,745	1,384	7,988,836	9,745	1,133	6,712,072	82%	84%
Pool pumps	748	345	640,677	748	345	640,698	100%	100%
Ceiling fans & power strips	620	14	49,860	620	14	49,862	100%	100%
Totals	**2,277,893**	**15,129**	**109,167,119**	**2,268,270**	**15,617**	**115,959,210**	**103%**	**106%**

[a] Ex post impacts reflect 9,624 fewer lighting units than ex ante, and one additional dehumidifier.

Reasons for Differences in Net Cost-Effectiveness Impacts

The evaluation team conducted quantitative surveys of program participants in support of the PY2011 evaluation to assess program attribution for two measures; dehumidifiers and appliance recycling. This research found higher levels of freeridership than are used to estimate ex ante savings. The difference in freeridership accounts for the different realization rates between Table 3-1 and Table 3-3 for dehumidifiers and appliance recycling.

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 LIPA-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 rebates for the early retirement of central air conditioning systems.

In 2012, the Cool Homes program provided incentives for the installation of 5,196 measures, including 3,768 CACs and 647 ductless mini-split systems. The number of CACs installed through the program increased by about 5% in 2012 (from 3,592 systems in 2011). The number of ductless mini-split systems decreased significantly (34%) in 2012 (from 983 systems in 2011). In addition, significantly fewer geothermal and air source heat pumps and furnace fans were installed through the program in 2012 as compared to 2011. The number of CAC and heat pump units processed through the program as "early retirement" has increased in recent years from 30% in 2011 (1,337 of 4,397 applications) to 48% in 2012 (1,977 of 4,136 applications). Combined, these changes in program participation resulted in a slightly higher evaluated coincident demand savings and lower energy savings compared to 2011.

Increasing both customer and contractor participation in the Cool Homes program will be critical if it is to reach its goals in future years. The Evaluation Team is conducting additional market assessment research in 2013 to assist the program in better understanding the CAC market on Long Island, and in tailoring the program and its marketing efforts to capture a larger share of the market (see Section 13 – Additional 2013 Research and Evaluation Activities).

Impacts for Goal Comparison

Table 4-1 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 4-1. Cool Homes Net Impacts for Goal Comparison

Category	Installs	Ex Ante		Evaluated		Realization Rate	
		kW	kWh	kW	kWh	kW	kWh
Central AC	3,768	3,798	2,616,075	3,706	2,557,797	98%	98%
Geothermal heat pump	222	241	570,386	298	618,703	124%	108%
Air source heat pump	235	211	385,319	215	407,724	102%	106%
Ductless mini-split	647	151	165,190	146	195,158	97%	118%
Furnace fan	324	53	159,080	53	142,305	100%	89%
Total	5,196	4,453	3,896,050	4,417	3,921,687	99%	101%

Reasons for Differences in Impacts

The algorithms within our analysis incorporated average installed size and efficiency for each measure, as determined through examination of the program install database. Normalized ex post savings-per-ton values were multiplied with total installed capacity in 2012 to ensure an "apples-to-apples" total savings comparison with ex ante values.

The Cool Homes ex ante measure-specific algorithms and assumptions were updated as a result of the 2011 evaluation. Ex ante and ex post savings feature identical quality install savings factors, as a result of discussions and follow-up from the 2011 evaluation. As a result, the program is generally experiencing more favorable realization rates than in previous evaluations. Based on the measure-specific evaluations and the total savings outlined in Table 4-1, the Evaluation Team has the following category-specific comments:

- Central air conditioner (CAC) units featured slightly lower evaluated savings, leading to a realization rate of 98% for both energy and peak demand. This small discrepancy is due to slight differences in baseline for early-replacement CACs. In cases where tracking data were missing baseline information, the evaluation used an assumed baseline values as documented in the TRM.

- Furnace fans with ECM motors featured higher evaluated savings for demand (106%) and lower for energy (89%). The energy discrepancy can be attributed to lower evaluated operating hours than ex ante.
- Geothermal heat pumps featured higher evaluated savings for demand (124% RR) and for energy (108%). 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 featured demand and energy realization rates of 97% and 118%, respectively. Evaluated energy savings are higher than ex ante due to differences in baseline efficiency values used by the evaluators and the program. 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 code baseline efficiency for end-of-life replacements or new construction projects.
- Air source heat pumps (ASHPs) featured slightly higher evaluated savings, leading to a realization rate of 102% for demand and 106% for energy. 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 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 last year with participating and non-participating customers as well as HVAC market actors, including contractors and equipment distributors (see last year's report for details). Table 4-2 shows a categorical breakdown of ex post savings compared with tracked program savings (ex ante) for air conditioners, heat pumps, ductless systems, and furnace fans rebated by the program. See the definitions in Section 1.1 for the difference between the ex ante and ex post values.

Table 4-2. Cool Homes Net Impacts for Cost-Effectiveness

Category	Installs	Ex Ante		Ex Post		Cost Effectiveness Realization Rate	
		kW	kWh	kW	kWh	kW	kWh
Central AC	3,768	3,798	2,616,075	3,017	1,741,350	79%	67%
Geothermal heat pump	222	241	570,386	317	617,377	132%	108%
Air source heat pump	235	211	385,319	245	463,411	116%	120%
Ductless mini-split	647	151	165,190	163	219,198	108%	133%
Furnace fan	324	53	159,080	57	142,000	106%	89%
Total	**5,196**	**4,453**	**3,896,050**	**3,799**	**3,183,336**	**85%**	**82%**

The program applies planning NTGR values of between 0.84 and 0.98 for each program measure category.[12] Additionally, the program NTGR differs for energy and demand for some measures. The Evaluation Team developed an updated NTGR for central air conditioner (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 4-3 shows the NTGR values for the Cool Homes program.

[12] LIPA 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 4-3. 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	0.86[b]	0.86[b]	1.00	1.00
Air source heat pump total	*0.86*	*0.86*	*0.98*	*0.98*
Ductless mini-split	0.87	0.87	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.

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.[13]

In an attempt to achieve greater peak demand savings within the two Home Performance programs, program staff made significant changes to program implementation across 2011 and 2012. In particular, changes in eligibility allowed a greater number of LIPA customers to take advantage of the HPwES program beginning in July 2011, which had a significant impact on the program. Additionally, changes in HPD program targeting with respect to heating fuel and central air conditioning also affected the HPwES participant base,

[13] During some of 2011, homes with non-electric heat and without central air conditioning did not qualify for either the HPwES or the HPD program.

Table 5-1. HPwES Program Changes between 2011 and 2012

Type of Program Change	Description	Date of Change
Changes related to savings	Requirement that every HPwES project include duct sealing in order to be eligible for Homeowner Financing Incentives for any measures	2/23/11
	Insulation measure requirement changes	2/24/11
Eligibility change	Increase incentive cap for electric-heated homes (from $3,000 to $5,000)	3/09/11 – 9/30/11
	Increase incentive levels by 50% for eligible measures; increase in the incentive cap	7/21/11 – 12/31/12
	Expanded eligibility to homes with fossil fuel heat with CAC or through-wall ACs (window units excluded)	7/21/11 – 12/31/12
	Increase incentive levels for oil-heated homes increases to 50% for eligible measures; increase the incentive cap	7/21/11 – 12/31/12
	Decrease incentive levels for HPwES follow-up projects for electric-heated homes (from 75% to 50%); decrease incentive cap	10/01/11 – Ongoing
	Incentive rate is 40%; total incentive cap is $2,000; ventilation incentive is 40% and falls under the incentive cap	5/5/12 – 5/15/12
	Incentive rate is 25%; total incentive cap is $1,500; ventilation incentive is 25%, up to $250, and falls under the incentive cap	5/15/12 – 12/31/12

Similar to all other LIPA programs, the HPwES program was affected by Hurricane Sandy, which caused a reduction in program activity during the fourth quarter of 2012. This was due in part to the participation of program contractors in the relief and rebuilding effort. The program may continue to feel the effects of this storm in 2013 as additional relief funds become available for construction.

Impacts for Goal Comparison

Table 5-2 provides a review of impacts for the program in 2012 by category. See the definitions in Section 1.1 for the difference between the ex ante and evaluated values. To support the 2012 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. Results from the billing analysis, which was conducted on 2011 participants, are presented for discussion purposes only and are not applied in the 2012 evaluation.

Table 5-2. HPwES Net Impacts for Goal Comparison

HPwES Measure Category	N	Ex Ante		Evaluated		Evaluated RR	
		kW	kWh	kW	kWh	kW	kWh
HVAC	126,811	245.5	147,686	231.1	148,586	94%	101%
Envelope	2,042,951	175.1	347,613	175.1	347,613	100%	100%
Air sealing	8,865	34.4	107,492	34.4	107,492	100%	100%
Lighting	1,795	11.6	92,254	11.6	104,351	100%	113%
Hot water	170	5.5	17,963	2.5	26,265	46%	146%
Refrigerator	1	1.5	2,998	0.1	542	4%	18%
Total	**2,180,593**	**473.5**	**716,006**	**454.7**	**734,848**	**96%**	**103%**

Reasons for Differences in Impacts

The Evaluation Team conducted an engineering review of the savings algorithms for this program and deemed savings values for each program measure. The team saw wide fluctuations in realization rate among measure categories with minimal participation. We have highlighted the primary reasons for these measure-level discrepancies below:

For Lighting measures, while the Evaluation Team found a realization rate of 100% for demand savings, our analysis used input values that differ slightly from ex ante assumptions. Specifically, the ex ante coincidence factor (0.12) is higher and the assumed delta watts (49.86 W) is lower than that recommended by the Evaluation Team, which used a coincidence factor of .11 and a program data derived delta watts value of 53.13 watts. Evaluated energy savings are 113% of ex ante values as the Evaluation Team used slightly higher hours of use and delta watts values than are used in program tracking data. The hours of use value used on the evaluation is consistent for residential lighting measures across all programs, 1,022 hours per year. The Evaluation Team used information regarding preexisting bulb wattage for each measure line item to estimate a weighted average delta watts value for all program installed lighting measures.

For Door/Window and Insulation measures, the Evaluation Team examined tracked install data on insulation square footage and pre- and post-install R-values. We attempted to use this tracking information with energy balance algorithms and Long Island degree-day information to estimate energy and demand savings. Our review of the results of the degree-day analysis indicates that it is not the most comprehensive method of capturing the complex characteristics of insulation measures. The program employed a modeling approach for envelope measures. Evaluators have examined screenshots and descriptions of the envelope modeling software and have concluded that its inputs and high-level algorithms are reasonable. Therefore, evaluators have assigned a 100% realization rate for energy and peak demand savings for HPwES envelope measures in this evaluation cycle. This upcoming summer, evaluators plan to examine residential envelope measures using a modeling approach that will frame future evaluation recommendations.

For Air Sealing measures, no information was available on algorithm inputs. 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 HVAC measures, the evaluated demand savings were 6% lower than the program's tracking data and the evaluated energy savings were 1% higher. We attribute these differences in realization rates to lower evaluated HVAC savings as compared to ex ante. In 2012, the HPwES program featured a small number of individual units of HVAC unitary equipment such as central AC systems and heat pumps, which are normally included in the Cool Homes program. The Evaluation Team determined that the HPwES equipment and Cool Homes equipment was similarly sized and therefore relied on per-install Cool Homes savings recommendations to define the HPwES HVAC evaluated savings. The per-install HPwES tracking savings were higher for demand savings and slightly lower for energy savings than the per-install Cool Homes tracking savings, resulting in different realization rates.

For Hot Water measures, the program's tracking data was not sufficiently detailed to ensure an "apples-to-apples" comparison with evaluated savings. For example, current tracked savings do not indicate the length or R-value of insulation installed per line item. Therefore, the Evaluation Team is comparing tracked savings with deemed savings representing a typical insulation length. The Evaluation Team recommends additions to the program's tracking database to capture additional per-install details.

For the lone **Refrigerator** install, evaluators noticed that the claimed savings are about 400% higher than average refrigerator savings claimed in EEP. Evaluators believe the inclusion of a refrigerator among HPwES projects may have been an error; nevertheless, we adjusted the refrigerator savings algorithm to reflect that of similar residential programs, which reduced the savings.

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
HVAC	126,811	245.5	147,686	170.8	111,136	70%	75%
Envelope	2,042,951	175.1	347,613	129.4	260,001	74%	75%
Air sealing	8,865	34.4	107,492	25.4	80,400	74%	75%
Lighting	1,795	11.6	92,254	8.5	78,051	74%	85%
Hot water	170	5.5	17,963	1.8	19,646	34%	109%
Refrigerator	1	1.5	2,998	0.0	405	3%	14%
Total	**2,180,593**	**473.5**	**716,006**	**336.1**	**549,639**	**71%**	**77%**

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 2012 evaluation. 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
Program Level	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 gross program savings for HPD and HPwES. Given the overlap in programs, the two programs were analyzed within a single model.

We evaluated a number of possible models, including statistically adjusted engineering estimates (SAE model), but ultimately chose a conditional demand analysis (CDA) model, which utilizes individual "dummy" variables to indicate the presence of any major measure installation. Billing analysis covers 2011 participants, because the method requires post-installation electricity usage data for approximately one year after participation. However, given the program changes that took place between 2011 and 2012, we do not feel that it is appropriate to apply the results of the billing analysis for the 2012 program. As a result, we provide the results of the billing analysis here to describe the 2011 program, but did not use them to determine 2012 program impacts.

Table 5-5 presents the end-use and overall program savings for 2011 participants in HPD and HPwES. As shown below, the 2011 Home Performance programs realized 62% of their expected gross savings. The realization rate is higher for electric space heat customers at 67%, and lower for other heat customers at 42%.

Table 5-5. Savings from Home Performance Billing Analysis Compared to Savings Expected from Program-Planning Estimates for 2011 Participants

End Use	N (Participants in billing analysis)[14]	Observed Savings		Program Planning Savings[15]		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	
All Program Participants	1,710	3.31	1,210	5.38	1,964	62%
Lighting, All Participants	1,245	1.67	611	3.19	1,165	52%
Electric Space Heat Participants	855	4.25	1,552	6.35	2,318	67%
Duct Sealing	417	2.94	1,073	1.93	703	152%
Insulation	486	5.82	2,124	4.56	1,663	128%
Other Fuel Participants[16]	855	1.48	540	3.48	1,272	42%

[14] 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.

[15] Excludes line losses.

[16] Defined as not having electric space heat.

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 LIPA-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).[17]

The program underwent a number of significant changes between 2011 and 2012. As shown in Table 6-1, a number of these changes had a potential impact on unit savings values. In addition, to support the duct-sealing requirement added in 2012, the HPD program expanded the length of a standard in-home audit to ensure that this work could be completed. 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 between 2011 and 2012

Type of Program Change	Description	Date of Change
Changes related to savings	Program institutes a 20 CFL bulb maximum per home (instead of guidelines to install a CFL in every incandescent socket).	4/13/12 – Ongoing
	Duct sealing becomes an HPD program requirement where site conditions allow it.	5/04/12 – Ongoing
Eligibility change	Relax HPD eligibility away from electric heat: The only HPD eligibility criterion for homes is central air conditioning.	9/29/11 – Ongoing
	Program changes target to focus on single-family detached homes. Leads for other residence types are not accepted.	5/04/12 – Ongoing

In addition, program staff began a collaboration and optimization process with the NYSERDA Green Jobs, Green New York program in 2012. Given that NYSERDA is fuel-neutral, customers can receive similar services from this entity and later apply for incentive offers through LIPA based on the improvements recommended by participating contractors. Leveraging the NYSERDA program in this manner allowed LIPA to optimize incentives, as well as reach a greater number of potential participants.

Finally, as mentioned in the HPwES section of this report, the HPD program was affected by Hurricane Sandy, which caused a reduction in program activity during the fourth quarter of 2012. This was due in part to the participation of program contractors in the relief and rebuilding effort. The program may continue to feel the effects of this storm in 2013 as additional relief funds become available for construction.

[17] 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.

Impacts for Goal Comparison

Table 6-2 provides a review of impacts for the program in 2012 by category. See the definitions in Section 1.1 for the difference between the ex ante and evaluated values. To support the 2012 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. Results from the billing analysis, which was conducted on 2011 participants, are presented for discussion purposes only and are not applied.

Table 6-2. HPD Net Impacts for Goal Comparison

Category	N	Ex Ante		Evaluated		Realization Rate	
		kW	kWh	kW	kWh	kW	kWh
HVAC	12,670	612	355,630	612	355,630	100%	100%
Lighting	32,053	210	2,153,045	210	1,896,951	100%	88%
Hot water	21	1	2,798	1	8,462	66%	302%
Air sealing	3.646	15	38,850	15	38,850	100%	100%
Totals	**48.390**	**838**	**2,511,478**	**838**	**2,299,893**	**102%**	**92%**

Reasons for Differences in Impacts for Goal Comparison

The Evaluation Team conducted an engineering review of the savings algorithms and deemed savings values for each program measure. The team saw wide fluctuations in realization rates for hot water measures. We have highlighted the primary reasons for measure-level discrepancies below:

For **Lighting** measures, while the Evaluation Team found a realization rate of 100% for demand savings, our analysis used input values that differ slightly from ex ante assumptions. Specifically, the ex ante coincidence factor (0.09) is lower and the assumed delta watts (62.74 W) is higher than that recommended by the Evaluation Team, which used a coincidence factor of .11 and a program data derived delta watts value of 53.13 watts. Evaluated energy savings are 88% of ex ante values as the Evaluation Team used slightly higher hours of use and lower delta watts values than are used in program tracking data. The hours of use value used on the evaluation is consistent for residential lighting measures across all programs, 1,022 hours per year. The Evaluation Team used information regarding preexisting bulb wattage for each measure line item to estimate a weighted average delta watts value for all program installed lighting measures.

For **Air Sealing and HVAC** measures, no information was available on algorithm inputs. 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 **Hot Water** measures, the program's tracking data was not sufficiently detailed to ensure an "apples-to-apples" comparison with evaluated savings. For example, current tracked savings do not indicate the R-value of insulation installed per line item. Therefore, the Evaluation Team is comparing tracked savings with deemed savings representing a typical insulation R-value. The Evaluation Team recommends additions to the program's tracking database to capture additional per-install details.

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	12,670	612	355,630	628	379,161	103%	107%
Lighting	32,053	210	2,153,045	108	1,055,026	52%	49%
Hot water	21	1	2,798	1	9,022	67%	322%
Air sealing	3,646	15	38,850	16	41,420	103%	107%
Totals	**48,390**	**838**	**2,550,323**	**753**	**1,484,629**	**90%**	**58%**

The program applies a planning NTGR of 1 for each program measure category. The Evaluation Team developed an updated NTGR for lighting only in 2011. For the 2012 evaluation, we applied the evaluated NTGR for lighting from 2011 and the program-planning values for all other 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
Lighting	1.0	1.0	0.516	0.556

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

Impacts Using Billing Analysis

The Evaluation Team conducted a billing analysis with the goal of determining ex post gross program savings for HPD and HPwES. Given the overlap in programs, the two programs were analyzed within a single model.

We evaluated a number of possible models, including statistically adjusted engineering estimates (SAE model), but ultimately chose a conditional demand analysis (CDA) model, which utilizes individual “dummy” variables to indicate the presence of any major measure installation. Billing analysis covers 2011 participants, because the method requires post-installation electricity usage data for approximately one year after participation. However, given the program changes that took place between 2011 and 2012, we do not feel that it is appropriate to apply the results of the billing analysis for the 2012 program. As a result, we provide the results of the billing analysis here to describe the 2011 program, but did not use them to determine 2012 program impacts.

Table 6-5 presents the end-use and overall program savings for 2011 participants in HPD and HPwES. As shown below, the 2011 Home Performance programs realized 62% of their expected gross savings. The realization rate is higher for electric space heat customers at 67%, and lower for other heat customers at 42%.

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

End Use	N (Participants in billing analysis)[18]	Observed Savings		Program Planning Savings[19]		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	
All Program Participants	1,710	3.31	1,210	5.38	1,964	62%
Lighting, All Participants	1,245	1.67	611	3.19	1,165	52%
Electric Space Heat Participants	855	4.25	1,552	6.35	2,318	67%
Duct Sealing	417	2.94	1,073	1.93	703	152%
Insulation	486	5.82	2,124	4.56	1,663	128%
Other Fuel Participants[20]	855	1.48	540	3.48	1,272	42%

[18] 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.

[19] Excludes line losses.

[20] Defined as not having electric space heat.

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 LIPA'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 and energy efficiency measures including refrigerators, CFL bulbs, pipe insulation, hot water heater tank wraps, and faucet aerators.

Program implementation remained consistent between 2011 and 2012. The staff involved in the program and the sub-contractors charged with implementation remained the same, as did the mix of measures provided. After taking over for the former implementer, Honeywell, partway through 2011, the current implementers (CSG and CMC) used 2012 to build a positive and productive relationship with LIPA. The most significant obstacle for REAP in 2012 was the devastation caused by Hurricane Sandy, which had a large impact on scheduling and therefore program participation toward the end of the program year. Further, while most program processes remained the same as in 2011, the program did begin targeting potential participants using the household assistance rate code, and also provided program contractors with guidance and instruction regarding customer communications.

Impacts for Comparison to Goal and Cost-Effectiveness

As in 2011, the Evaluation Team used two methodologies to estimate ex post savings for the REAP program: 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. The results of this year's billing analysis are very similar to the results of last year's billing analysis of 2010 participants (cost-effectiveness realization rate of 44% 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		Cost-Effectiveness Realization Rate	
		kW	kWh	kW	kWh	kW	kWh
All	3,538[a]	720.1	5,739,480	321	2,344,848	45%	41%

a=Number of homes as of December 15, 2012.

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 that an engineering approach uses to obtain net savings. These results are applicable to both the comparison to goal and the cost-effectiveness calculation.

Billing Analysis

The evaluation design included a comparison group of customers who participated in the 2012 program year. This model allows us to compare the post-installation billing records of the first group (2011 participants) to both its own pre-participation records and to the first-year (i.e., 2010) billing records of the comparison groups. Those two periods (pre-participation for participants and 2010 for the comparison group of later participants) are contemporaneous. Best practices in the use of billing analysis are to use at least 12 months of data after the installation of program measures. As such, the results of our billing analysis show savings from the 2011 participants as noted above.

In terms of comparability across program years, there were slight differences in share of measures between the 2011 and 2012 program years (as shown in Table 7-2), but no substantive change in program design across the two years. In both years, lighting contributed around 70% of ex ante program savings, and refrigeration contributed a significant share (29% in 2011 and 24% in 2012). While two new measures—air sealing and building envelope work—were added in 2012, these measures are a relatively small share of ex ante program savings and average household savings. As such, we have applied the program-level realization rate of this analysis to the program-planning estimates for 2012.

Table 7-2. REAP Installations by Program Year

Category	2011		2012	
	Number of Installs	Percentage of Ex Ante kWh	Number of Installs	Percentage of Ex Ante kWh
Lighting	33,033	69.8%	51,927	72.5%
Refrigerator	963	28.5%	1,388	23.8%
Hot water	226	0.9%	469	2.7%
HVAC	400	0.7%	169	0.6%
Envelope	N/A	N/A	30,787	0.2%
Air sealing	N/A	N/A	1,523	0.2%

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. This customer orientation (propensity to participate) is important for comparability, but is often difficult to measure or control for 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 addresses this problem to a very large degree. We also examined their billing histories during the pre-participation period (2010) to confirm that the 2011 and 2012 participants had similar patterns of electricity consumption in each month.

The model we used was a fixed-effects panel model. This type of model allows all household factors that do not vary over time to be absorbed by (and therefore controlled for) the constant term 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 and would probably be a wash over the sample. The critical things to include in these models are the time-varying factors, including weather.

Please see Section 14 for a more detailed discussion of the billing analysis method and our model specification.

Table 7-3 presents the end-use and overall program savings for the 2011 participants. As described above, we have applied the realization rate of the *overall* program to the 2012 program. The end-use specific realization rates in the table below are for descriptive purposes only. Because (a) the precision levels of end-use specific realization rates are not as strong as the program overall, and (b) 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 2012 program. 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 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 29 HVAC participants and 35 DWH 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)[21]	Program Planning Savings[22]		Observed Savings		Realization Rate[23]
		Weighted Average Household Daily Savings (kWh)[24]	Weighted Average Household Annual Savings (kWh)	Weighted Average Household Daily Savings (kWh)	Weighted Average Household Annual Savings (kWh)	
Overall Program	986	4.21	1,539	1.84	673	44%
Lighting	922	2.95	1,078	1.29	471	44%
Refrigerators	470	1.22	445	0.43	157	35%

[21] 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.

[22] Excludes line losses.

[23] Relative precision is greater than 30% for individual end uses. Realization rates are provided for directional purposes only.

[24] These averages include *all* households, even those that did not install measures (their "zero" savings values are part of the average).

Net Impacts Using Engineering Approach

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 an NTGR of 1.0, which is typical for low-income programs. As such, the gross and net impacts are identical.

Table 7-4 provides a review of impacts for the program in 2012 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	Ex Ante		Ex Post		RR	
		kW	kWh	kW	kWh	kW	kWh
Lighting	51,927	354.3	4,162,911	316.3	2,857,207	89%	69%
Refrigerator	1,388	213.5	1,364,263	94.3	767,899	44%	56%
Hot water	469	77.4	155,156	32.1	100,768	41%	65%
HVAC	169	68.3	35,609	68.3	35,609	100%	100%
Air sealing	1,523	4.7	9,749	4.7	9,749	100%	100%
Envelope	30,787	1.9	11,792	1.9	11,792	104%	193%
Total	**86,263**	**720.1**	**5,739,480**	**517.7**	**3,783,023**	**72%**	**66%**

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:

Lighting: For lighting measures, the Evaluation Team found a realization rate of 89% for demand savings, as our analysis used a lower delta watts assumption that is used in the ex ante savings calculation. The Evaluation Team used information regarding preexisting bulb wattage for each measure line item in program tracking data to estimate a weighted average delta watts value for all program installed lighting measures (54.08 watts). Evaluated energy savings are 69% of ex ante savings due to the lower evaluated delta watts and hours of use values. The hours of use value used on the evaluation is consistent for residential lighting measures across all programs, 1,022 hours per year.

Refrigerators: For refrigerator measures, the Evaluation Team noticed inconsistencies between the deemed savings used in program algorithms and those recommended by ENERGY STAR®. Ex post savings calculations compare the energy consumption between the installed ENERGY STAR-qualified units and the replaced federal-standard units at the vintage specified in the tracking data. Evaluators determined a realization rate of 44% for peak kW and 56% for kWh, which are similar in the 2011 evaluation results. Evaluators recommend that the REAP program realign with ENERGY STAR recommendations on annual consumption for both efficient and old refrigerators.

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 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 program-tracking data.

Air- and duct-sealing measures are quantified by the number of hours billed by a contractor in the program-tracking data, and values vary widely among line items. Given that the savings algorithm is deemed appropriate, we have not de-rated the ex ante savings values. We recommend a thorough review of the manner in which these calculations are applied to install quantities in the program-tracking database to estimate ex ante savings.

Envelope: For attic, roof, and wall insulation measures, the Evaluation Team examined tracked install data on insulation square footage and pre- and post-install R-values. We attempted to use this tracking information with energy balance algorithms and Long Island degree-day information to estimate energy and demand savings. Our review of the results of the degree-day analysis indicates that it is not the most comprehensive method of capturing the complex characteristics of insulation measures. The program employed a modeling approach for envelope measures. Evaluators have examined screenshots and descriptions of the envelope modeling software and have concluded that its inputs and high-level algorithms are reasonable. Therefore, evaluators have assigned a 100% realization rate for energy and peak demand savings for HPwES envelope measures in this evaluation cycle. This upcoming summer, evaluators plan to examine residential envelope measures using a modeling approach that will frame future evaluation recommendations.

Domestic Hot Water (DHW): Pipe insulation, tank wrap, showerhead, and temperature reset measures account for the domestic hot water (DHW) savings attributable to the REAP program. The Evaluation Team found that the deemed savings values and algorithms used to estimate ex ante energy and demand savings are not well documented. As such, we used a DOE 3E-Plus software to analyze heat loss from insulated and un-insulated pipes, and to determine ex post savings per lineal foot of pipe insulation. While we cannot identify some of the inputs used in the ex ante savings algorithm, we suspect that the discrepancies in ex ante and ex post savings estimates are attributable to pertinent variables such as the coincidence factor, annual operating hours, and hot water temperature.

Additionally, the program's tracking data for DHW measures were not sufficiently detailed to ensure an "apples-to-apples" comparison with evaluated savings. For example, the tracked savings currently do not indicate the R-value of insulation installed per line item. Therefore, the Evaluation Team is comparing tracked savings with deemed savings associated with a typical insulation R-value. The Evaluation Team recommends additions to the program's tracking database to capture additional per-install details.

8. ENERGY STAR® LABELED HOMES (ESLH) PROGRAM

LIPA'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. In addition, the ESLH program uses 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. A total of 429 ENERGY STAR homes were completed through the program. Program staff note that many builders decided to no longer participate in the program due to the increased requirements associated with ENERGY STAR Version 3.0, including additional checklists, new HVAC contractor training and certification, and non-energy-related requirements. However, citing its influence on local building practices, the program also claimed incremental savings above code on 301 non-ENERGY STAR homes with a HERS score below 70 (referred to as "HERS Index homes"). The Evaluation Team has assigned partial savings for these homes, and categorized these savings as program spillover. The program worked with raters to identify the homes and provided a $100 incentive to submit the REM/rate file. Program staff note that this effort also helped to inform future program design and document the levels of HERS scores being achieved on Long Island.

In 2013, the ESLH program revised its incentive structure and now offers incentives on homes that are not ENERGY STAR-qualified but have reached a HERS score below 70, along with other program requirements. Program staff believe that this will increase program participation and allow builders who do not wish to build to the ENERGY STAR platform to still take part in the program.

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

Category	Ex Ante Impacts			Evaluated Impacts			Realization Rate	
	N	kW	kWh	N	kW	kWh	kW	kWh
ENERGY STAR homes	429	813	1,320,317	429	813	1,320,317	100%	100%
Spillover (HERS Index homes)	301	627	518,031	103	235	192,204	37%	37%
Total Savings	**730**	**1,440**	**1,838,348**	**532**	**1,048**	**1,512,522**	**73%**	**82%**

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 LIPA consider updating its rating system and minimum requirements to be consistent with the updated national protocols.

Reasons for Differences in Impacts

The ESLH program assumes an NTGR of 1, with no participant free ridership or spillover. However, in addition to the 429 program-qualifying homes, the program also claimed savings for 301 homes that were not ENERGY STAR-qualified but achieved a HERS Index score below 70. These homes were built by a mix of builders who previously participated in the program and builders who have not participated in the program. The program claimed savings on all of these homes, previously participating or not, citing its influence on local building practices across the market. The Evaluation Team has taken the following approach to assign spillover savings for these HERS Index homes:

- **Homes built by previous participants:** We have assigned 100% credit in spillover savings to the program for the 103 HERS Index homes built by builders who previously participated in the program[25], as we can reasonably say that their building practices have been influenced through following program requirements, receiving technical assistance, and attending program trainings.
- **Homes built by non-participants:** Without specific research into the role of the program in influencing the practices of non-participating builders, we do not have a basis for apportioning savings to the remaining 198 HERS Index homes. We therefore do not assign savings credit to these homes.

[25] Previously participating builders were identified by comparing the names of the HERS Index builders to ESLH program data from 2010, 2011, and 2012.

While we do not have a basis for attributing program influence to HERS Index homes built by non-participants in 2012, we acknowledge that the ESLH program may have also influenced non-participating builders to some extent. Additional research will be conducted in 2013 to further explore LIPA's influence on the area's building practices.

9. SOLAR PHOTOVOLTAIC (PV) PROGRAM

The LIPA Solar Photovoltaic (PV) program is an incentive program that offers rebates to approved residential and nonresidential customers 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 LIPA's energy and capacity requirements.

In 2012, LIPA provided rebates for 975 solar PV systems, a decrease from 1,160 in 2011. The lower participation level may have resulted from several factors. First, in an effort to maintain available funding through the whole year, the program limited customers to receiving rebates for 50 kW of installed panels within a 12-month period, preventing organizations from receiving rebates for multiple projects.[26] Second, in July 2012 LIPA instituted the Clean Solar Initiative Feed-In Tariff, which pays owners of eligible (>50 kW) systems a fixed rate per kWh generated. The program managers believe that because the tariff targets larger systems, contractors focused on selling to these accounts in the first half of the year to take advantage of the upcoming tariff, and did not push sales of smaller residential systems. Finally, the effects of Hurricane Sandy may have decreased potential participants' interest in and ability to install solar PV systems in the last quarter of 2012.

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	789	2,380	7,913,971	2,891	7,145,428	126%	90%
Commercial	96	1,187	3,923,129	1,495	3,582,896	126%	91%
Municipal	90	673	2,218,198	837	2,005,071	124%	90%
Total	**975**	**4,240**	**14,055,298**	**5,313**	**12,733,394**	**125%**	**91%**

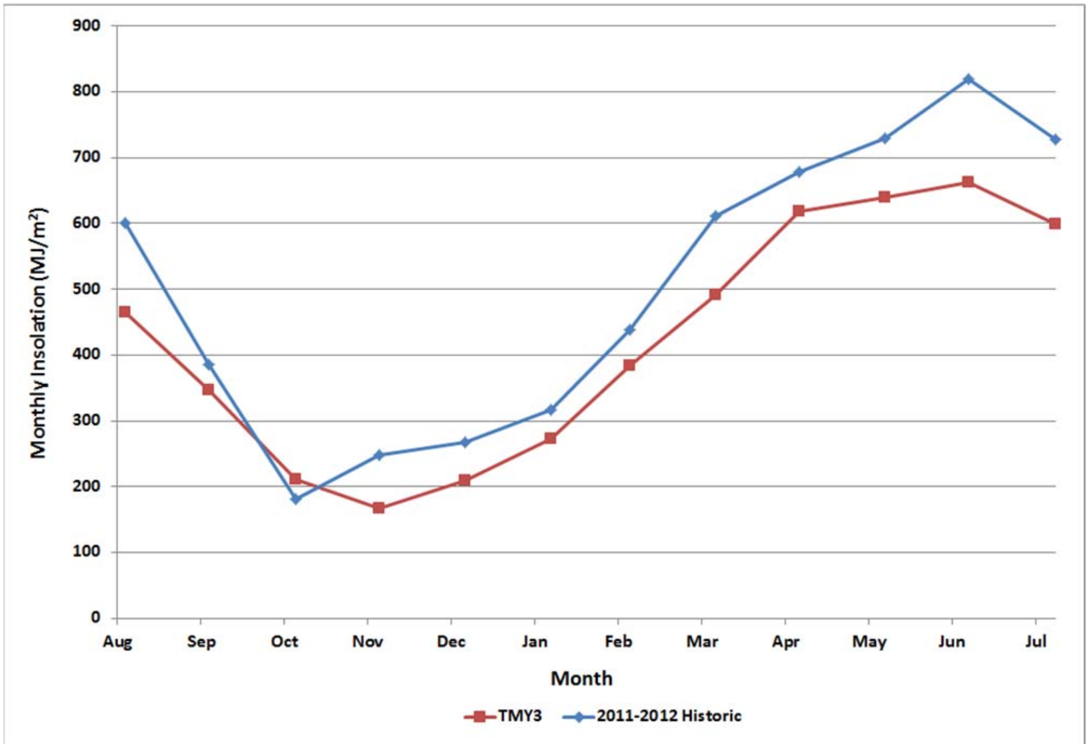
For the PY2012 evaluation, the Evaluation Team reviewed LIPA's solar PV performance analysis that uses contractor- and manufacturer-supplied hourly interval data to calculate realized energy savings from a sample of 2012 solar projects. To normalize capacity versus performance, LIPA performed an in-house 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 975 installations in 2012.

To determine long-term PV output over the life of the panels, we normalized solar kWh production from 2011-12 to 30-year typical meteorological year (TMY) weather for Islip, NY. The data showed that through the course of a year, monthly solar insolation patterns can fluctuate, as shown in Figure

[26] In another effort to maintain funding through all of 2012, the program also decreased the rebate amount at regular intervals or when certain participation thresholds were met.

1-1. The data indicates that the typical insolation patterns over the last 30 years are lower than those observed in 2011-12.

Figure 9-1. Solar Radiation Trend for Islip, NY



The ex-post peak demand analysis used average 14-year peak day/hour information provided by LIPA, along with the 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 1999-2012, as outlined in Table 9-2.

Table 9-2. Solar Peak Hour Weighting Factors

Peak Hour Weighting		
Hour Starting	# Years	Weighting
2 p.m.	2	14.3%
3 p.m.	4	28.6%
4 p.m.	7	50.0%
5 p.m.	1	7.1%

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 LIPA incentives on PV installations on Long Island can be found in the Program Guidance Document for 2011.

Values in Table 9-3 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. 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	789	2,380	7,913,971	2,891	7,145,428	126%	90%
Commercial	96	1,187	3,923,129	1,495	3,582,896	126%	91%
Municipal	90	673	2,218,198	837	2,005,071	124%	90%
Total	975	4,240	14,055,298	5,313	12,733,394	125%	91%

Reasons for Differences in Impacts

The program currently uses a coincidence factor of 0.41. Our analysis determined an ex post coincidence factor of 0.51 using the average 14-year peak hour weighting in Table 9-2. This is the sole reason for 25% 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 2012 alone. This discrepancy caused a 9% reduction in ex post energy savings as compared with ex ante.

10. SOLAR HOT WATER PROGRAM

The LIPA Solar Hot Water program is an incentive program that 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 LIPA's energy and capacity requirements.

As was the case in 2011, the Solar Hot Water program provided rebates to only three projects. According to the program manager, the large difference between the participation goal and the actual participation was due to a delayed launch and LIPA's prioritization of other programs. Additionally, the program requires participants to have electric water heating, which limits the number of potential participants on Long Island, where other fuels are more commonly used for water heating. Lastly, many customers that responded to an e-mail blast for solar hot water systems chose instead to install solar PV systems.

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	3	5.94	8,680	5.94	8,680	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.

The Solar Hot Water program funded three projects in 2012, its third year of existence. 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. As the program grows and funds more installations, we will more closely examine program processes and impact calculations.

11. BACKYARD WIND PROGRAM

The Backyard Wind (also called Small 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, and training market actors. LIPA staff also report working with county and town government officials to modify zoning regulations where appropriate. Work with five towns on the east end of Long Island is nearing completion and LIPA is awaiting town officials to adopt the standard procedures.

Only five new turbines were rebated in 2012 compared to two in 2011 and falling short of the goal of 22 systems. The program has not met the targeted number of systems in each of the past three 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. 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		Ex Post		Realization Rate	
	2011[1]	2012[2]	kW	kWh	kW	kWh	kW	kWh
Residential	0	0	-	-	-	-	N/A	N/A
Commercial	2	5	6.56	137,854	16.62	113,263	253%	82%
Municipal	0	0	-	-	-	-	N/A	N/A
Total	**2**	**5**	**6.56**	**137,854**	**16.62**	**113,263**	**253%**	**82%**

[1] The program claims a 35% carryover of energy savings from 2011 projects.

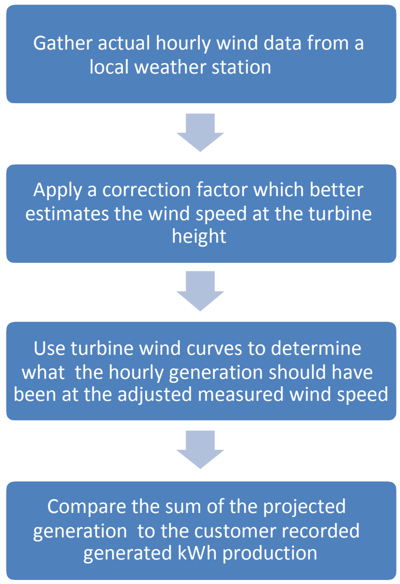
[2] The program claims 65% of energy savings from 2012 projects.

Estimation of Savings

To determine ex post gross energy and demand impacts, the Evaluation Team conducted a review of performance data for wind turbines incentivized through LIPA's Backyard Wind program. The system performance data consisted of electric generation data gathered by the wind turbines' inverters. The inverters track cumulative energy production, which customers log on the first of each month and report to LIPA. The program funded five wind turbine installations in 2012, but interval performance data were only available for one system. As such, we based our impact evaluation on the performance of one 2012 and two 2011 installations 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 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 (TMY [Typical Meteorological Year] weather data), and actual hourly wind speed from the nearest weather station (Westhampton 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.

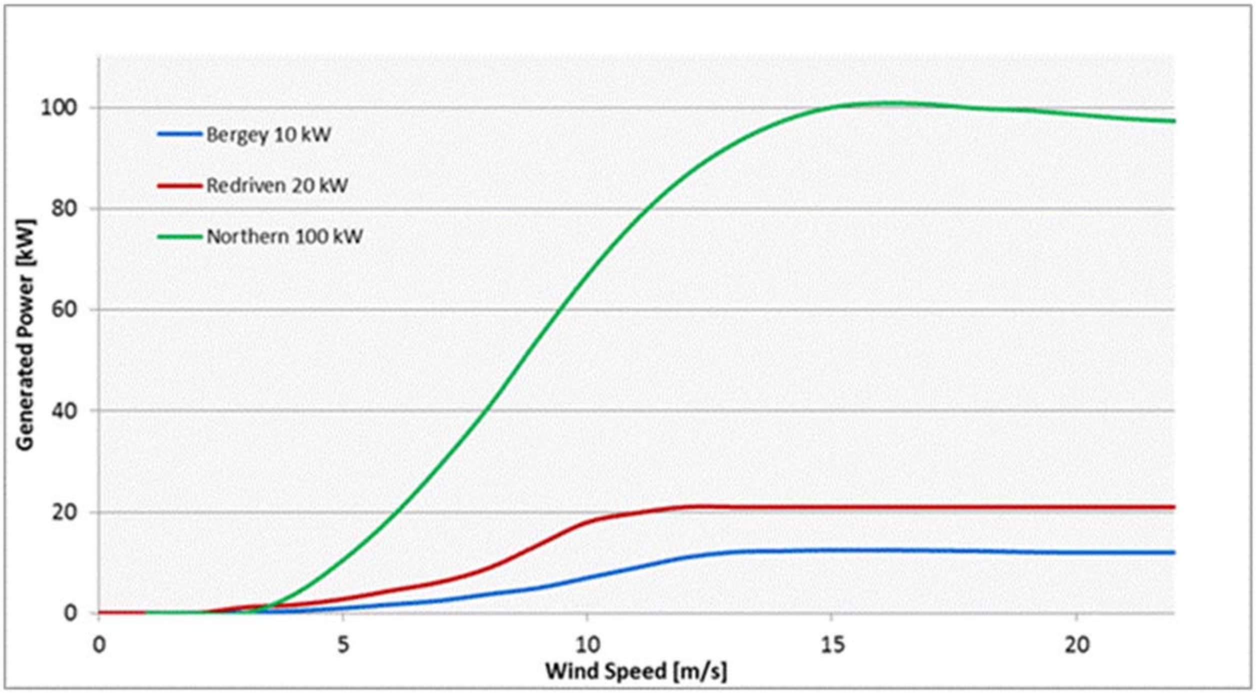
We acquired the turbine power curves for each turbine installed and used these to calculate the predicted generation for each hour, based on actual wind conditions. The turbine efficiency is the sum of the actual production of the turbine recorded by the owner divided by the sum of the predicted performance 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.[27]

To determine ex post demand savings, the Evaluation Team used the average wind speed during each of LIPA's annual peak hours, dating back to 1999. We obtained wind speed data from the National Oceanic and Atmospheric Administration (NOAA) during LIPA system peak hours from the West Hampton Beach Airport. We then adjusted wind speeds to represent estimated hub-height wind speed. We used these data, along with the power curves, for installed wind turbine types presented in Figure 11-2, to determine ex post demand savings.

[27] These calculations essentially replicate the methodology used by LIPA's software to predict performance using actual wind speed rather than typical wind speed.

Figure 11-2. Power Curves by Turbine Type



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. 2012 Site-Level Results (at Customer Meter)

Project #	Type	Installed kW	2012 On-Line Date	Expected Annual Production (kWh)	RR on Expected Production	Ex Ante kWh	Ex Post kWh	RR on Ex Ante kWh
1	Commercial	10	Mar-12	14,412	53%	9,368	7,697	82%
2	Commercial	20	Aug-12	36,000	53%	23,400	19,226	82%
3	Commercial	10	Jan-12	11,002	53%	7,151	5,876	82%
4	Commercial	10	Jun-12	10,728	53%	6,973	5,729	82%
5	Commercial	10	Mar-12	11,220	53%	7,293	5,992	82%

Reasons for Differences in Impacts

The evaluation findings indicate that LIPA's method of estimating ex ante energy savings is reasonably accurate, if the turbines are all working properly. On the other hand, the Evaluation Team believes that the program currently underestimates turbine output during the peak hour. Even a slight change in wind speed can result in a significant change in turbine output; this is the primary reason for the high peak demand realization rate. Based on our evaluation, we provide the following recommendations:

- Demand impacts will vary significantly from year to year. Ten years of wind data showed a range of 1.8 to 9.4 meters per second (average of 4.9 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. A service factor should be applied 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 four program years (i.e., sixteen 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. PROGRAM-SPECIFIC RESEARCH

While the impact assessment was the primary focus of the 2012 evaluation effort, the Evaluation Team also completed research on specific programs and select markets targeted by key LIPA programs to enhance program design, delivery, and performance. These efforts focused on four aspects of LIPA's program implementation: 1) CEP program delivery and SBDI market traction; 2) EEP program participation; 3) Cool Homes program participation; and 4) ENERGY STAR® Labeled Homes program process assessment. Below we present the detailed process findings from these four research areas.

12.1 COMMERCIAL EFFICIENCY PROGRAM

LIPA's Commercial Efficiency Program (CEP) is multi-faceted and comprehensive. The program provides incentives and technical support to commercial customers with facilities in LIPA's service territory and caters to all business customers in LIPA's service territory, including small business customers and not-for-profit entities. CEP offers incentives for a wide variety of energy-efficient equipment options, and provides other types of support, such as energy audits and technical assistance studies.

In 2012, LIPA continued to deliver the CEP program through four sales methods:

- Prescriptive: Offers predefined replacement and retrofit measures that are rebated at set incentive amounts.
- Retrofit Existing: Offers retrofit measures using the specific measures installed in the existing site as the determination of savings. These measures are rebated at set incentive amounts.
- Direct Install: Offers only lighting measures through a turnkey approach to small business customers.
- 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 to 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 LIPA to better meet customers' needs and engage customers with the program.

The program is delivered through three delivery channels, each implemented by a dedicated contractor: CEP Mid-Market (implemented by National Grid), Solutions Provider (implemented by TRC), and Small Business Direct Install (SBDI, implemented by Lime Energy). The CEP Mid-Market and Solutions Provider program components work with customers to obtain savings through the Prescriptive, Retrofit Existing, or Custom elements. Customers must work with Lime Energy to participate through the Direct Install component. However, customers involved with SBDI can also work with CEP Mid-Market or Solutions Provider.

LIPA chose to focus the 2012 evaluation activities for CEP on the SBDI program component and conduct a limited process review of the other program components. Our targeted market research activities for the SBDI program component focused on developing a more complete understanding of program participation and identifying opportunities and areas for improvement in program outreach and marketing moving forward. We completed the following tasks:

- Secondary review of existing literature related to SBDI program design and implementation
- Analysis of LIPA customer and SBDI program-tracking data
- In-depth interviews with SBDI program staff
- Primary research with non-participating SBDI-qualifying customers

To support the limited process evaluation of the other CEP program components (Prescriptive, Existing Retrofit, and Custom), we performed in-depth interviews with program staff. The goal of the interviews was to understand and document programmatic changes that occurred in 2012.

In the sections below, we provide findings from the process-related research efforts. Due to differences in goals and research scope, the results are presented separately for the SBDI program component.

12.1.1 CEP Participation Overview

From 2011, total participation across all CEP program components more than doubled and reached 4,138 in 2012 (as compared to 1,690 in 2011). While the number of Prescriptive and Custom applications decreased, participation in the SBDI and Existing Retrofit programs increased substantially. The majority of commercial participants completed Existing Retrofit projects in 2012 (54%). Due to its late launch, the SBDI program accounted for 3% of all applications in 2011. In 2012, SBDI program participation increased to 1,528 applications and currently represents 37% of total commercial portfolio applications.

Table 12-1. Participation Overview

Program Component	2011		2012	
	Number of Applications	% of Applications	Number of Applications	% of Applications
Prescriptive	495	29%	309	7%
Existing Retrofit	787	47%	2,237	54%
Custom	354	21%	64	2%
SBDI	54	3%	1,528	37%
Total	**1,690**	**100%**	**4,138**	**100%**

Prescriptive, Existing Building, and Custom Program Components for 2012

In 2012, LIPA continued to further enhance and refine the CEP program design, delivery, marketing and outreach, and project management structures to increase participation levels, streamline program delivery, improve program-tracking data accuracy, and achieve high levels of customer and trade ally satisfaction. As such, the changes spanned a variety of areas including incentive structures, measure offerings, marketing and outreach strategies, trade ally engagement, application, and data-tracking processes.

Measure and Incentive Offerings

Throughout 2012, LIPA continuously added measure offerings to the existing menu of equipment rebated through CEP. Additions included LED lighting, lighting controls, HVAC, and refrigeration measures, among others. More specifically, LED measures offered through the program more than doubled, increasing from 14 in 2011 to 38 in 2012. Four HVAC equipment options were also added, including three categories of geothermal heat pumps, room air conditioners, ductless mini-split AC systems, and heat pumps.

In response to the T12 lighting phase-out, between September 1 and October 26 the program offered enhanced rebates for T12 retrofit projects. Initially, the plan was to offer the rebate through December 2012, but because of the initial success that the offering generated, LIPA terminated the offering earlier than planned to avoid an overrun of the program implementation budget.

Marketing and Outreach Efforts

Direct contact with customers continued to be the main vehicle for promoting CEP in 2012. The effort included a dedicated team of Senior Territory Managers reaching out to customers directly and engaging them with the program. On-the-ground outreach was enhanced in 2012 through engaging two field representatives who connected with manufacturers and trade ally groups, and provided representation at trade shows.

Marketing to customers in 2012 also included more traditional venues such as radio, print advertising, targeted mailers and flyers, testimonials, LIPA’s website, and the Energy Efficiency Conference for Long Island Businesses held in February of 2012. Outreach through Major Account Executives was a big part of the program activities as well.

Program-specific marketing and outreach was further supported and enhanced through LIPA’s more high-level marketing of its energy efficiency portfolio.

Trade Ally Engagement

A major emphasis of CEP program outreach activities focused on trade allies.[28] The CEP staff worked closely with trade allies over the course of 2012. The core efforts included:

- Direct outreach to trade allies by program staff and field representatives
- Periodic meetings and training sessions
- Coordination of trade ally engagement with the Trade Ally Partners Program and other energy efficiency programs in LIPA’s program portfolio

Throughout 2012, CEP field staff worked with trade allies to answer questions, provided information about the program offerings, and facilitated engagement with the program. CEP program staff also offered weekly open house sessions where trade allies could have their project-related questions answered by LIPA staff, as well as quarterly breakfast sessions, during which the program staff reviewed programmatic changes (e.g., design, incentives, bonus programs, etc.) and provided trade ally training.

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[28] Trade allies refer to any third party who promotes the distribution of and/or installs equipment. This may include contractors, distributors, and other professionals.

In 2012, CEP program staff continued working on building its Commercial Efficiency Partner base (known as LIPA Efficiency Partners). Trade allies who completed three or more projects were listed as LIPA Efficiency Partners on LIPA's website. This provided trade allies with another opportunity to market their services to prospective commercial customers.

To further spur trade ally engagement with the program as well as to even out the flow of applications throughout the year[29], LIPA offered bonus incentives to trade allies based on the number of projects they completed through the CEP program. Contractors who completed 12 or more projects by the end of 2012 (with a $1,000 customer rebate minimum per project) were eligible to receive a sliding-scale incentive based on the date the twelfth project was completed, outlined in Table 12-2.

Table 12-2. Trade Ally Bonus Incentive Structure

Incentive Tier	Project Completion Deadline	Incentive Amount	Maximum Quarterly Incentive
Tier 1	3/31/12	20%	$100,000
Tier 2	6/30/12	15%	$75,000
Tier 3	9/30/12	10%	$50,000
Tier 4	12/31/12	5%	$50,000

CEP program staff also worked to leverage LIPA trade ally outreach and engagement efforts implemented through other programs. For example, CEP program staff attended quarterly contractor breakfasts hosted by the Cool Homes program to expose the Cool Homes pool of contractors to commercial program offerings.

Based on the interviews with program staff, the total number of CEP participating trade allies increased from around 300 to over 500 in 2012.

Application Process

In 2012, CEP program staff reorganized the application forms to make them more user-friendly as well as to provide a greater level of detail about the participation process.

LIPA also implemented a newly designed interactive Excel application form in 2012. One unique feature is the automated customization of the application form based on the end use technology. Each application includes a list of required documents, as well as an outline documenting sequence steps required for program participation. According to program staff, the new design simplified the application process for customers while also enabling faster and more accurate transfers of project data into LIPA's program-tracking database, Siebel. LIPA retained the PDF versions of applications as an option for those who were unable to access or were uncomfortable using the Excel-based form.

[29] Historically, most of the Commercial Efficiency program applications occur in the last quarter of the year.

Implementation and Data-Tracking Processes

In 2012, LIPA standardized the pre-approval, pre-inspection and post-inspection requirements across all program components. All Custom, Existing Retrofit, and Prescriptive projects must now undergo pre-approval, pre-inspection, and post-inspection regardless of project size. Pre-approval for projects at Friday Open House Meetings originally offered to customers and trade allies through a portion of 2011 was discontinued in 2012.

To help facilitate the assignment of customers to the appropriate implementation contractor (Solutions Provider or National Grid) and avoid bottlenecks associated with the customer transfer from one implementation contractor to the other, LIPA created a shared e-mail account. The account is integrated with the Siebel system to allow automatic assignment of projects to the appropriate implementation contractor.

CEP continued to rely on Siebel as its primary project-tracking database. In 2012, LIPA finalized a formal guide document for CEP implementation processes and procedures in order to ensure consistencies across the implementation contractors. The document included formal protocols for interfacing with the Siebel database, including naming conventions for attachments, and required fields to be populated for all opportunities. In October 2012, CEP launched an automated import tool that populated Siebel data fields (e.g., savings values) by automatically extracting the needed information from the electronic Excel application forms. Program staff believe that this addition helped in expediting data entry and eliminating data entry errors.

12.1.2 SBDI Market Traction Assessment

LIPA's Small Business Direct Install (SBDI) program, now in its second year of implementation, is a turnkey program implemented by Lime Energy that offers lighting measures to qualified commercial customers. To qualify, customer average monthly demand should not exceed 145 kW and a customer must be on a capacity-constrained circuit as defined by LIPA. The program design includes a free energy audit and rebates for installation of energy-efficient lighting improvements. LIPA covers 70% of the total project cost, and customers are responsible for the remaining 30%, with financing available through Lime Energy.

Based on the interviews with the SBDI program staff, marketing and outreach efforts for the SBDI program consist of several targeted efforts including door-to-door visits and phone calls covering a portion of the population of eligible customers, and direct mail sent to the entire population. Lime Energy also utilizes press events, radio spots, newspaper ads, and testimonials on community websites to increase awareness of and interest in the program, but limits these activities to areas with large concentrations of businesses on constrained circuits.

Research Findings and Conclusions

This section summarizes findings from the SBDI market traction research and analysis efforts, draws conclusions about possible implications of the findings on the SBDI program moving forward, and provides recommendations on possible future programmatic changes.

SBDI Program Design and Implementation Elements

Utilities around the country have been administering Small Business Direct Install (SBDI) programs for decades. These programs generally have a unique design that caters to the needs and addresses the barriers of small business customers. The core elements include user-friendly turnkey delivery strategy that often includes a no-cost energy assessment of a small business facility; direct installation of low-cost measures such as CFLs or LEDs; expedited measure installation, generally through a force of pre-selected installation contractors; and generous incentive structures. LIPA's SBDI program features design and implementation elements similar to the other SBDI programs across the country. The elements that are unique to LIPA's SBDI program include geographic focus (on especially constrained load circuits), as well as its focus on lighting measures only.

In light of ever-increasing goals, LIPA's SBDI program might benefit from adopting some of the elements that other SBDI programs across the country use, including the following:

- No-cost direct installation of lighting measures, such as CFLs or LEDs, at the time of the audit. Given that 62% of SBDI-eligible customers do not move beyond audit due to a variety of reasons, costs and hassle-factor among them, this enhancement might help the program capture additional savings.

- Customer pre-screening to identify presence of opportunities for improvement. This step might help reduce costs associated with conducting audits at facilities with no opportunities for energy savings.

- Exploring the possibility of expanding the measure offerings to include non-lighting measures (including HVAC, refrigeration, kitchen, or motors). Results of the survey effort with non-participating customers indicate that, depending on the equipment type, between 33% and 77% of customers have opportunities for non-lighting measure retrofit, and between 18% and 20% are interested in replacing the equipment within the next year. Furthermore, 21% of SBDI-eligible customers who received an audit but did not install audit-recommended improvements report that the audit did not identify opportunities for improvements.

  When considering the possibility of adding non-lighting measures as part of the program offerings, however, it is important to consider and balance possible challenges that this change might pose to the streamlined delivery of the program.

SBDI Program-Eligible Customer Characteristics

SBDI-eligible customers represent a considerable share of the commercial customer base (24%). This indicates limited potential for expanding the number of circuits currently targeted by the program, as such a change may increase overlap with the commercial customer base targeted by other CEP programs components, thus potentially reducing savings and causing customer confusion. SBDI-eligible customers differ from non-eligible customers with regard to business segment representation. The population of SBDI-eligible customers includes a larger share of lodging, agricultural, food service, and retail businesses as compared to non-eligible customers. LIPA may wish to consider these differences as it continues to refine the program marketing and outreach tactics. Segment-specific messaging and outreach strategies may increase customer engagement and participation.

SBDI Program Marketing and Outreach

From program inception through the end of 2012, Lime Energy has been marketing the program through a variety of outreach mechanisms, including direct mail, in-person door-to-door outreach, and telemarketing. Door-to-door outreach has proven a core driver of audit completion and program participation. Approximately 26% of SBDI-eligible customers exposed to in-person marketing and outreach receive audits, as compared to 14% of eligible customers receiving any form of program outreach and 4% of eligible customers that did not receive in-person outreach. Lime Energy should continue leveraging in-person outreach as part of its core marketing and outreach structure.

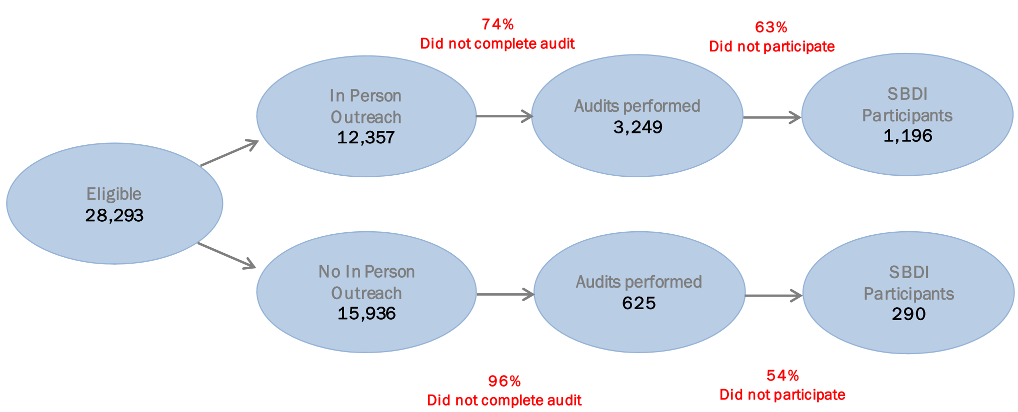
Despite the breadth and reach of program marketing and outreach efforts, awareness of the SBDI program among SBDI-eligible customers remains relatively low (33%). Furthermore, awareness of the core components of the SBDI program is lacking somewhat, even among customers who received an audit through the program. For example, 69% of customers who completed an audit through the SBDI program were aware that Lime Energy offers no-interest financing of the balance of the project costs. This suggests opportunities for increased education of eligible customers regarding the program and its benefits. Revisiting the design and the content of the marketing materials provided to customers to focus on key program offerings and benefits, as well as looking for opportunities to incorporate other sources of outreach, might help bridge the gap in program awareness.

Customers who completed an audit through the SBDI program but did not proceed with the installation of the high-efficiency equipment report being likely to install the audit-recommended equipment within the next six months. Given this finding, the SBDI program staff might consider integrating more frequent follow-up activities with customers who were already "touched" by the program.

SBDI Program Participation

Of all eligible customers, 14% received an audit and 5% installed audit-recommended equipment, resulting in an overall audit-to-project conversion rate of 38%. Figure 12-1 below provides a more detailed overview of SBDI-eligible customer flow.

Figure 12-1. SBDI-Eligible Customer Flow from Outreach to Participation



Not surprisingly, participation in the SBDI program varies by business type and geography. For example, offices as a segment within SBDI-eligible customers represent significant potential for savings. Offices comprise 22% of eligible customers, and only 3% of eligible office customers have completed a project through the program. With respect to geography, participation is substantially lower in the Hamptons, Southold, and Shelter Island despite aggressive outreach. LIPA may wish to consider targeting underperforming customer segments and geographies with enhanced outreach through targeted marketing.

While opportunities for increased and targeted marketing and outreach remain, there are a variety of barriers that prevent customers from participation. In addition to audits failing to identify opportunities for improvement, non-participants list costs and the hassle-factor associated with program participation as the core barriers to moving ahead with the program. Highlighting the generous incentives that the SBDI program currently offers and the hassle-free, fast, and unobtrusive installation process through marketing and outreach may prove a helpful tactic to engage customers with the program.

Another key barrier that limits the SBDI program's achievement of goals is the presence of the competing program offerings in the marketplace. SBDI-eligible customers are also eligible to participate in the Mid-Market component of CEP. Our analysis reveals that 2% of SBDI-eligible customers participated in the Mid-Market program component through installing lighting improvements consistent with the SBDI program offerings and achieving 2.6 MW and 8,727 MWh in savings. Such customer attrition can negatively affect the SBDI program's ability to meet the SBDI savings goals. LIPA should consider this factor when determining savings and participation goals for the SBDI program.

Subsections below provide more detailed findings with respect to the SBDI market traction assessment.

Detailed Findings

Comparison of LIPA's SBDI Program to Other Programs across the Country

As part of the SBDI market traction research, we performed a literature review of the SBDI programs administered throughout the United States. The goal of the review was to document the specifics of the SBDI program design and implementation, compare and contrast them, and highlight the similarities and differences of the other programs and LIPA's SBDI program.

Our review included 11 programs across the country, eight of which are administered in the northeastern United States, including New York State. Table 12-3 details the utilities whose SBDI programs we included as part of our review. In addition to the review of individual programs, we reviewed a variety of white papers and other publications that cover the topic of the SBDI programs and design and implementation elements that contribute to the programs' success. The Detailed Methods section of the report contains details on the sources that we included in our review.

Table 12-3. List of Programs Reviewed as Part of the Secondary Data Review

Utility	State
Con Edison	NY
NYSEG	NY
Orange and Rockland	NY
RG&E	NY
PSE&G	NJ
Cape Light, National Grid, NSTAR, Unitil, WMECO	MA
Connecticut Light and Power	CT
National Grid	RI
Xcel Energy	MN
ComEd/Nicor, ComEd/Peoples Gas/North Shore Gas	IL
SDG&E	CA

There are a variety of design and implementation elements that are unique to SBDI programs. In this section, we provide an overview of these elements and draw parallels with LIPA's SBDI program. Table 12-4 provides a high-level overview of the core design and implementation components of the SBDI programs that we included as part of the review. Following the table, we provide detailed findings across each of those elements.

Table 12-4. Comparative Overview of the SBDI Program Design and Implementation Components

Program Component	Detailed Description of the Component	LIPA	Xcel Energy	ComEd	MA Utilities	SDG&E	NYSEG	RG&E	Con Edison	Orange & Rockland	PSE&G	CT Light & Power	National Grid RI
Turnkey Program	Program is designed to be cost-effective, low-involvement, “turn-key” energy-savings service	√	√	√	√	√	√	√	√	√	√	√	√
Eligibility Threshold	Customers are qualified by peak demand	≤145	≤400	≤100	≤300	<100	<100	≤100	<100	<100	<150	10-200	<200
	Customers must meet additional criteria	√		√							√		
FREE Energy Assessment	Free energy assessment is offered to all qualifying customers	√	√	√	√	√	√	√	√	√	√	√	√
	Select products provided at no-cost during energy assessment			√				√	√	√			
Equipment	Lighting Measures	√	√	√	√	√	√	√	√	√	√	√	√
	Non-Lighting Measures			√	√			√		√	√	√	√
Incentive	Incentive offered for percent of project cost	70%		30-70%	70%	70%	70%	100%	70%	70%	80%	35%-50%**	70%
	Incentive offered per kW saved		$525/kW saved*										
Financing	Financing options available for the remaining installation cost	√	√		√			Unclear			√	√	√

** Up to 60% of total installed cost.*
***The program features various measure- and project-level cost-caps.*

Eligibility Thresholds

Eligibility for participation in SBDI programs is nearly always determined by the business's average peak monthly demand. The demand thresholds that qualify small business customers for participation range from 100 kW to 400 kW.

Consistent with the other SBDI programs, LIPA's SBDI program is accessible to small business customers with average monthly demand of 145 kW or less. However, because one of the goals of LIPA's SBDI program is to reduce load in capacity-constrained areas, the program uses business location as an additional qualification criterion.

Both the ComEd and PSE&G programs require participants to meet additional qualification criteria as well. ComEd's program is restricted to those who are customers of both ComEd and one of the gas utilities, while the PSE&G program is restricted to government and non-profit facilities.

Turnkey Program Delivery

Lack of financial resources, lack knowledge of energy-efficient options, and lack of time pose significant barriers that prevent small businesses from making energy-efficient improvements. Literature on the topic of small business program design reveals the importance of utilizing a turnkey program design to address these common barriers to participation. Turnkey programs typically include a free no-obligation energy audit of the facility with recommendations for energy-saving improvements; provision of qualified contractors to complete the project; incentives covering all or a portion of project costs; and financing for the balance not covered. Such program delivery structures help to avoid hassle associated with researching the improvements appropriate for the business, contractor searches, and rebate application processes. Our review of literature revealed that most programs for small business customers are designed as turnkey programs.

LIPA is no exception—its SBDI program is designed as a turnkey program to eliminate the barriers to participation that exist among the small business customers.

Marketing and Outreach

In-person outreach, whether from the Program Administrator, a third-party implementer, or another program vendor, is the primary driver of participation for all of the programs that we looked at for which detailed information on marketing activities was available. Direct mailings, bill inserts, phone calls, and e-mail blasts are also common marketing tactics. SDE&G's program also uses more traditional marketing tactics such as print advertising. Additionally, two programs (Massachusetts SBDI program and SDG&E's SBDI program) work with local community groups and champions to educate customers about and engage them with the program. SDE&G and Con Edison also work with Chambers of Commerce, Business Improvement Districts, and other organizations to increase program awareness and participation.

LIPA's SBDI program outreach is consistent with the efforts used by the other programs, and includes in-person outreach, direct mail, and telemarketing. LIPA's SBDI program geographic eligibility requirements prevent the program from using widespread marketing and outreach. In areas with large concentrations of businesses on constrained circuits, Lime Energy employs in-person door-to-door outreach, press events, radio spots, newspaper ads, and testimonials on community websites to spread awareness of and interest in the program.

Free Energy Audit

Similar to LIPA's SBDI program, all of the SBDI programs we reviewed offer a free, no-hassle energy assessment of the customer's facility as the first step to program participation. Depending on the program, either the program's implementer or a program-designated installation contractor visits the customer facility to assess the state of the existing equipment, identify opportunities for improvement, and continue educating the customer on the program. After the energy assessment is completed, the customer receives a report outlining recommended measures and associated project costs and savings. This step is generally used as a final opportunity to sell the customer on the benefits of the program and close the deal.

Center for Energy and Environment (CEE), the program implementer for Xcel Energy's SBDI program, utilizes a third-party telemarketer to screen customers prior to offering an energy assessment, to determine whether they are a good candidate for the program based on other criteria such as how recently the facility has been retrofitted, the type of lighting equipment currently in use, and the presence of a budget to carry out an energy efficiency project. This strategy allows the program to focus its resources and prioritize follow-up activities on the facilities with the highest propensity to project implementation.

RG&E, ComEd, Con Edison, and Orange and Rockland attempt to address the hurdle of getting customers to sign up for energy assessments by offering immediate savings through the direct installation of select products for free at the time of the assessment. Products offered for free include low-flow faucets, low-flow aerators, low-flow showerheads, pre-rinse spray valves, vending machine controls, and CFLs.

Equipment Installation Services

Providing quick, hassle-free equipment installation is key to addressing the time constraint barrier experienced by many small business customers. All programs that we reviewed provide participants with qualified contractors to complete the installation work. One main point of differentiation is around the staging of when the installation contractor becomes involved in a project.

SDG&E's SBDI program and the SBDI program run by the Massachusetts utilities use a strategy where the contractor who completes the energy assessment and promotes the program also performs the installation. Under this structure, the installation may occur concurrently with the assessment visit. This structure focuses on facilitating quick turnaround between an audit and project completion.

In the ComEd and Xcel Energy programs, the installation contractor is activated after the energy assessment is complete and the customer has agreed to the proposed scope of work. This is the delivery structure that LIPA currently uses for its SBDI program.

In the white paper "Small Business Energy Efficiency: Roadmap to Program Design," CEE makes a strong case for keeping the role of the auditor separate from the technical role of the installation contractor.[30] In response to low participation rates in the program's first year, Xcel Energy's program implementer shifted its sales strategy from recruiting auditors based on their technical abilities to

[30] "Small Business Energy Efficiency: Roadmap to Program Design." Center for Energy and Environment, August 2012. For a full listing of SBDI programs documents reviewed see the Analytical Methods section.

hiring auditors based on their sales experience. The program now relies on the sales team's skill set to sell the program in a way that meets each potential customer's unique needs, and attributes a 50% sales rate increase in the second year to the new mentality.

SBDI Measure Offerings

Lighting measures are the most common measures offered through the SBDI program. As shown in Table 12-5 below, all of the programs we reviewed offer participants lighting measures. A little over half (55%) of the 11 programs offer at least one other measure in addition to lighting. Commonly offered non-lighting measures include refrigeration, HVAC, motors, air compressors, VFDs, and programmable thermostats.

Half of the programs promote refrigeration upgrades as a program offering. For example, Connecticut Light and Power provides anti-condensation door heater controls, evaporator fan controls, open case night covers, and electronically commutated motors under its SBDI program. Five programs out of the 11 that we reviewed offer HVAC measures, which include programmable thermostats (offered by two programs) as well as HVAC equipment upgrades and maintenance. Motors, VFDs, water heaters and air compressors are offered to a lesser extent.

Table 12-5. Overview of Measure Offerings

Measure	# of Programs that Offer Measure	% of Programs that Offer Measure
Lighting	11	100%
Refrigeration	6	55%
HVAC	5	45%
Motors	2	18%
VFDs	2	18%
Water Heaters	2	18%
Air Compressors	1	9%

Incentives Structures

Financial concerns present a significant barrier to participation for small businesses; therefore, offering substantial incentives is key. The majority of programs (92%) we reviewed cover a portion of the project costs. SDG&E's Commercial Direct Install program is the only program that provides complete coverage of project costs. Program incentives cover between 30% and 70% of the project costs. LIPA's SBDI program covers 70% of project costs—in line with most other programs that we reviewed.

The Xcel incentive structure is unique. It will pay a set amount ($525) per kilowatt saved, up to 60% of the program cost. The white paper "Ingredients for a Successful Direct Install Program" suggests that one benefit to paying out incentives based on performance is that contractors are more likely to install items where the energy savings are the greatest rather than where their profit margins are the greatest.[31]

[31] "Small Business Energy Efficiency: Roadmap to Program Design." Center for Energy and Environment, August 2012. For a full listing of SBDI programs documents reviewed see the Analytical Methods section.

Financing Options

Even with incentives, upfront costs can remain a barrier that a lot of small businesses cannot overcome. LIPA and five of the 10 programs we reviewed did not cover 100% of the project costs (Xcel, Massachusetts SBDI program, PSE&G, Connecticut Light and Power, and National Grid Rhode Island) offered financing for the balance of project costs (50%). Financing is either provided directly through the utility or through an implementation contractor, and is offered with an on-bill option by two out of 10 programs. LIPA's program also offers a 12- or 24-month financing plan to customers through the program implementer as one of its program components.

Industry literature supports on-bill financing as the best scenario for the customer, because it allows them to finance the project with no out-of-pocket costs and pay off their portion over time with the savings from the installed measures. Because it lessens the upfront financial barriers and makes the improvements cost-effective over time, on-bill financing has proved to result in higher participation rates.

Overview of SBDI Participation Patterns

As previously mentioned, to qualify for LIPA's SBDI program small business customers should be associated with a capacity-constrained circuit. As of the end of 2012, LIPA has identified 28,293 commercial accounts as eligible for the SBDI program.[32] Based on the analysis of LIPA's CIS customer database, SBDI-qualifying customers represent a considerable share of LIPA's commercial customers (24%).[33] This might indicate limited potential for expanding the number of circuits currently targeted by the program to increase SBDI participation, as such a change may increase overlap with the commercial customer base targeted by the other CEP program components, thus potentially reducing CEP program savings and confusing customers.

An analysis of program and LIPA customer data indicates that the pool of SBDI-eligible customers differs from non-eligible customers with respect to business type, with lodging/hospitality, agricultural, food service, retail facilities, and businesses located in residential-style homes being more likely to be eligible for the SBDI program as compared to other segments, meaning higher proportions of LIPA customers of these business types are eligible for the SBDI program.[34]

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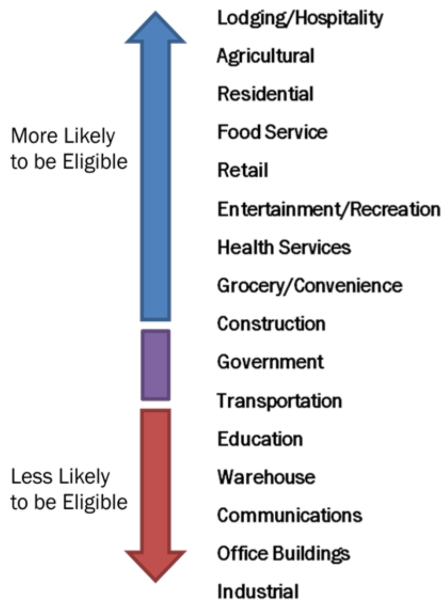
[32] This count excludes accounts not able to be retrofit, such as cable, sewer/pipes, HOA, and CPP accounts. Refer to the Detailed Methods section for details on the customer data cleaning and preparation for analysis.

[33] Please note that this percentage is based on the merge of the LIPA customer data extract with the SBDI-eligible customer database. We were unable to merge all records due to account attrition or customer accounts becoming inactive over time. The Detailed Methods section provides greater detail on data cleaning and merging steps that we performed.

[34] Business segment analysis was performed using SIC codes available through the LIPA customer data extract. Please note that, due to account attrition, not all eligible accounts were included in the analysis. The Detailed Methods section provides greater detail on data cleaning and merging steps that we performed.

Figure 12-2. Business Type Comparison among SBDI-Eligible vs. Non-SBDI-Eligible Customers



Source: Customer Data and Program Tracking Data

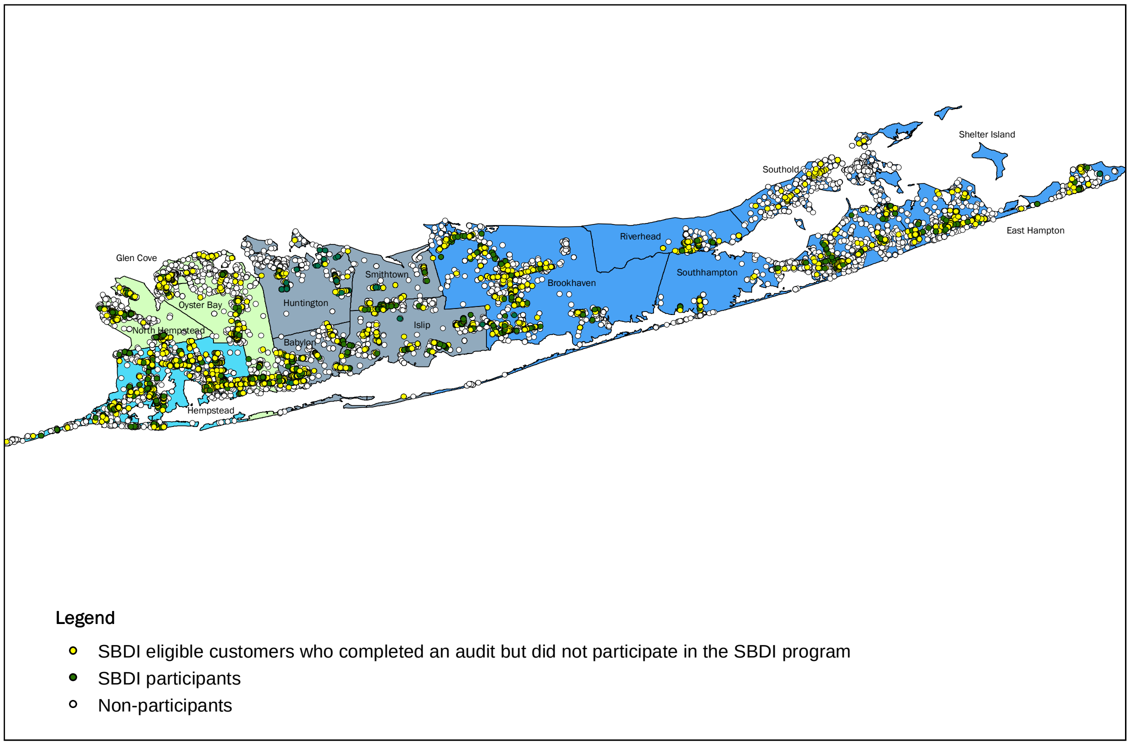
As part of the survey effort with non-participating customers, we explored the business type of the respondents' facilities. Retail and service (35%), medical and health (13%), office buildings (11%), and food service (7%) segments were the most prevalent among non-participants.

Of the 28,293 SBDI-eligible customers, 3,874 (14%) received an audit through the program, and 1,486 participated in the program either in 2011 or 2012, resulting in overall audit-to-project conversion rate of 38%.[35]

The map below illustrates the geographical dispersion of the SBDI program-eligible customers with an overlay of audit and participation.

[35] 1,486 is the total number of unique accounts that participated in the program in 2011 and 2012. In the program tracking data, a single account could be associated with more than one application/projects, resulting in the total number of 1,583 projects.

Figure 12-3. Map of SBDI-Eligible Population



Eligible participants
Map_bounds.pdf

As seen on the map, eligible customers are more heavily concentrated in the north and south forks of the Eastern Suffolk Division, the Central and Queens Divisions, and to a lesser degree the central portion of the island. Audit completion and program participation trends, however, do not follow the same pattern. As seen in Table 12-6 below, eligible-to-audit conversion rates and audit-to-project conversion rates are highest in Smithtown, Islip, and Babylon townships. Interestingly, Riverhead, Huntington, Hempstead, and Southampton have fairly low eligible-to-audit conversion rates but achieve fairly high audit-to-project conversion rates. Overall eligible-to-project conversion rates are the highest for Islip, Babylon, and Smithtown. Shelter Island and Southold feature 0% eligible-to-project conversion rates. These findings indicate that the SBDI program is more successful in some communities than others. The findings in the subsequent sections of this report shed more light on the possible reasons for low conversion rates, including differences in intensity of marketing and outreach each community was exposed to, the township composition in terms of business segments (which might drive presence of opportunities for improvements), or the seasonal nature of the businesses located in those townships.

Table 12-6. Overview of SBDI Customer Conversion Rates by Township

Township	Eligible-to-Audit Conversion Rate*	Audit-to-Project Conversion Rate**	Eligible-to-Project Conversion Rate***
Smithtown	21%	37%	8%
Islip	21%	43%	9%
Babylon	20%	44%	9%
North Hempstead	17%	41%	7%
Glencove	16%	28%	5%
Brookhaven	15%	35%	5%
Riverhead	15%	40%	6%
Huntington	14%	48%	7%
Oyster Bay	13%	32%	4%
Hempstead	12%	40%	5%
South Hampton	11%	41%	4%
East Hampton	10%	31%	3%
Southold	6%	0%	0%
Shelter Island	0%	0%	0%
TOTAL	**14%**	**38%**	**5%**

Source: Customer data and program-tracking data.
**Eligible-to-audit conversion rate was calculated by dividing a total number of eligible customers by the total number of eligible customers who received an audit through the SBDI program.*
***Audit-to-project conversion rate was calculated by dividing the total number of customers who received an audit by the total number of customers who installed audit-recommended measures through the SBDI program.*
****Eligible-to-project conversion rate was calculated by dividing the total number of eligible customers by the total number of customers who installed audit-recommended measures through the SBDI program.*

Eligible-to-audit and audit-to-project conversion rates vary by customer segment as well, with the grocery/convenience, industrial, retail, transportation, and warehouse sectors showing high rates of conversion.[36] As shown in Table 12-7 below, the grocery/convenience sector represents 5% of the total eligible customer base and 11% of customers who participated in the program. The audit-to-project conversion rate for this sector is among the highest (47%). Similarly, the industrial, retail, transportation, and warehouse sectors feature a higher percentage of businesses that complete audits and participate than the share of the overall customer base that those businesses represent. Office sector represents the missed potential, as they comprise 22% of eligible customers, yet eligible-to-project conversion rate is below average (3%).

[36] Please note that this percentage is based on the merge of the LIPA customer data extract with the SBDI-eligible customer database. We were unable to merge all records due to account attrition or customer accounts becoming inactive over time. The Detailed Methods section provides greater detail on data cleaning and merging steps that we performed.

Table 12-7. Overview of SBDI Customer Conversion Rates by Business Segment

Customer Segment*	% of All SBDI-Eligible Customers	% of All Customers Who Completed an Audit	% of Participating Customers	Within-Segment Audit-to-Project Conversion Rate**	Within-Segment Eligible-to-Project Conversion Rate***
Agricultural	2%	1%	1%	35%	3%
Communications	1%	0%	0%	13%	1%
Construction	3%	3%	3%	37%	5%
Education	3%	2%	2%	41%	5%
Entertainment/Recreational	3%	2%	1%	24%	3%
Food Service	7%	9%	7%	33%	6%
Government	2%	1%	1%	42%	4%
Grocery/Convenience	5%	9%	11%	47%	13%
Health Services	7%	7%	5%	32%	5%
Industrial	3%	6%	7%	47%	11%
Lodging/Hospitality	4%	1%	1%	20%	1%
Office Buildings	33%	22%	20%	35%	3%
Residential	3%	0%	0%	36%	1%
Retail	15%	20%	19%	37%	7%
Transportation	5%	9%	12%	51%	13%
Warehouse	4%	7%	8%	43%	10%

*Note that the basis for the customer segment assignment is SIC codes listed in LIPA's CIS data extract.
**Audit-to-project conversion rate was calculated by dividing the total number of customers who received an audit by the total number of customers who installed audit-recommended measures through the SBDI program.
***Eligible-to-project conversion rate was calculated by dividing the total number of eligible customers by the total number of customers who installed audit-recommended measures through the SBDI program.

As previously mentioned, the SBDI program offers rebates for energy-efficient lighting improvements exclusively. The top two measures installed through the program are T8 and LED lighting measures.

Table 12-8. Overview of SBDI Rebated Measures

Equipment Type	% of Projects That Included Equipment Installation	% of Total Gross MW Savings	% of Total Gross MWH Savings
T8	98%	73%	73%
LED	72%	23%	23%
CFL	8%	3%	3%
T5HO	4%	1%	1%
Occupancy Sensors	1%	0.1%	0.1%

Overview of Program Cross-Participation

SBDI-eligible customers are also eligible to participate in the Mid-Market component of CEP. Our analysis indicates that 495 SBDI-eligible customers (2%) participated in the Mid-Market CEP component. Of those, 448 (91%) made only lighting improvements through the program, 35 (7%) made only non-lighting improvements, and 12 (2%) made both lighting and non-lighting improvements.

Of the 460 SBDI-eligible customers who made lighting improvements through CEP (2%), 50 (11%) received an audit through the SBDI program. Overall, the 460 participants who installed lighting equipment through the Mid-Market program achieved 2.6 MW and 8,727 MWh in savings. Lighting improvements included LEDs, Linear Fluorescent (T5 or T8), Custom Lighting, Metal Halide, and Occupancy Sensors, while non-lighting improvements included Refrigeration, HVAC, and Compressed Air (Dryers), among other things. Lighting improvements installed by those participants were consistent with the measures offered through the SBDI program. A presence of SBDI-eligible customer attrition to other LIPA programs can negatively affect Lime Energy's ability to meet the SBDI program goals. LIPA should take this into account when developing savings and participation goals for the SBDI program.

Table 12-9 shows the breakdown of the equipment installed by the 495 SBDI-eligible customers that participated in the Mid-Market program.

Table 12-9. Overview of the Mid-Market Program Rebated Measures

Equipment Type	% of Projects That Included Equipment Installation
LED	58%
Fluorescent	44%
Refrigeration	11%
Occupancy Sensors	10%
Custom Lighting	6%
HVAC	6%
Compressed Air	1%
Metal Halide	<1%
Other	2%

Customer Awareness of the SBDI Program

As mentioned previously, marketing and outreach strategies attempted as part of the SBDI program primarily focused on in-person outreach, direct mail, and phone calls through a third-party telemarketer. In-person outreach efforts entailed Lime Energy program staff visiting business customers to inform them of the SBDI offering and, depending on the level of interest, setting up a time to perform the energy audit. Areas where all small businesses are on constrained circuits received additional marketing efforts including community outreach, press events, radio spots, newspaper ads, and testimonials on community websites.

Lime Energy provided the Evaluation Team with their marketing campaign database which tracks primary marketing activities, including direct mail, in-person, and over-the-phone outreach efforts made to 28,293 eligible customers.

Table 12-10 below provides an overview of the intensity of the marketing and outreach efforts, and shows percent of eligible customers exposed to the various marketing and outreach methods; average number of customer touches overall and by outreach method; and the maximum number of touches overall and by outreach method. As seen in the table, Lime Energy reached the majority of eligible customers (97%) with at least one of the three primary forms of marketing and outreach. Eligible customers who were reached by marketing efforts received up to seven touches.[37] On average each eligible customer received three touches through any combination of Lime Energy-led marketing and outreach efforts. Direct mail efforts were the most widespread, covering 94% of customers. Lime Energy targeted customers with up to four direct mail pieces since the start of the program.

Lime Energy touched fewer customers with in-person and phone outreach efforts. Lime Energy representatives visited 44% of eligible customers and made phone calls to 27%. Lime Energy touched customers a maximum of two times by phone and no more than once in person.[38]

Table 12-10. Marketing and Outreach Exposure

Outreach Method	% Exposed to Outreach Method	Average # of Touches by Outreach Method	Maximum # of Touches by Outreach Method
Any (Mail, In Person or Phone)	97%	3	7
Mail	94%	2	4
In Person	44%	1	1
Phone	27%	1	2

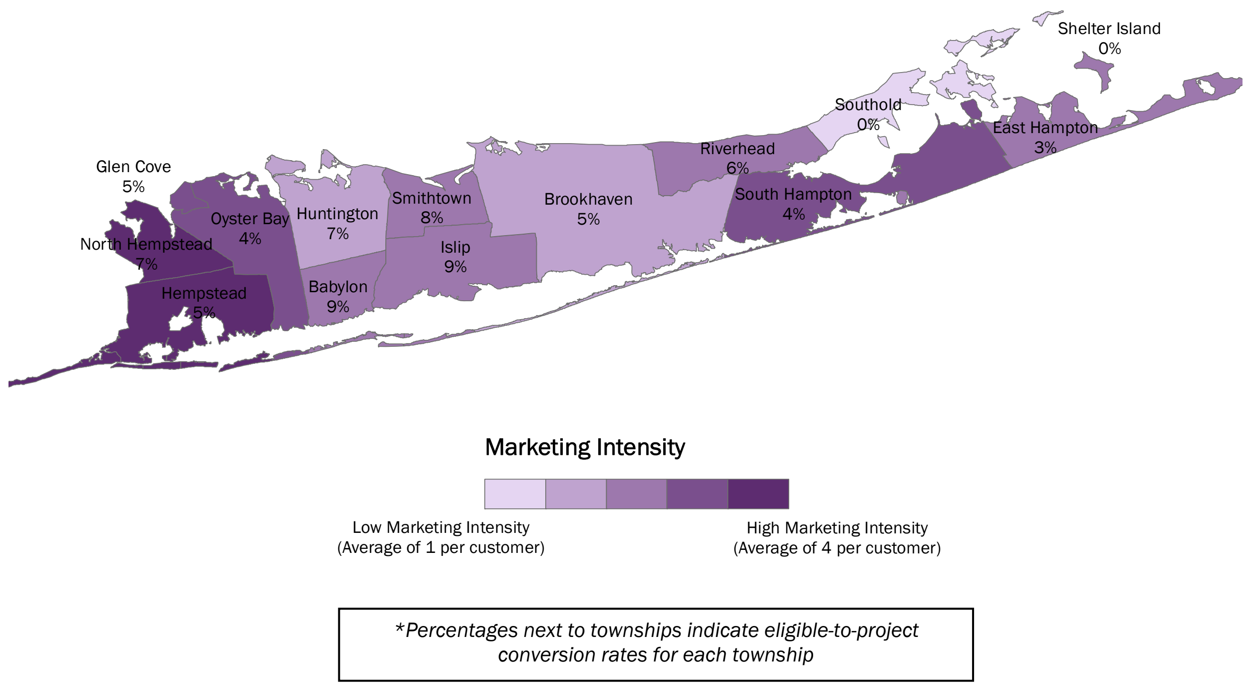
Source: Lime Energy Marketing Campaign Tracking Database.

The intensity of the marketing and outreach efforts varies by geography. The map below (Figure 12-4) shows the intensity of marketing and outreach by township as well as eligible-to-project conversion rates in each township. Together, these two metrics provide an overview of intensity of marketing and customer participation. As seen in the map, North Hempstead and Hempstead townships received more intense marketing and outreach as compared to the other townships in LIPA's service territory. Conversion of eligible customers to projects, however, is around average in Hempstead (5%) and slightly above average in North Hempstead (7%). Interestingly, intensity of marketing and outreach in Islip, Smithtown, and Babylon is less intense, yet participation is higher than average (9%, 8%, and 9% eligible-to-project conversion rates, respectively).

[37] The Evaluation Team defines a "touch" as a single outreach attempt through mail, in-person visit, or phone call.

[38] Lime Energy representatives visited one eligible customer in person two times.

Figure 12-4. SBDI Marketing Intensity Outreach



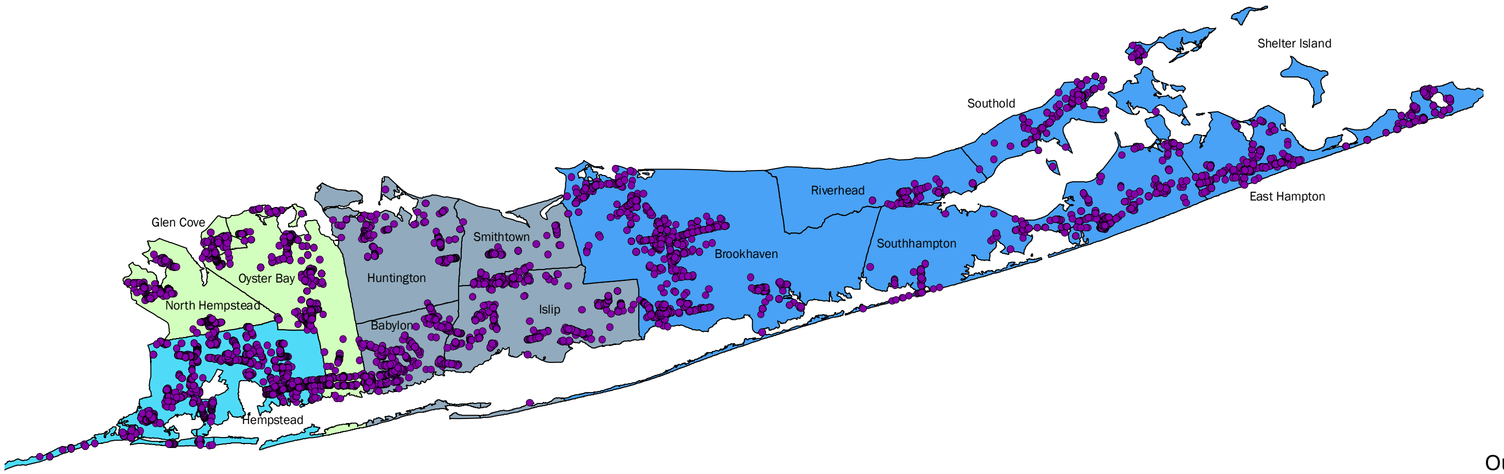
**Outreach intensity was calculated at a township level by calculating the average number of "touches" each SBDI-eligible customer was exposed to.*

Exposure to marketing and outreach efforts appears to be critical to whether or not a customer completes an audit. Of the entire pool of 28,293 eligible customers, less than 1% of customers who were not exposed to any of Lime Energy's primary outreach efforts completed an audit, compared to 14% who were touched by marketing efforts at least once.

Furthermore, in-person outreach appears to be an effective vehicle for converting eligible customers into audit participants. Of the 12,357 eligible customers who were exposed to in-person marketing efforts, 26% completed an audit. Conversely, only 4% of customers of the 15,936 who did not receive in-person outreach completed an audit. This indicates that Lime Energy's use of in-person outreach was the right decision.

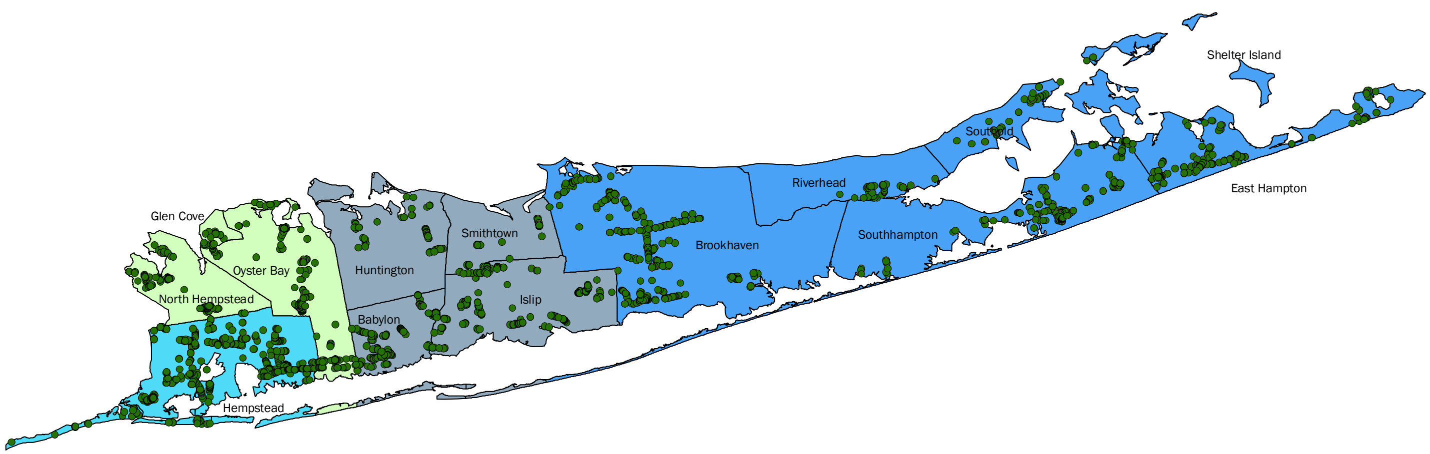
Figure 12-5 and Figure 12-6 below demonstrate the geographical dispersion of the in-person outreach efforts and participants.

Figure 12-5. Map of SBDI In-Person Outreach Attempted in 2011-2012



InPerson Outreach_bounds.pd

Figure 12-6. Map of SBDI Projects Completed in 2011-2012

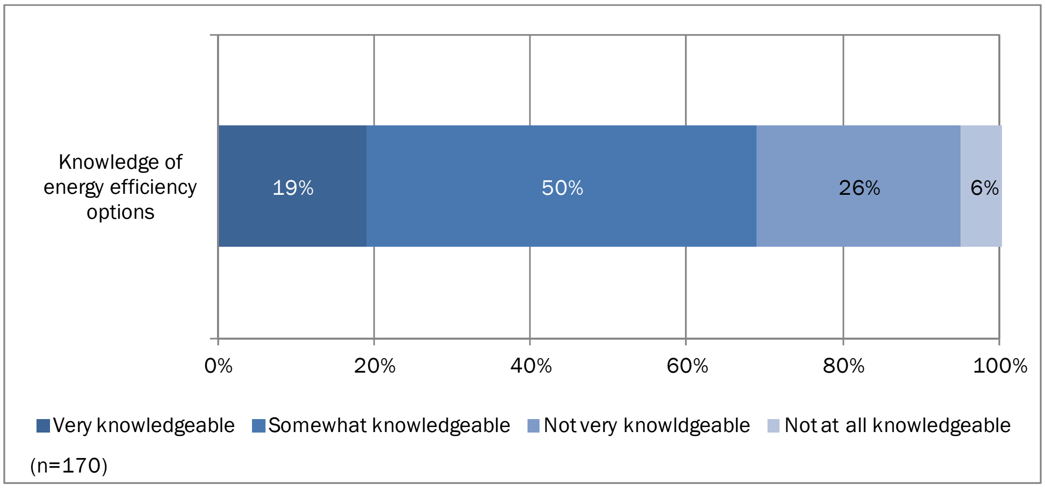


SBDI Projects_bounds.pdf

As part of the SBDI customer survey, we interviewed SBDI-eligible customers who did not install SBDI program-rebated equipment, including customers who received an audit through the program in either 2011 or 2012 and program-eligible customers who did not. Throughout the rest of this section, we will refer to these customers as non-participants.

Generally, non-participants consider themselves knowledgeable about energy efficiency options, with 19% saying they are "very knowledgeable" and 50% saying they are "somewhat knowledgeable."

Figure 12-7. Knowledge of Energy Efficiency Options



Non-participants are also aware of LIPA's energy efficiency program offerings in general. However, when asked about awareness of the SBDI program specifically, only one-third (34%) said they were aware. Knowing that Lime Energy targeted every SBDI-eligible customer with mailers, this finding might suggest that mailers Lime Energy sent might not be reaching a fairly large share of non-participants. Furthermore, of the respondents who said they were unaware of the SBDI program, over one-quarter (28%) are recorded in Lime Energy's program-tracking database as receiving telemarketing calls, and over half (56%) as receiving in-person outreach.

Figure 12-8. General Awareness of LIPA's Energy Efficiency Offerings

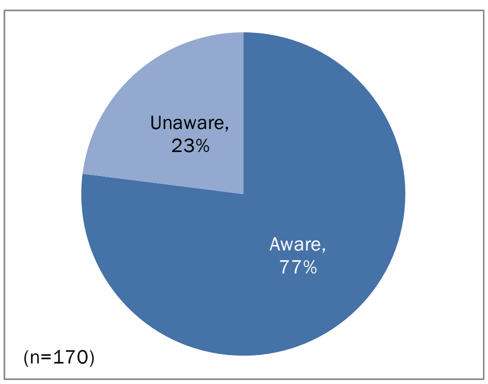
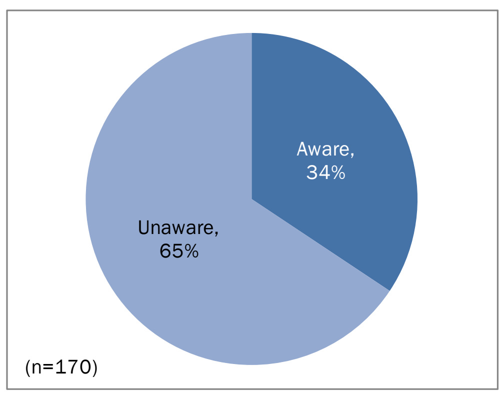
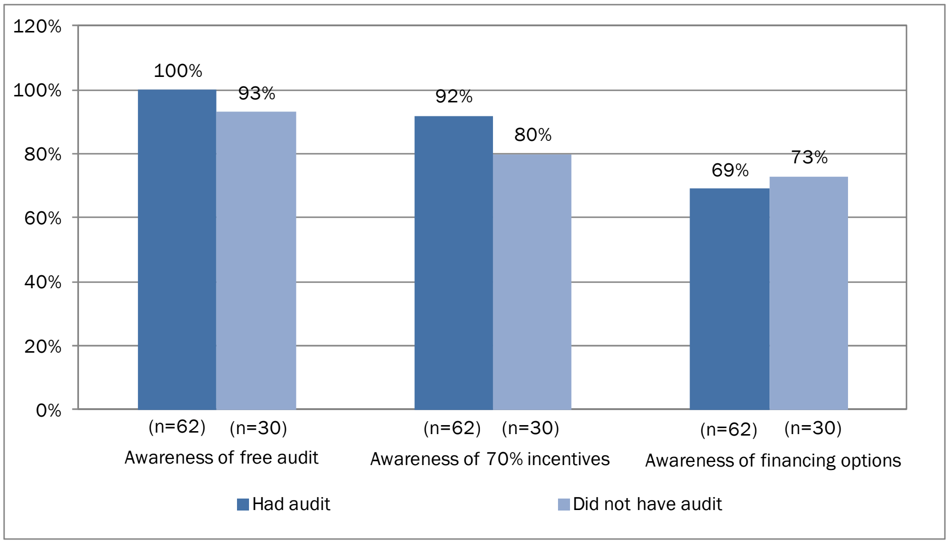


Figure 12-9. Awareness of the SBDI Program



Awareness levels of the various SBDI program components among non-participants also vary. Familiarity with the SBDI free audit and 70% incentive offering are high. However, awareness of these two offerings is lower among customers who did not have an audit as compared to those who did. Both customer groups are less familiar with the financing options available through Lime Energy as compared to other program components.

Figure 12-10. Awareness of Various SBDI Program Components

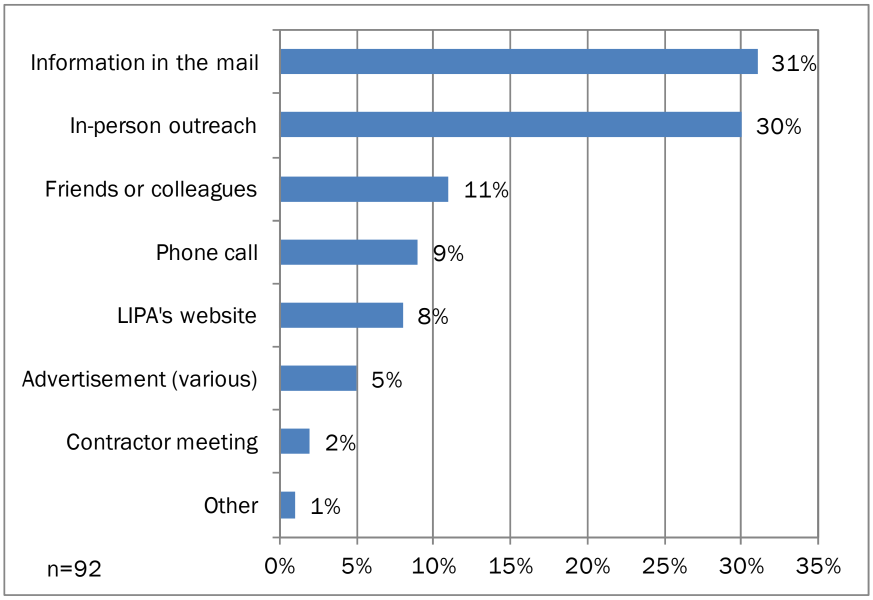


Sources through which non-participants learned about the SBDI program are not entirely consistent with the key outreach and engagement strategies recorded by Lime Energy. While mailers are the most common source of information, only 31% of non-participants recall receiving them[39], although according to Lime Energy's database they were distributed to nearly all customers. Further analysis shows that close to one-third (30%) of non-participants who do not remember receiving a mailer received more than two over the course of 2011 and 2012 (based on Lime Energy's database), while over a third (36%) of those who do not remember a Lime Energy representative visiting them in-person are recorded as having received in-person outreach in Lime Energy's database. Such discrepancies could be for a variety of reasons, including the tendency of mailers to not make it into the hands of the appropriate contact within the company, or in-person visits failing to reach the decision-maker in a business.

In-person visits were recalled by 30%, with customers who had an audit significantly more likely to have heard about the SBDI program through in-person outreach than those who did not have an audit (50% vs. 23%).

[39] Note that this percentage is based on the unaided open-ended question.

Figure 12-11. Sources of SBDI Program Information



*The percentages in this figure are based on the unaided open-ended question.

Awareness of LIPA's other programs for non-participants is low. A total of 16% are aware that LIPA offers other programs in addition to the SBDI program. As shown in Figure 12-12 and Figure 12-13 below, the rates of familiarity for LIPA's other lighting and non-lighting programs are similarly low, as 14% are aware of LIPA's other lighting programs and 10% are aware of LIPA's other non-lighting programs. Those who are aware are highly familiar with the other LIPA program offerings, both lighting (82 percent very or somewhat familiar) and non-lighting (90 percent very or somewhat familiar).

Figure 12-12. Awareness of LIPA's Other Lighting Programs

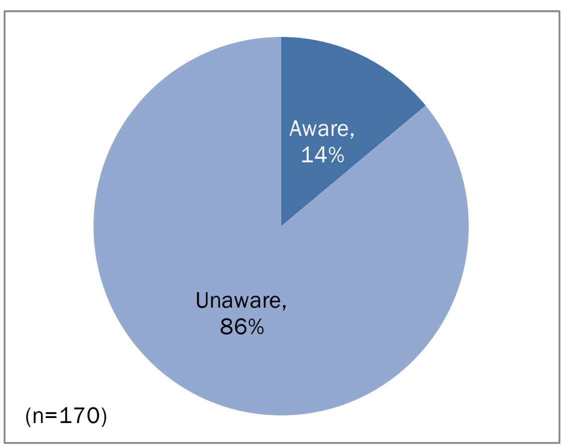
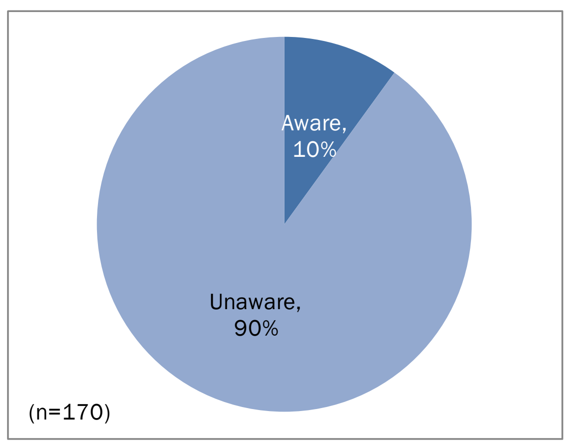


Figure 12-13. Awareness of LIPA's Non-Lighting Programs

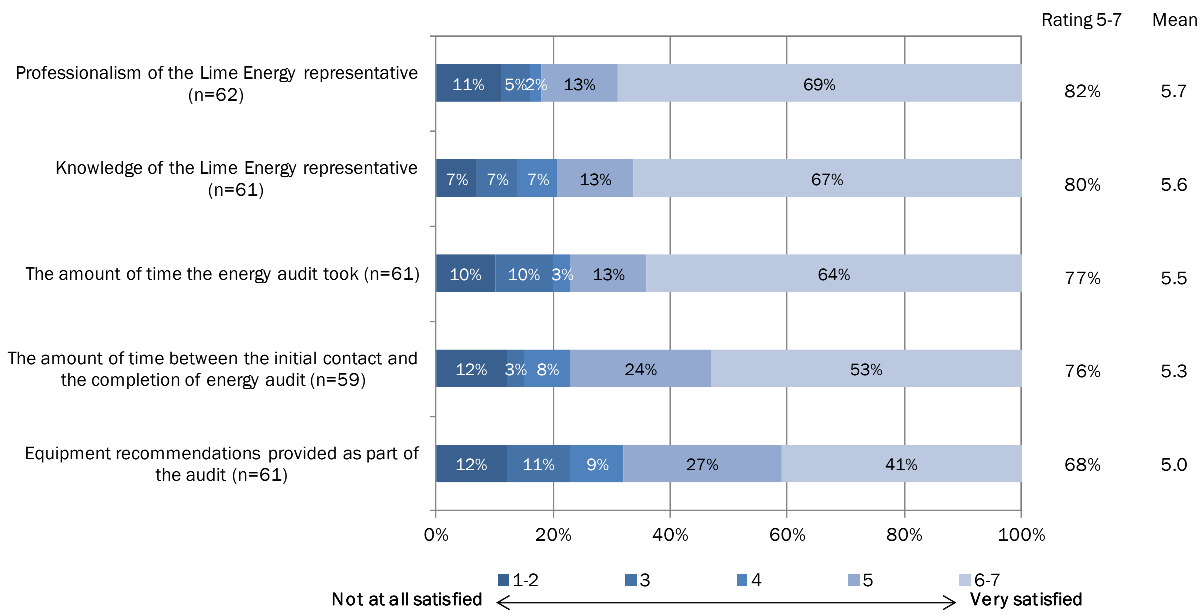


Customer Experiences with the Program

We asked customers who received an audit through the SBDI program about their experiences scheduling the audit and having the audit performed. Respondents are generally satisfied with the audit experience, including lead-time between scheduling and completing the audit, the amount of time the actual audit took, and the professionalism and knowledge of Lime Energy staff. Room for improvement exists, however.

Very few (8%) had difficulty scheduling their audit with Lime Energy, citing timing issues and lack of follow-up as the reasons for their answer. As shown in Figure 12-14 below, satisfaction with the various aspects of the audit process is generally high.

Figure 12-14. Satisfaction with Audit Components



Over three-quarters of participants (79%) rate the information provided as part of the audit survey report easy to understand[40] and a similar percentage (75%) find the information provided as part of the audit report useful.[41] Project financing options and equipment information were the areas that were cited as the most difficult to understand.

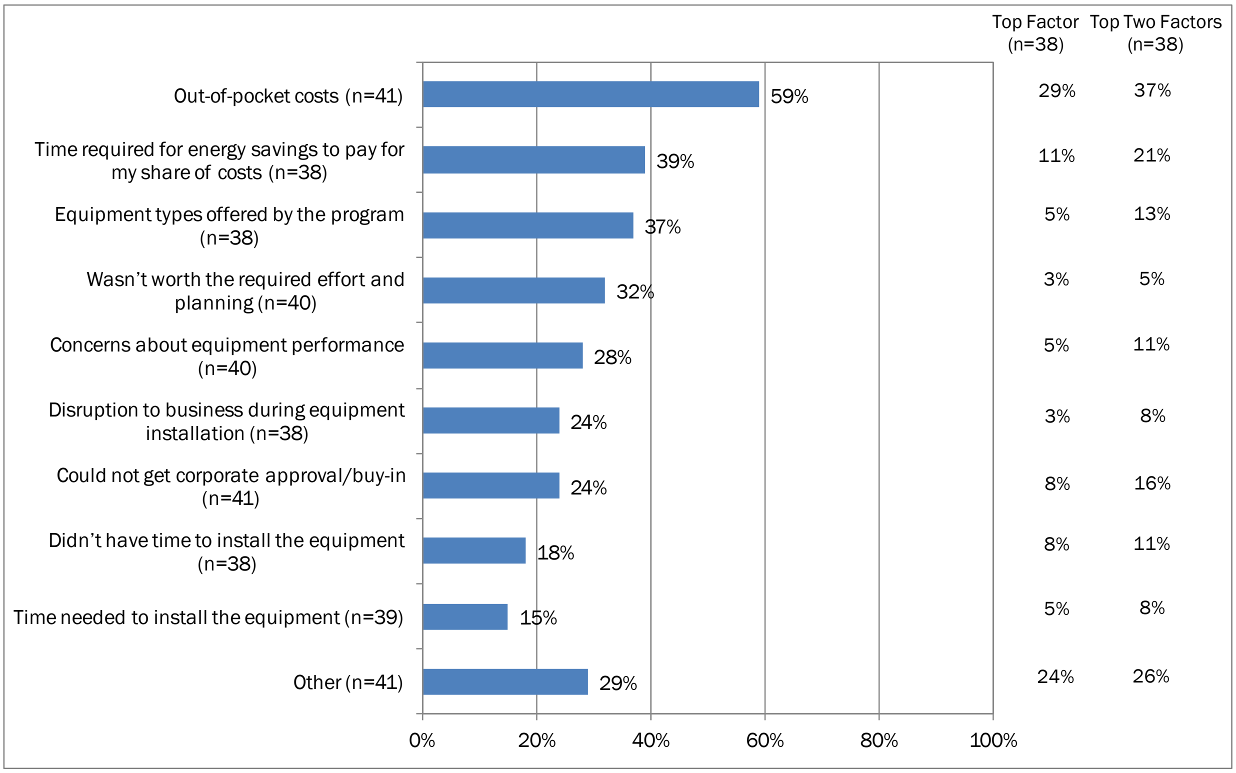
[40] On a scale of 1 to 7, where 1 is “very difficult” and 7 is “very easy.”

[41] On a scale of 1 to 7, where 1 is “not at all useful” and 7 is “very useful.”

Reasons for Non-Participation

Reasons for non-participation vary from lack of opportunities for improvements to financial and other barriers. One-fifth (21%) of customers who received an energy audit but did not install measures through the program report that the audit did not identify any opportunities to install program-eligible lighting improvements. In cases where the audit did identify opportunities to participate, customers list out-of-pocket costs and the "hassle factor" associated with program participation as the core barriers to moving forward through the program. Congruently, out-of-pocket cost was also the top reason identified in the database of lost projects maintained by Lime Energy.

Figure 12-15. Reasons for Non-Participation



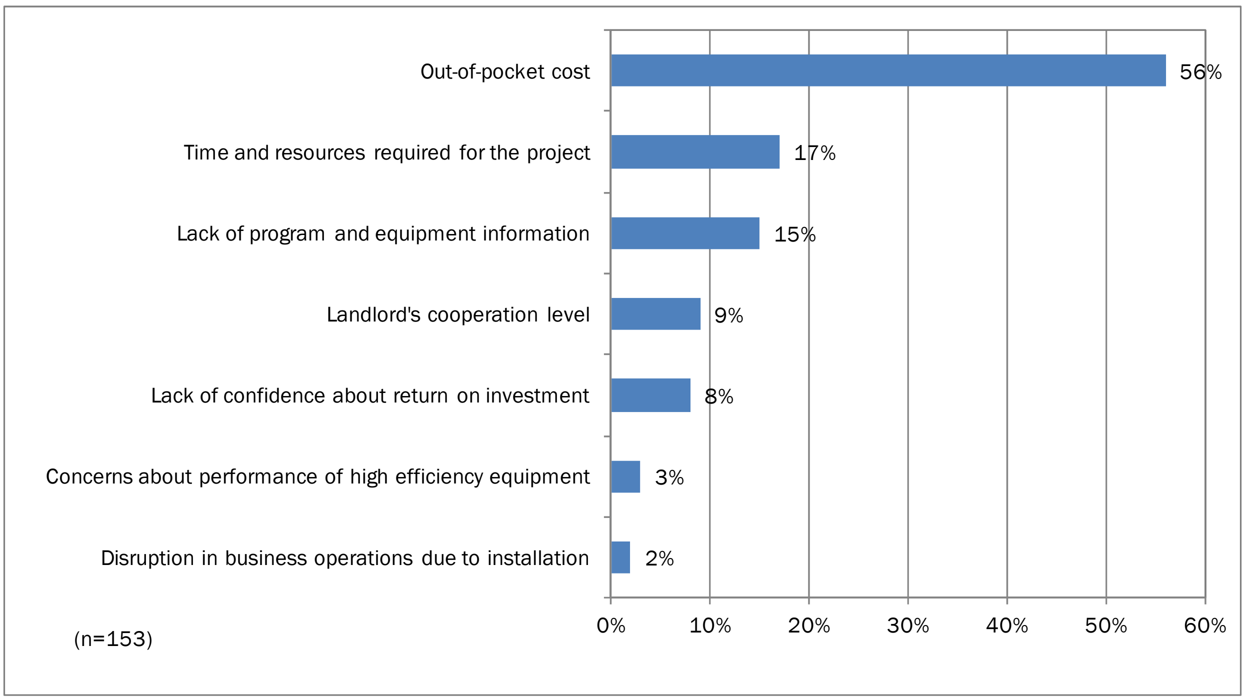
SBDI-eligible customers who are aware of the SBDI program but did not schedule an audit cite lack of time, lack of need for improvements, lack of funding, and the fact that they are not responsible for the electric bill as the reason for not scheduling the audit.

Examination of SBDI Program Opportunities and Barriers Preventing Future Participation

Cost savings are the core motivator to energy efficiency. When asked to name the main benefit to small business from energy-efficient improvements, non-participants nearly universally named cost savings (92%). Less than one-quarter (19%) cited positive environmental impact. Interestingly, 5% said that they don't see any benefits to becoming more energy-efficient, while 10% didn't know what the benefits are. This might suggest the need for further customer education.

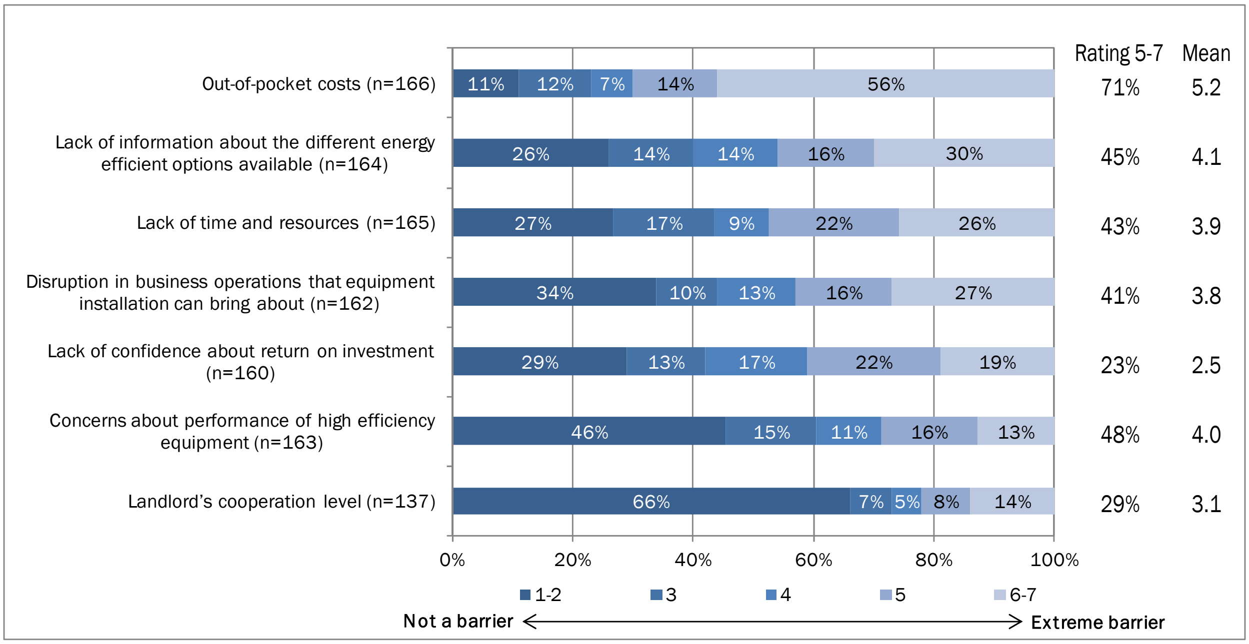
Non-participants were asked to name, in an open-ended fashion, what they considered to be the main barrier to adoption of high efficiency by small businesses. Not surprisingly, out-of-pocket costs were named as the main barrier by over half of customers (56%). Lack of time and resources, and lack of information about energy efficiency programs and equipment options were also named, among other things.

Figure 12-16. Main Barriers to Making Energy-Efficient Improvements



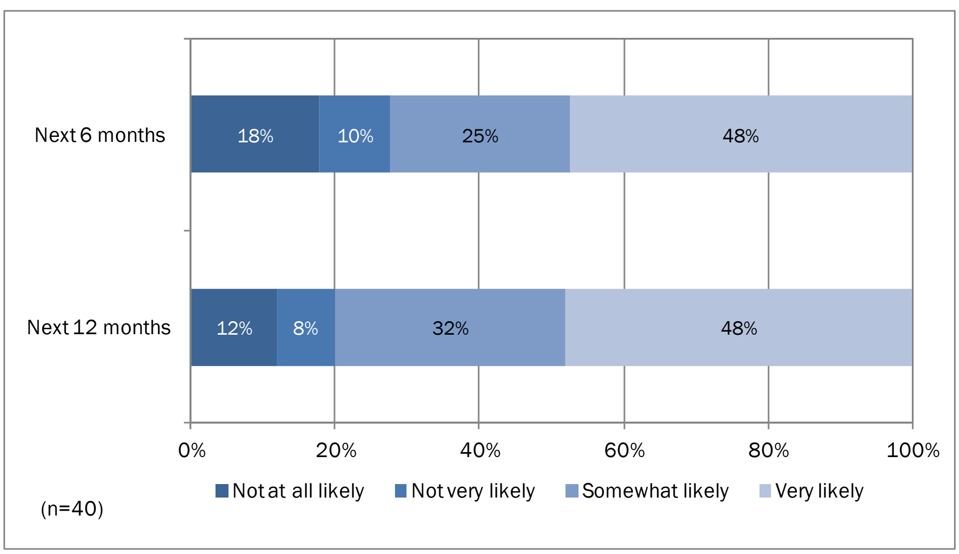
Non-participants were also asked to rate a list of factors that can prevent small business customers from making energy-efficient improvements using a scale from 1 to 7, where 1 means "not a barrier" and 7 means "extreme barrier." Similar to the unaided question, concerns with upfront costs, lack of information, lack of time and resources, and disruption to business operations were cited by customers as the main barriers.

Figure 12-17. Barriers Preventing Small Businesses from Making Energy-Efficient Improvements



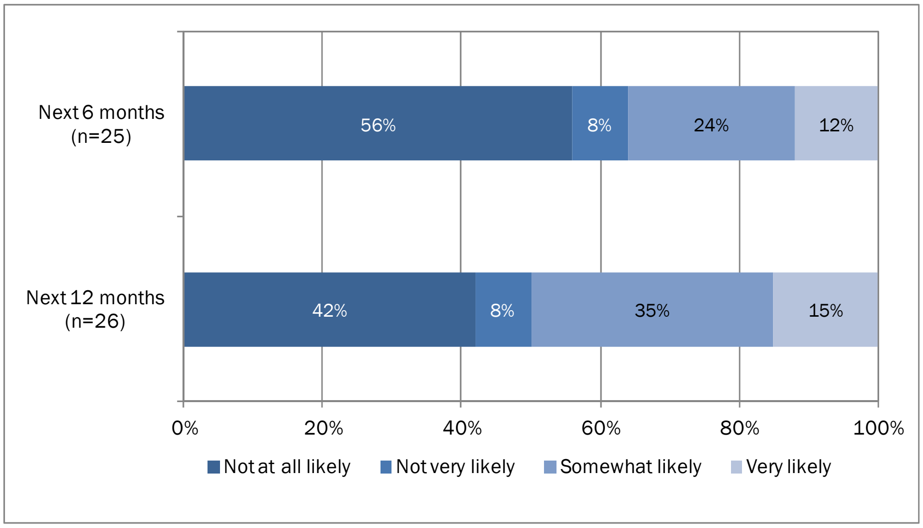
Despite the barriers, non-participants are generally open and interested in further exploring and making energy-efficient improvements at their facilities. Close to a half (48%) of customers who had an audit through the SBDI program said they are very likely to install the audit-recommended equipment within the next six months.

Figure 12-18. Likelihood to Install Audit-Recommended Equipment



Among customers who are aware of the program but have not scheduled an audit, likelihood to do so exists—over one-third (36%) of customers are likely to do it within the next six months.

Figure 12-19. Likelihood to Schedule an Audit



As part of the survey, the Evaluation Team explored the presence of other end-use opportunities at small business customer facilities. The results suggest that there is potential to integrate non-lighting measure offerings as part of the SBDI program design. In addition to lighting, heating, and water heating equipment, more than half of non-participants use cooling (77%) and refrigeration (54%) equipment at their facility. As shown in Table 12-11 below, while about one-third of respondents have replaced their cooling (36%) and refrigeration (31%) equipment in the last two years, 20% are generally interested in replacing the equipment in the next 12 months.

Table 12-11. Penetration of Equipment Types

End-use	Use Equipment	Replaced Within Last 2 Years (%)		Interested in Replacing Within Next 12 Months (%)[42]		
	%	%	n	%	n	mean
Lighting	100%	43%	167	25%	163	2.6
Heating	100%	23%	165	16%	164	2.1
Water Heater	100%	18%	166	14%	160	2.0
Cooling	77%	36%	130	20%	128	2.5
Refrigeration	54%	31%	89	20%	87	2.2
Motors or Drives	36%	31%	59	17%	58	2.5
Compressed Air	34%	18%	58	17%	58	2.0
Kitchen	33%	33%	58	18%	55	2.2

[42] Responding 5, 6, or 7 on a scale of 1 to 7, where 1 means "not at all interested" and 7 means "extremely interested."

12.2 ENERGY-EFFICIENT PRODUCTS

The Energy-Efficient Products (EEP) program offers discounts on several energy-efficient products, including lighting, appliances, pool pumps, and televisions. Rebates are also provided for recycling old appliances. Applied Proactive Technologies, Inc. (APT) is the program implementer for lighting and other energy-efficient products, while Energy Federation, Inc. (EFI) processes incentive payments for manufacturers, retailers, and customers. The Appliance Recycling component of the program is implemented by Appliance Recycling Centers of America, Inc. (ARCA). The program implementers work jointly with LIPA to plan, design, and promote the program to the marketplace.

We based our process assessment of the 2012 EEP program on data and information from two data collection and analysis efforts, including:

- In-depth interviews with program staff and program implementation contractors: We conducted interviews with three LIPA staff members, two APT staff members, two EFI staff members, and one representative from ARCA.

  Key questions explored during these interviews included:

  - What are the goals of the program?
  - Have roles or responsibilities changed for the program in 2012?
  - What are the major strengths or successes of the program, and what are the major challenges or barriers?
  - Were there changes to rebate levels, product types, program designs, or processes?

- Review of program databases and materials: We reviewed the program-tracking database and program promotional materials.

Below we present our process findings by product type, and discuss program participation, any changes that occurred during the program year, marketing and outreach efforts, data tracking, and potential recommendations.

Lighting

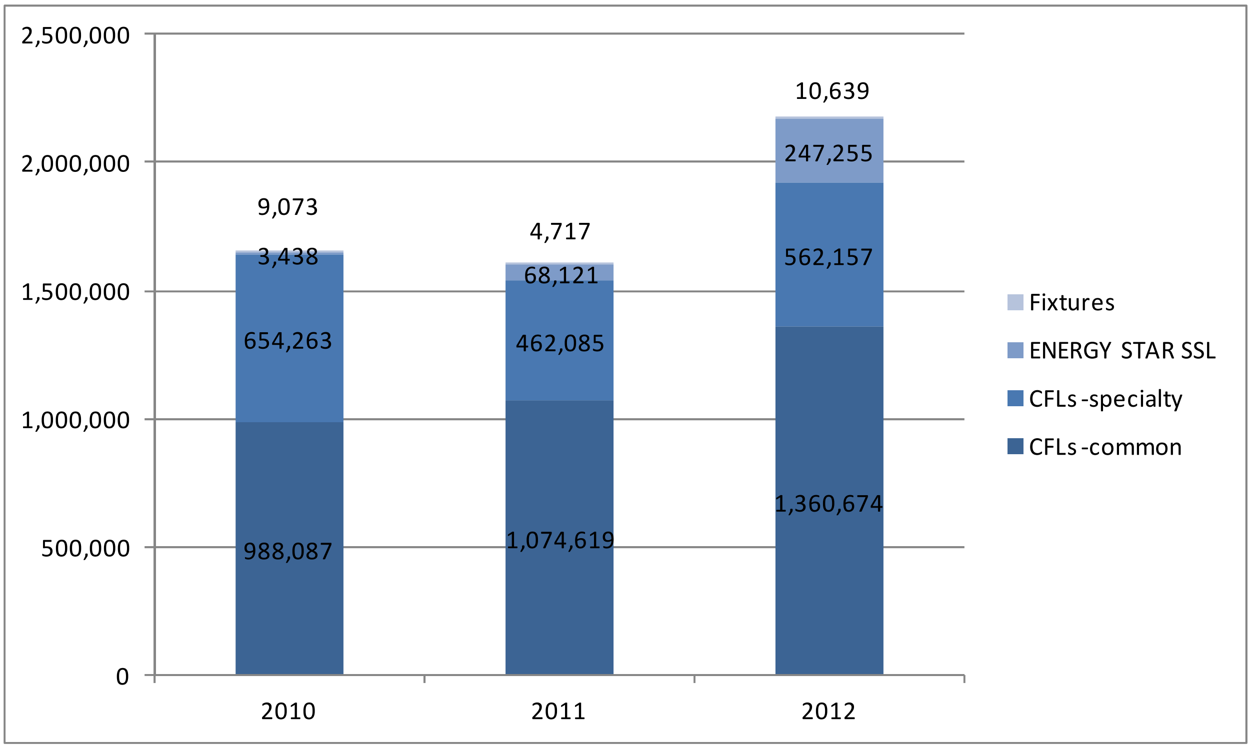
The program offers discounts on ENERGY STAR-qualified CFLs and LEDs. As shown in Table 12-12, the lighting component of the EEP program exceeded its unit sales goals in the standard CFL, solid-state lighting (SSL), and fixture categories. Although the program did not meet its specialty CFL goal, it saw tremendous growth in the sale of SSL bulbs, many of which are meant for specialty sockets. SSL bulbs have gone from less than 1% of all bulbs sold through the program in 2010, to 4% in 2011, to 11% in 2012. In total volume, the program sold 3,438 SSL bulbs in 2010, 68,121 in 2011, and 247,255 in 2012.

Table 12-12. Lighting Goal versus Actual Units by Product Type

Lighting Type	2012 Unit Goals	2012 Actual Units	Actual as Percentage of Goal
CFLs – common	970,000	1,360,674	140%
CFLs – specialty	700,000	562,157	80%
ENERGY STAR Solid State Lighting*	108,633	247,255	228%
CFL Fixtures**	2,000	10,639	532%
Total	**1,780,633**	**2,180,725**	**122%**

* Includes bulbs and fixtures.
**Includes two ceiling fans.

Figure 12-20. Lighting Sales by Bulb Type



As part of Opinion Dynamics' research later this year, the Evaluation Team will explore customer awareness of and preference for the different lighting technologies available. This research will help inform decisions about future program support of CFL and SSL bulbs.

In 2012 the program discounted lighting through five different channels. As shown in Table 12-13, most program bulbs (97%) were purchased at retailers that mark down the price of program CFLs and LEDs on the shelf, charging customers a reduced price when they check out. LIPA reimburses these retailers only after they sell participating products and submit an invoice for the purchases. Markdown retailers tend to be retailers that are part of a larger national or regional chain.

Table 12-13. Lighting Units Sold by Discount Type (2012)

Discount Mechanism	Number of Units Sold	Percentage of Total Units
In-store Markdown	2,115,591	97%
TechniArt Mall Promotion	58,095	3%
On-line Catalog	3,290	<1%
Coupons	2,480	<1%
Bulk Purchase Rebate Program	1,269	<1%
Total	**2,180,725**	**100%**

To help promote specialty CFLs and LEDs, in 2012 LIPA also offered a new mall promotion for lighting products. The mall promotions were managed by APT and administered by TechniArt. Kits containing 12 specialty CFLs, 2 CFL fixtures (a desk lamp and clip-on lamp), and 1 LED night light were sold for $10 in September, targeting the "back to school" shoppers. The mall promotion ran again in December and incorporated LEDs. Kits contained 6 CFLs, 2 LEDs, 2 CFL fixtures (a desk lamp and clip-on lamp), and 1 LED night light for $10. Three percent (3%) of all program bulbs were purchased at the TechniArt mall promotions.

The Bulk Purchase Rebate component of the lighting program allows homeowners, builders, and contractors whose lighting needs exceed the 20-bulb program limit to receive the discount and participate in the program, although few program bulbs (<1%) were purchased this way. Customers can also purchase discount lighting through EFI's online catalogue, although again, few program bulbs (<1%) were purchased in this manner.

In 2012, LIPA discontinued the instant coupon portion of the lighting program. However, a number of coupons were not processed until early in 2012, resulting in some carryover savings. In prior years, instant coupons enabled smaller retailers who did not have the sales and tracking systems necessary to participate in the markdown program. Customers filled out a coupon at the register and received the discount immediately. However, the decision was made to cancel the coupon program, as very few program sales went through this channel and program staff also noted that in some instances the validity of the coupons was called into question.

Changes were made to lighting incentive levels throughout the 2012 program year. In response to decreased sales of specialty CFLs, LIPA increased the incentive from an average of $1.88 per bulb to $2.50 per bulb. LIPA also decreased their incentive on LEDs from $15 to $12 in response to market trends.

Dehumidifiers and Refrigerators

LIPA offers customer rebates on program-qualified dehumidifiers and refrigerators. In 2012, in addition to the ENERY STAR-certified refrigerator rebate, LIPA added an ENERGY STAR Most Efficient refrigerator category. ENERGY STAR-certified refrigerators are 20% more energy-efficient than the minimum federal standard, and ENERGY STAR Most Efficient designated models are at least 30% more efficient than new, non-ENERGY STAR-certified models.

As shown in Table 12-14, the Dehumidifier and Refrigerator program components exceeded their participation goals.

Table 12-14. Appliance Rebate Goal versus Actual Units

Program Component	Unit Goals	Actual Units	Actual as Percentage of Goal
Dehumidifiers	6,050	7,321	121%
Refrigerators			
ENERGY STAR	19,000	22,009	116%
ENERGY STAR Most Efficient	1,000	1,998	200%
Total Refrigerators	20,000	24,007	120%
Total Units	**26,050**	**31,328**	**120%**

Program records show that in 2012 customers purchased dehumidifiers at 277 different store locations and refrigerators at 310 different locations, including online. While customers are not required to purchase appliances at participating store locations, as of the end of 2012, the EEP program had partnered with 163 different retail locations[43] to promote the appliance rebates to customers. No memoranda of understanding (MOU) are prepared between LIPA and the retailers, but participating retailers agree to place promotional signage in their stores and to have their sales staff members participate in training sessions on the program and ENERGY STAR appliances.

Customers who purchase a qualified appliance fill out the rebate form and submit it to LIPA along with a receipt that shows the appliance's model number, manufacturer, and price, as well as a copy of a recent electric bill. Customers who purchase a refrigerator must check a box to designate one of the two refrigerator categories for which they are applying. Customers received $75 for ENERGY STAR refrigerator purchases and $100 for ENERGY STAR Most Efficient refrigerator purchases.[44] In October, the rebate for dehumidifiers increased from $20 to $50.

Room Air Conditioners

In 2012 the program offered an upstream discount to participating retailers selling program-qualified room air conditioners (RACs). The RAC program component exceeded its overall participation goals but did not achieve the program's desired distribution of units by size. In 2012, LIPA added a third tier to the RAC program offerings. This third tier is for RAC units between 8,001 BTU/h and 14,000 BTU/h. The program's goal was for 40% of sales to be smaller units (6,000 Btu/h or less), 43% to be medium units (6,001 to 8,000 Btu/h), and 17% to be larger units (8,001 to 14,000 Btu/h). Actual sales for larger units were nearly double the unit goal.[45]

[43] List of participating retailers on LIPA website, 12/31/12.

[44] LIPA decreased the incentive for dehumidifiers to $40 and decreased the incentive for ENERGY STAR refrigerators to $50 in 2013.

[45] Overall, the Evaluation Team validated the total number of units sold through the program in 2012. However, the Team found a discrepancy in LIPA's count for 6,001 to 8,000 BTU/h RACs and 8,000 to 14,000 BTU/h RACs for the month of June. In the LIPA sales and energy-tracking data sheet, there were 256 RACs of 6,001 to 8,000 BTU/h and 214 RACS of 8,001 to 14,000 BTU/h. For the evaluation, we used three files provided by LIPA for the month of June and found that 16 units were counted as 6,001 to 8,000 BTU/h when

Table 12-15. Room Air Conditioner Goal versus Actual Units

Unit Size	Unit Goals	Actual Units	Actual as Percentage of Goal
6,000 BTU/h or less	9,000	10,485	117%
6,001 to 8,000 BTU/h	10,000	8,527	85%
8,001 to 14,000 BTU/h	4,000	7,605	190%
Totals	**23,000**	**26,617**	**116%**

Since 2009, discounts on RACs have been offered through an upstream retailer discount program. Ten retailers participated in the RAC program in 2012, and most were independently owned single-store retailers. For the 2013 program year, LIPA has decided to change the program design from an upstream model to a downstream model where customers fill out and submit a mail-in rebate. Program staff note that this change was made to increase customer awareness of LIPA's sponsorship of the discount.

Pool Pumps

The program offers rebates for both two-speed and variable-speed pool pumps. As shown in Table 12-16, LIPA has not met its participation goals for this product category. Program staff sent one direct mail to customers with pools; however, staff note that more targeted marketing information and approaches may be necessary to improve participation.

Table 12-16. Pool Pump Rebate Goal versus Actual Units

Type	Unit Goals	Actual Units	Actual as Percentage of Goal
Two-Speed	300	106	35%
Variable-Speed	900	642	71%
Total Pool Pumps	**1,200**	**748**	**62%**

In 2012, to combat cost, LIPA increased the incentive from $75 to $125 for two-speed pool pumps. The incentive for variable-speed pumps in 2012 was $200. In an effort to encourage pool pump installers to promote the program, LIPA also offered a dealer incentive of $75 for two-speed and $100 for variable-speed pump installations.

However, cost may still be the primary barrier for most customers, and balancing the cost of an energy-efficient pool pump with other desired pool features can be challenging. Program staff have received feedback that many customers would rather install the device on their own and forego the rebate because it is less costly and requires less effort in terms of coordination and paperwork. Program staff also suggest that existing pool pumps are typically only replaced on failure, lengthening the time until equipment replacement for many customers. In response to the cost barrier, for 2013 the program has increased customer incentives to $200 and $400 for two-speed and variable-speed pumps, respectively.

To help LIPA understand the market for the pool pump program, we will conduct additional research in the summer of 2013 as part of our in-home lighting study. While in homes, we will collect

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they belonged in the larger category. Therefore, LIPA's tracking sheet reports fewer large unit sales (8,001 to 14,000 BTU/h) than we do in both the process and impact evaluations.

information on the presence of in-ground pools, the type of pump installed, and the approximate age of the pump.

Appliance Recycling Program

LIPA's Appliance Recycling program is administered by ARCA, as noted above. In 2012, the program participation goal was lowered to 1% of LIPA's residential customer base, in line with the industry standard. Despite increasing the recycling incentive to $50 for the entire program year, the program did not reach its unit goal. As shown in Table 12-17, the program achieved approximately 80% of the unit goals with 8,815 refrigerators or freezers recycled out of a goal of 11,000. A large majority of recycled appliances (86%) were refrigerators. A total of 8,431 LIPA customers participated in the program, with 96% recycling a single large appliance and 4% recycling two large appliances.

Table 12-17. Refrigerator Recycling Actual versus Unit Goals

Appliance	Unit Goals	Actual Units	Actual as Percentage of Goal
Refrigerators	NA	7,561	NA
Freezers	NA	1,254	NA
Total	**11,000**	**8,815**	**80%**

In 2012, LIPA expanded the recycling program to include room air conditioners (RACs) and dehumidifiers. These appliances could only be picked up in conjunction with the pickup of a refrigerator or freezer. ARCA staff promoted the small appliance recycling at the point of scheduling. Eight percent (8%) of large appliance recyclers also recycled a small appliance through the program, with 69% recycling one small appliance, 23% recycling two small appliances, and 8% recycling three small appliances. As shown in Table 12-18 below, dehumidifier recycling exceeded its goal by 19% while 693 RAC units were recycled out of a goal of 1,000. A majority of small recycled appliances (75%) were RACs.

Table 12-18. Small Appliance Recycling Actual versus Unit Goals

Appliance	Unit Goals	Actual Units	Actual as Percentage of Goal
Room Air Conditioners	1,000	693	69%
Dehumidifiers	200	237	119%
Total	**1,200**	**930**	**78%**

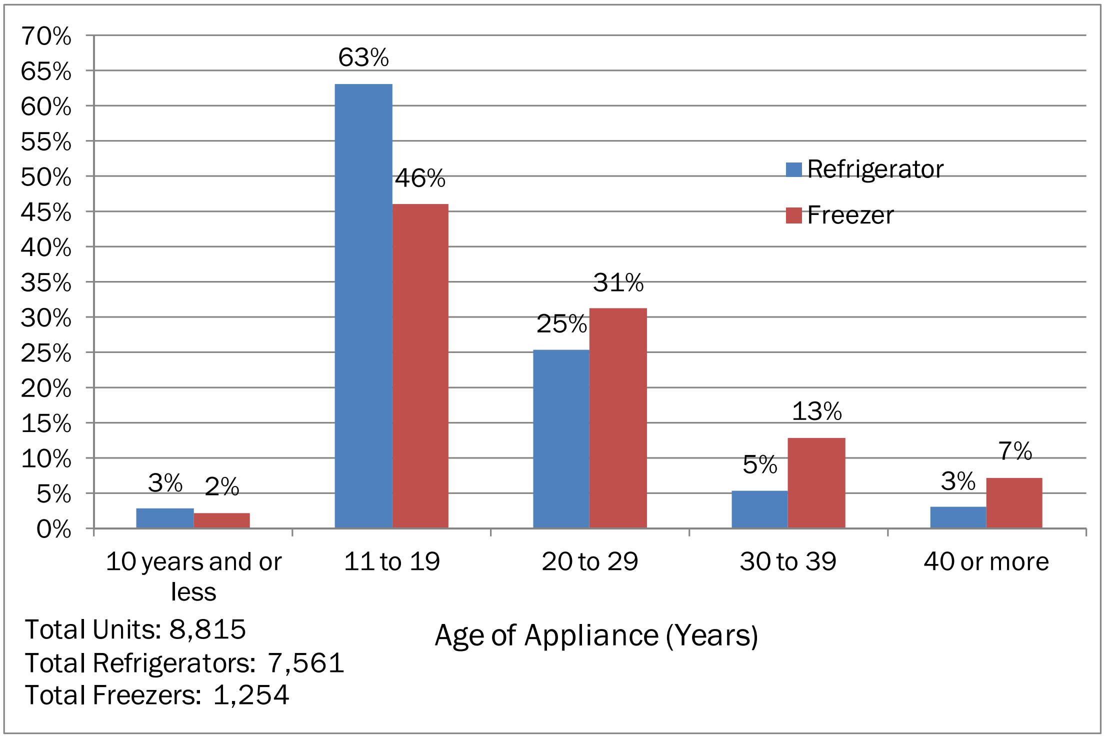
LIPA gave customers who were recycling a small appliance a $20 voucher for use in the online catalogue. Program staff reported that few customers redeemed the coupons.

In addition to unit counts, the program-tracking database also contains information about the age of the appliances recycled through the program. As a part of our process evaluation efforts, we reviewed refrigerator and freezer unit ages and sizes against program guidelines. We found record of some refrigerators and freezers that did not appear to meet the program's age requirement (a unit must have been manufactured prior to 2001). The program-tracking database included 544 units that were manufactured in 2001. However, federal appliance codes were enacted on July 1, 2001, midway through the year. For our analysis we assume that units labeled as 2001 were manufactured prior to the July 1, 2001. code change, and therefore qualify for the program.

As Figure 12-21 also shows, about 3% (213) of refrigerators and 2% (29) of freezers were manufactured after 2001 (represents the "10 years or less" category) and should have been ineligible for the program but were still picked up by ARCA. For the purpose of our evaluation, we assume that these data entries were recorded in error, and the units qualify for the program. However, in the future the program should perform additional quality assurance efforts to ensure that all units submitted to the program meet established requirements.

According to the program-tracking database, the average age of refrigerators and freezers recycled through the program was 18 and 21 years (manufactured in 1991 and 1994), respectively. Most appliances were less than 30 years old, and 37 percent were manufactured prior to 1994 when federal appliance standards first went into effect with higher efficiency requirements.

Figure 12-21. Age Distribution by Type of Appliance Recycled



The program-tracking database also includes a record of the appliance's size. Program guidelines state that refrigerators must be 10 to 30 cubic feet. In the 2012 data we found 139 refrigerators that were outside of the program's size limitations. As previously mentioned, in the future the program should focus additional quality assurance efforts on ensuring that appliances are meeting program requirements.

It is possible that the number of program-qualifying secondary refrigerators is dwindling. According to a study by the Association of Home Appliance Manufacturers, 38% of all refrigerators in use nationwide were manufactured prior to 2001.[46] This would include primary refrigerators as well as secondary refrigerators. As part of our in-home lighting study, we will record information on the presence of secondary refrigerators and freezers, and the approximate age of both primary and secondary appliances. We will also ask customers about their willingness to dispose of their secondary appliances through LIPA's EEP program, and about their intentions for the current primary appliance and whether they would consider turning that appliance into a secondary appliance in the

[46] Kevin Messner, presentation at ACEEE National Symposium on Market Transformation, March 26, 2013.

future, as well as replacing it with a newer, more energy-efficient model if it is older. This information will help LIPA with future program planning and goal setting.

Televisions

The television program was operated as a mid-stream incentive program and provided a $10 incentive to the retailer per qualifying unit. In 2012 there were two participating retailers, Best Buy and Sears. As shown in Table 12-19, LIPA met 46% of its unit goal for televisions.

Table 12-19. Television Goal versus Actual Units

Type	Unit Goals	Actual Units	Actual as Percentage of Goal
ENERGY STAR Televisions	40,000	18,489	46%

Several issues contributed to the Television program not reaching its unit goal. The program was not offered at Best Buy until the end of April due to issues with finalizing the memorandum of understanding. Program staff also noted other challenges, including a very high unit goal that may have overestimated potential program sales; some retailer dissatisfaction with the amount of paperwork required to participate; and reduced television sales in 2012 compared to previous years. Televisions have become more affordable in recent years and the importance of television capabilities and features tend to outweigh the financial benefit of a $10 discount. As a result, LIPA has decided to discontinue the Television program for the 2013 program year.

Advanced Power Strips Pilot

LIPA ran a pilot program in 2012 to test the appeal of advanced power strips. The instant $10 rebate was only available for purchases through the online catalogue. As a result, the EEP program did not focus significant marketing efforts on this program to customers. Still, as shown in Table 12-20, the pilot program exceeded its goals for 2012 by over 300%.

Table 12-20. Advanced Power Strips Goal versus Actual Units

Program Component	Unit Goals	Actual Units	Actual as Percentage of Goal
Advanced Power Strips	200	618	309%

Marketing and Outreach Efforts

LIPA works with its program implementers to perform marketing and outreach efforts for each product category under the EEP program. Marketing efforts in 2012 did not change significantly from the previous year.

For the lighting and appliance rebate components, the program partners with retailers and manufacturers, promotes the program directly to LIPA customers, and produces in-store marketing materials. APT, the program implementer, also conducts periodic trainings for retailers to teach them about the products, visits each store every one to four weeks, and regularly performs in-store promotions where it exposes customers to CFLs and their benefits. In addition, the program supports participating retailers through cooperative advertising. LIPA provides retailers with ENERGY STAR and LIPA logos, and also provides supplemental funding toward the costs of the print advertising. LIPA must approve advertisements before retailers can run them. Lighting and appliances are also marketed through other channels, like bill inserts, radio, and print advertising.

The Appliance Recycling program implements an aggressive marketing campaign to promote the recycling of old, inefficient appliances. LIPA works with ARCA and utilizes a number of marketing channels, including billboards, “e-blasts,” bill inserts, program flyers, radio, television, and print advertising, and promotion through the LIPA website.

To promote pool pump rebates, the program primarily focuses on reaching out to installers and dealers. A targeted mailing to pool owners was also implemented in 2012. APT conducts various activities to engage trade allies, such as breakfast meetings where manufacturers demonstrate their products.

Data Tracking

Overall, the EEP program collects data necessary for program tracking and management, as well as to support the evaluation process. APT, EFI, and ARCA are responsible for tracking program participation and providing LIPA with updates on a regular basis. Our review of the measure-level program databases shows that data fields are populated and only a few entries are outside plausible data ranges.[47]

However, we found that our final program participation counts did not always match LIPA’s program counts. We worked closely with LIPA to resolve these differences, and we were able to either eliminate or reduce our differences in program counts to the point that they are very small and should have a negligible impact on EEP savings.

Table 12-21 shows the differences in reported and evaluated participation for lighting, room air conditioners, and dehumidifiers. Please note that the total number of room air conditioners reported matches the total number evaluated, and the only difference is within the sub-totals for the different categories of room air conditioners. Reported and evaluated unit counts matched for all other product categories.

[47] We found one appliance in the refrigerator recycling database that was so old that it was likely a data entry error. For example, the database showed the manufacture date of one refrigerator as 1892. The refrigerator recycling database also contained 242 entries where the age of the appliance was outside of program requirements (manufactured after 2001) and 146 entries where cubic feet measurements were outside of the 10-30 cubic feet parameter. These data discrepancies are assumed to be data entry errors.

Table 12-21. Program-Reported Participation Compared to Evaluated Participation

Program Component	2012 EEP-Reported Participation	2012 Evaluated Participation	Difference in Units (Evaluated – Reported)
Lighting			
CFLs – common	1,359,912	1,360,674	762
CFLs – specialty	561,549	562,157	608
ENERGY STAR Solid State Lighting*	258,886	247,255	-11,631
Fixtures**	10,000	10,639	639
Total Lighting	*2,190,347*	*2,180,725*	*-9,622*
Room Air Conditioners			
6,001 – 8,000 BTU/h	256	240	-16
8,001 – 14,000 BTU/h	214	230	16
Total Room Air Conditioners	*470*	*470*	*0*
Dehumidifiers	7,320	7,321	1

*Several LED bulbs were reported at the end of 2012, but not invoiced until the beginning of 2013. To stay consistent with previous years' accounting of savings, we are only including units that were invoiced during the program year. Units invoiced in 2013 will be included in 2013 savings.
**Includes two ceiling fans.

Conclusions and Recommendations

LIPA's Energy-Efficient Products (EEP) program exceeded its demand and energy savings goals by more than 20%, driven by a significant increase in sales of efficient lighting products. The program exceeded its unit sales goals for several product categories, including ENERGY STAR common CFLs, LEDs, fixtures, dehumidifiers, refrigerators, room air conditioners, advanced power strips, and dehumidifier recycling. The program fell short of unit goals for specialty CFLs, pool pumps, televisions, room air conditioner recycling, and refrigerator/freezer recycling.

Overall, the program processes work well. However, we have identified a few areas the program may want to consider addressing in the future related to quality assurance efforts, program participation, and marketing. These recommendations are presented below by product type.

Lighting

- **Quality Assurance Efforts:** The 2012 data provided by the program included some invoices for LEDs that were reported at the end of 2012 but with invoices that did not go through until early 2013. To be consistent with how savings were accounted for in prior years, the Evaluation Team did not count these units in the 2012 totals. In the future LIPA should work with its implementers to ensure that units are reported in the year in which they are invoiced.

Appliances

- **Quality Assurance Efforts**: LIPA added an additional tier to its Refrigerator program for "most efficient" models. In the bi-weekly file outputs there were 316 entries where the product is an ENERGY STAR refrigerator and the rebate amount is $100 when it should be $75. Given this discrepancy, we recommend adding an additional quality assurance check to ensure that data is consistent across the rebate amount and product fields.

- **Program Participation**: The addition of the ENERGY STAR "Most Efficient" category proved to be a popular option for customers, with LIPA almost doubling its per-unit goal. The program may want to consider increasing its goal for this category while at the same time decreasing its goal for the standard ENERGY STAR units in order to achieve higher levels of program savings.

Pool Pumps

- **Marketing and Outreach:** In 2012 the Pool Pump program did not meet its goals. LIPA already promotes the program through a direct mailing to pool owners, bill inserts, and print advertising. LIPA also promotes the program to contractors. To gain more traction in the market, we encourage LIPA to consider increasing its outreach efforts to both pool dealers/installers and pool owners. Aside from the cost barrier, lack of awareness of pool owners and contractors about benefits of efficient pool pumps is also a market barrier. Among pool owners, the program could also promote the requirement for contractor training as a signal of quality, which might separate it from non-eligible pool pumps. Program messaging could focus on the energy-saving benefits of a qualifying pool pump, in addition to non-energy-saving benefits, such as a longer-lasting system and a quality installation by a trained professional.

Refrigerator Recycling

- **Quality Assurance:** LIPA's Appliance Recycling program has restrictions on age and unit size. According to program language, recycled units must be manufactured prior to 2001 and must be 10 to 30 cubic feet. In our review of the data, we found that entries outside of the program bounds were included in LIPA's 2012 EEP reported participation numbers. As noted in Figure 12-21, about 2% of freezers and 3% of refrigerators were manufactured after 2001 (2002 to 2011) and picked up through the program. Additionally, 146 units were outside of program size limitations. While we are assuming that these are input errors, LIPA should put a policy in place to check the data every month for eligibility and follow up with ARCA if ineligible units are found.

- **Marketing and Outreach:** Despite increasing the incentive to $50 per appliance, LIPA did not meet its participation goals. Program staff project that the market for secondary appliances on Long Island may be close to exhausted. We will conduct additional research to help LIPA understand the remaining potential and barriers to participation that could be addressed through special or targeted promotions.

12.3 Preliminary Results of Cool Homes Market Characterization

For the last two program years, the LIPA Cool Homes program has not experienced the anticipated level of program participation, resulting in savings below the program's goals. Prior market research conducted by the Evaluation Team has indicated that the program is capturing a relatively small share of the overall residential central air conditioning (CAC) market, and that participating Cool Homes contractors comprise a relatively small portion of all Long Island residential cooling contractors. In addition, past research indicates that due to perceived burdens associated with the program requirements, some participating contractors are not taking advantage of the program as often as they could to promote qualifying high-efficiency equipment and quality installations. To meet program goals in future years, significant efforts aimed at capturing a greater share of the Long Island cooling market will be necessary.

To help the program effectively target these efforts, the Evaluation Team conducted a process assessment of the Cool Homes program in 2012. It consisted of:

- Interviews with non-participating residential cooling contractors on Long Island: The Evaluation Team interviewed several Long Island residential cooling contractors to: 1) identify the reasons why more contractors are not participating in the Cool Homes program; 2) identify characteristics of non-participating contractors that will assist the program in its marketing and outreach efforts (e.g., demographics, best means of reaching target market, etc.); and 3) better understand the awareness and influence of the Cool Homes program on contractor equipment recommendations as a means of assessing non-participant spillover and market transformation.

- A focus group with participating Cool Homes contractors: The Evaluation Team conducted a focus group with participating Cool Homes contractors to identify specific aspects of the program requirements that prevent them from increasing their level of participation. Participating contractors were asked about general concerns they had about the program, the level of burden they perceived to be associated with various program requirements, and their opinions of different potential program designs and features.

- A review of existing high-efficiency cooling programs in the U.S.: The Evaluation Team researched other programs in the U.S. that incentivize high-efficiency CAC equipment in order to better understand how other programs are structured, program requirements, incentive levels, and what level of participation they experience. From an initial review of 24 residential cooling programs, we focused our efforts on seven programs representing a variety of different program structures and features. The residential high-efficiency central air conditioning programs include Consolidated Edison (Con Edison), New Jersey's COOLAdvantage, Massachusetts and Rhode Island's Mass Save, Kansas City Power and Light, Gulf Power, Pacific Power, and Ameren. The programs were chosen based on geography and program design. For these programs we conducted a literature review and secondary data collection, and interviewed program administrators and implementers.

While the preliminary results of these activities are presented here, ultimately this research will feed into the comprehensive Cool Homes Market Characterization study, which is ongoing. The Cool Homes Market Characterization research will also be informed by a participant survey, a non-participant survey (including on-site survey of baseline efficiencies of newly installed CACs), and in-depth interviews with non-active participating Cool Homes contractors. The results of these activities and those described above will be fully analyzed and integrated into a report on the CAC market on Long Island to be completed in the summer of 2013.

The methods we used for each of these research activities are described in more detail in Section 14 – Detailed Methods. The preliminary research results presented here are organized by the following topic areas:

- Characterization of Long Island HVAC Contractors
- Barriers to Participation
- Cool Homes in Comparison to Other High-Efficiency CAC Programs

Characterization of Long Island HVAC Contractors

To identify reasons that more contractors are not participating in the Cool Homes program, it is important to understand basic differences between the characteristics of participating and non-participating contractors including the business size.

Table 12-22 displays differences in number of employees between participating and non-participating contractors. All participating contractors with the primary Standard Industrial Classification (SIC) code of 1711 (heating and air conditioning) in the Hoovers database and located in the counties of Suffolk, Nassau, Queens, or Kings are included in this table. This includes 130 of the 184 contractors found on the Cool Homes program website. The non-participating contractors are comprised of the 713 contractors with a primary SIC code of 17110400 (heating and air conditioning contractors) or 17110405 (warm air heating and air conditioning contractor industry) located in LIPA territory (Suffolk County, Nassau County, and the Rockaways) who are not currently enrolled in the program. The Evaluation Team selected these SIC codes because about two-thirds of Cool Homes program-participating contractors were classified under these two SIC codes. Table 12-22 provides a general indication of the non-participating residential HVAC contractor size distribution compared to participating contractors. However, some of the contractors included in the non-participating contractor group may not be in scope, and some in-scope HVAC contractors may not be classified as being in one of the subject SIC codes comprising this group.

Table 12-22 reflects a pattern that interviewers contacting non-participating contractors also noticed: many of the large residential HVAC contractors in Long Island were already participants in LIPA's Cool Homes program, but most of the small contractors do not participate. While the program has signed up a larger share of the larger contractors, there are still many contractors who are not currently participating in the program for a variety of reasons discussed in the next section.

Table 12-22. Comparison of Participating and Non-Participating Firms by Number of Employees

Employees	Non-Participating Contractors in selected SIC Codes		Participating Contractors in SIC 1711	
	#	%	#	%
More than 20	25	4%	16	12%
6 – 20	87	12%	43	33%
3 – 5	131	18%	32	25%
1 – 2	467	66%	38	29%
Total	710	100%	129	100%
Mean	4		10	

Table 12-23 shows participation levels for large and small contractors in the Cool Homes program in 2012. Small firms are defined as those with one or two employees, while large contractors have 10 employees or more. On average, large contractors had 51.1 successful applications to the Cool Homes program in 2012, while smaller contractors averaged 13.6 successful applications. However, some small contractors have high levels of participation. Notably, there are three participating contractors with one or two employees that successfully submitted over 70 Cool Homes applications in 2012.

Table 12-23. Participation Levels for Small and Large Contractors in 2012

	1 - 2 employees	10 employees or more
Contractors	37	29
Total Units Incented by Contractors in this Group	504	1,482
Active Contractors*	24	22
% Active Contractors	65%	76%
Average Units per Contractor	13.6	51.1
Average Units per Active Contractor	21.0	67.4
Max Units from Single Contractor	78	310

*Indicates contractors who submitted one or more applications through the Cool Homes program in 2012.

Table 12-24 includes all large contractors (>9 employees) with a primary SIC code of 17110400 (heating and air conditioning contractors) or 17110405 (warm air heating and air conditioning contractor industry) located in LIPA territory (Suffolk County, Nassau County, and the Rockaways) that install residential central air conditioning on Long Island as well as the number of applications successfully submitted to the Cool Homes program.

It should be noted that the number of employees is only one indication of the potential number of residential CAC system installations. Some of the businesses shown install systems for both commercial and residential customers, and some conduct a portion of their work outside of the LIPA territory. Interviews with non-active participating contractors are planned for spring 2013 to obtain a qualitative understanding of why some firms have low participation rates.

Table 12-24. Large Participating and Non-Participating Long Island HVAC Contractors (>9 Employees)

Company Name	CAC Applications in 2012	Employees
Apollo H.V.A.C. Corporation	1	85
Cool Power, Inc.	171	60
Master Cooling & Heating Service, Inc.	1	60
Best Temp Mechanical Corp.	0	50
Kolb Mechanical Corp.	12	50
Martack Corporation	non-participant	43
Weber and Grahn Conditioning Corp.	non-participant	42
Dynaire Service Corp.	19	40
Howard Stern Mechanical Inc.	non-participant	35
True Mechanical Corp.	32	35
Martack Air Conditioning Corp.	1	30
Robbin's Heating & Air	non-participant	30

Company Name	CAC Applications in 2012	Employees
Dix Hills Air Conditioning Inc.	141	25
Elm Air Conditioning Corp.	166	25
Pam Air Conditioning Inc.	non-participant	25
All Weather Temperature Control Inc.	87	23
Gallettair Inc.	310	22
Sunray Systems Inc.	68	21
Air-Ideal Inc.	7	20
B & I Installations Ltd.	0	20
East Bay Mechanical Corp.	0	20
Phoenix Air Conditioning & Heating Inc.	0	20
Precision-Aire Inc.	non-participant	20
American Cool Air Corp.	non-participant	18
Cool-Temp Mechanical Inc.	non-participant	18
S.A. Fink, Inc.	33	18
Seasons Air-Conditioning Co., Inc.	119	18
Arenz Heating & Air Conditioning Corporation	6	17
Integrated HVAC Systems & Services Inc.	0	17
Airmax Long Island	184	16
Homan and Homan Air Conditioning and Heating Corp.	4	16
Precision Heating & Air, Inc.	non-participant	16
T F O'Brien Co. Inc.	86	16
Bryant Air Conditioning Contractors Inc.	non-participant	15
Xtraire Service, Inc.	non-participant	15
Frigidyne Air Conditioning Co. Inc.	0	13
Advanced Heating Air Conditioning & Refrigeration	14	12
Associated Energy Services Inc.	non-participant	12
Centigrade Heating & Cooling Corp.	non-participant	12
Heating & Cooling Supply Llc.	non-participant	12
Therm-A-Trol Inc.	non-participant	12
Jack Gayson Plumbing & Heating Co Inc.	0	11
T N T Air Conditioning and Heating Corp.	non-participant	11
A-1 Expert Mechanical Service Corp.	15	10
Tempco, Inc.	5	10

Barriers to Participation

Based on interviews with non-participating contractors and focus groups with participating contractors, the following issues emerged as barriers to participation in LIPA's Cool Homes program.

Time to Complete Paperwork

In both the participating contractor focus group and interviews with non-participating contractors, the time required to complete the applications and supporting documentation was identified as a barrier to participation in the Cool Homes program.

Small contractors often do not have enough of their own time available or that of clerical staff to complete rebate applications. As one small non-participating contractor said, "I don't have the manpower or the office staff to deal with the bureaucracy, and I've got to take care of my customer first. If the customer has to wait or I can't do a job, then it is impossible to join." This concern was also echoed by another small non-participating contractor who had lost jobs by not participating in the program. He stated, "It is very time-consuming for a small company to do all of that additional paperwork."

The participating contractors in the Cool Homes focus group were also concerned about the time required to complete paperwork. Contractors find that requiring their employees to document their work is a challenge. As one contractor put it, "Just getting my guys to fill it out at the end of the day, it's like you know they'll work all day with tools but get them to use a pen, no."

Upfront Costs

Small contractors find the initial investment in the Manual J software and tools to be a barrier to joining the Cool Homes program. The smallest contractors in particular are not certain they can achieve the 20 successful applications in their first year necessary for partial reimbursement. One contractor said, "I thought the initial investment for a contractor, especially if you are a small firm, okay, I didn't think that was fair." A second contractor said, "If they want us in the program, they'd give it to us." In the focus group with participating contractors, the upfront costs were mentioned but it was not a topic of particular concern.

Quality Installation Requirements

Several non-participating contractors reported the steps necessary for quality installation to be a barrier to program participation. Manual J load calculations emerged as one of the most significant barriers in both the focus group and interviews. Airflow was a burden for participating contractors in the focus group, but it was not mentioned as a barrier by non-participation contractors.

- Upfront costs. Contractors reported being reluctant to invest in the Manual J software.
- Risk of under-sizing systems. Contractors worry that if they follow Manual J procedures the CAC system will end up being under-sized. They are concerned that a system that does not cool the home sufficiently even on the hottest days of the year will result in dissatisfied customers and callbacks.

  To avoid the perceived risk of under-sizing systems, contractors in our focus group spoke of techniques they use to make sure they do not undersize. One participating contractor said, "We fudge it every time anyway because…if I know it's just an easy four ton, six ton and

Manual J comes up with a two ton system, I'm not putting a two ton system in, I'm putting a four in because that's what it needs. So we have to make the windows a little bigger because straight out reporting this to them, we have to make the rooms a little bigger. It's just what you have to do. It's still a good quality installation but you know that's what you got to do to get the rebate."

- **Time requirements.** Contractors report that properly sizing a home using Manual J can take three to four hours. Although state code mandates that load calculations are performed, four of the five participating contractors in the focus group and all of the non-participating contractors interviewed reported that they do not regularly perform Manual J outside of the Cool Homes program.

- **Manual J is viewed as unnecessary.** Eight of the nine contractors we spoke with (five participating, four non-participating) believe that a Manual J load calculation is not necessary for every installation. One contractor stated that if a system is 15 or 20 years old, is running fine, and is only being replaced to become more efficient, the system must be properly sized and there is no need for a Manual J load calculation. Others believe their experience to be more accurate than the Manual J load calculations, and adjust the load calculations so that they match the system size their experience tells them is necessary.

  There are some contractors who rely on the Manual J calculations at times. One non-participating contractor reports using load calculations when a building has certain features he does not have experience with, such as large windows or modern floor plans. Additionally, one participating contractor reports that he conducts a load calculation for every job he performs, including installations outside of the Cool Homes program.

- **Checking airflow is burdensome and unnecessary.** Participating contractors report that the time and effort needed for checking the system airflow to meet Cool Homes requirements is a burden. When explaining why, one contractor noted, "[The technician is] in the attic eight hours at 120 degrees, it's hard to get them to go fumble around with these little two hoses." Contractors also view this step as unnecessary. One non-participating contractor noted that he does not check the airflow because most of the time he can get it right without checking. On the rare occasions that the airflow is not correct, he will get a call from the homeowner and will come back and fix it the next day. He finds this method much more efficient in terms of time, and believes it to be just as effective.

Ability to Dissuade Customers from the Program

In our conversations with non-participating contractors they report that they frequently encounter customers who request rebates from Cool Homes. One of the four non-participating contractors interviewed to date reports occasionally losing jobs because he cannot offer the incentives. The other three contractors, however, report that they are able to convince customers that participating in the Cool Homes program is not advantageous, either by claiming that even with the incentive the additional cost of high-efficiency equipment would take 10 to 20 years to recoup, or that the program's sizing requirements will result in an undersized system that will not be able to keep the home comfortable on hot days.

Misinformation about the Program

In our conversations with non-participating contractors, we found that some were significantly misinformed about the program. The misinformation kept some contractors from considering participating in the Cool Homes program. Among the misinformation was the following:

- Contractors do not receive financial incentives from LIPA.
- Every system must be inspected by LIPA and a technician must be available for half a day in order to be present during the inspection.
- It costs $2,000 to purchase the tools to join the program.

After explaining to one contractor that contractors earn financial incentives and that not every system is reviewed, he said, “Well that’s making it more powerful. I’ll say that much.” He indicated that he would be more open to the program now. If misconceptions about LIPA’s Cool Homes program can be addressed, more contractors may become interested in the program.

Cool Homes in Comparison to Other High-Efficiency CAC Programs

Residential high-efficiency central air conditioning programs across the country differ significantly in program design, incentives, and features. The Evaluation Team reviewed several program designs and spoke with program managers to better understand what has been successful elsewhere, particularly in terms of generating contractor and customer interest and participation. Seven of these were chosen for review, and they are listed in Table 12-25. The Evaluation Team selected programs to review that were geographically close to Long Island, as well as several programs that had very different designs from that of the Cool Homes program. We reviewed the residential central air conditioning programs of Consolidated Edison (Con Edison), Mass Save (Massachusetts and Rhode Island), and COOLAdvantage (New Jersey). These programs have similar climates, demographics, and energy prices to Long Island, allowing a more relevant comparison of program features. We also reviewed four additional programs from across the U.S. to provide a more diverse array of program designs.

Table 12-25. Residential Central Air Conditioning Programs Reviewed

Program or Utility	State
Con Edison	NY
COOLAdvantage	NJ
Mass Save	MA & RI
Cool Homes (KCP&L)	MO
Gulf Power	FL
Pacific Power	WA
Ameren	IL

The variety of program features and designs are discussed below and are summarized in Table 12-26.

Equipment Types and Minimum Efficiency Levels

Each of the programs we reviewed offers financial incentives to customers for the installation of traditional split central air conditioners and air source heat pumps. These programs require that split-system central air conditioners and air source heat pumps meet energy efficiency levels ranging from 14 SEER to 16 SEER.

Four programs, including LIPA, offer incentives specifically for ductless mini-split systems. Some programs include ductless mini-split systems along with their heat pump incentives. LIPA requires that ductless mini-split systems are 18 SEER or above, while the other programs reviewed have minimum efficiency ratings of 16 SEER. In addition to a minimum SEER rating, Pacific Power requires a minimum heating efficiency level of 9 HSPF (Heating Seasonal Performance Factor), and Gulf Power requires that a 0.9 AFUE furnace is also installed.

LIPA and five of the reviewed programs offer incentives for geothermal heat pumps. The efficiency requirements for geothermal heat pumps vary more widely than other equipment types. For example, COOLAdvantage requires that units are ENERGY STAR-qualified, and Ameren will incent any newly installed geothermal heat pump.

Financial Incentives for Contractors

In four of the programs reviewed, including LIPA, contractors receive financial incentives for installing high-efficiency CAC systems. These incentives range from $50 to $850 per installed system. In some programs the contractor incentive varies with the type and efficiency of the measure installed. In other programs, such as LIPA, the incentive to contractors is the same regardless of the efficiency or type of equipment installed. Cool Homes is the only program reviewed that offers a different contractor incentive per system when more than one system is installed in the same home.

There are four programs that do not offer contractor incentives. Two of these programs are implemented by Proctor Engineering. They require limited paperwork for contractors and generate business for contractors through a rebated tune-up program. The program managers for these programs report meeting and exceeding contractor participation and savings goals. They also report that contractors perceive participation in these efficiency programs to be a minimal investment of time and effort. Although these programs do not offer contractor incentives for system installations, both programs offer smaller incentives (less than $100) for related activities such as tune-ups and ductwork. Of the two other programs that do not provide contractor incentives, one did not meet program savings goals in 2012 and the evaluation team was unable to obtain program savings information from the other program.

Some programs offer different incentive amounts to contractors based on installation practices. The details of these program designs vary. For example, Con Edison offers customer incentives for all high-efficiency central air conditioning systems installed by any licensed contractor, but will only offer contractor incentives for installations that meet their quality installation requirements. At Pacific Power, customers can choose between “Qualified Contractors” and “Participating Contractors.” Qualified contractors have received additional training and are offered a larger financial incentive for their more rigorous installation practices.

While other programs offer customer rebates for efficient furnace fans, LIPA is the only program reviewed that offers a contractor rebate for the installation of furnace fans. To be eligible, LIPA customers must install the furnace fan with a 16 SEER central air conditioner and the previous unit must be eligible for early retirement. At least four of the programs, including LIPA, offer contractor incentives for the installation or repair of ductwork.

Instant Customer Savings

Cost is the biggest barrier to installing a high-efficiency central air conditioner for many customers. Customer rebates make high-efficiency central air possible for many homeowners. However, rebates are not able to reach individuals who cannot afford to pay for the entirety of the cost of the system upfront. Instant customer savings, where the contractor discounts the invoice, are mandatory in three programs and optional in three additional programs, including Cool Homes.

Cool Homes' instant savings option is limited by contractors' willingness to provide it. Contractors in the Cool Homes contractor focus group expressed a reluctance to offer customers instant discounts because outstanding LIPA balances are deducted from the rebate before being issued to the contractor. In 2012, 10% of Cool Homes participants utilized the instant savings option.

Early Replacement, End-of-Life Replacement, and New Installations

LIPA and six of the programs reviewed offer customer rebates for central air conditioning systems replaced at the end of the useful life of a previous system. These incentives range from $100 to $750 per unit replaced. Only one of the reviewed programs, Cool Homes Missouri, does not offer rebates for End-of-Life replacements.

Six programs, including LIPA, offer rebates for central air conditioning systems installed in new construction or in homes where no central air conditioning system previously existed. These incentives range from $100 to $750 per unit installed.

Early replacement programs provide incentives for customers and contractors to remove existing lower-efficiency systems and replace them with new, high-efficiency equipment. Early replacement programs can produce large savings because for several years the new efficiency can be compared to the previously installed system, which is often lower than the 13 SEER minimum. Typically incentives for customers or contractors are larger for systems that are designated as early replacement.

The Evaluation Team's review of high-efficiency residential cooling programs paid particular attention to early replacement programs. With LIPA's Cool Homes program recently adjusting the requirements and incentives for early replacement and with these installations playing a larger role in the overall program, we looked at how other programs define and incentivize early replacement.

Four of the programs we reviewed offer early replacement incentives, as does LIPA. All of the programs we reviewed require that the previous equipment be operational at the time of replacement. Gulf Power and KCP&L require that the existing systems function no better than 8 EER after a tune-up. Ameren and Mass Save require nameplate SEER values to be under 10 SEER. LIPA is the only early replacement program we reviewed that does not require a maximum efficiency level of the existing system. LIPA's Cool Homes program is also the only program we reviewed that includes inoperable systems in their early retirement program. LIPA requires that these systems be repairable for $1,000 or less.

Requirements for Contractor Participation

Contractors must meet certain requirements in order to participate in the residential central air conditioning programs that we reviewed. These requirements vary significantly between programs. Con Edison's program requires that contractors be licensed , but requires no specific training or preregistration, while New Jersey allows self-installed units in their program Other programs require contractors to attend trainings, purchase tools, and provide documentation such as proof of insurance and completed W-9s. LIPA and three of the programs we reviewed require contractors to obtain training specific to their program.

In order to participate, programs require varying levels of documentation. Con Edison's program and New Jersey's COOLAdvantage require limited documentation. . Most other programs require an application and ask for proof of insurance. In addition to these requirements, Ameren asks to see a completed W-9. LIPA requires an EPA refrigerant handling certificate, home improvement contractor license, proof of general liability insurance, and two of the following: a) satisfactory banking reference, b) three satisfactory professional/trade references, and c) a minimum of three satisfactory customer references.

Three programs (Con Edison, Mass Save, and Pacific Power) have two levels of participation for contractors: highly qualified program contractors and less-vetted or un-vetted contractors. Both groups can submit qualifying systems to their programs, but the more qualified contractors earn a larger incentive requisite of their additional expertise and time commitment. Mass Save offers contractor rebates only to the more qualified contractors. In some programs the customers using the more qualified contractors will also receive a higher rebate. The higher rebate helps them cover the higher cost of the higher quality installation by the highly qualified contractors.

Tiered programs must be clearly explained to customers to avoid confusion. Pacific Power clearly states on their contractor list that Participating Contractors are contractors who have agreed to the terms and conditions and are eligible to install incented systems, but Qualified Contractors with additional training are clearly identified and are listed first on the program's list of participating contractors.

A program design being used by Con Edison allows contractors the option to choose whether to complete the quality installation requirements based on the needs of the individual homeowner. Contractors in the focus group stated that they sometimes install qualifying equipment in the homes of their customers, but for one reason or another, cannot meet the other Cool Homes quality installation requirements for that installation. In Con Edison's program a contractor can receive higher incentives for qualifying systems with quality installations and lower incentives for qualifying equipment without the quality installation.

Table 12-26. Detailed Program Features

Program Feature		LIPA Cool Homes (NY)	Con Edison	COOLAdvantage (NJ)	Mass Save (MA & RI)	KCP&L Cool Homes (MO)	Gulf Power (FL)	Pacific Power (WA)	ActOnEnergy (IL)
Financial Incentives for Customers	Maximum customer incentive for end of life or new system	$1500 / system	$600 / system	$500 / system	$500 / system	N/A	$500 / ton	$750/ system	$600 / system
	Maximum customer incentive for early replacement	$1,500 / system	N/A	N/A	$500 / system	$850 / system	$1,000 / system	N/A	N/A
Instant Customer Savings		Optional	Not available	Optional	Optional	Mandatory	Mandatory	Not available	Mandatory
Financial Incentives for Contractors – Installation of Central A/C Systems	Maximum end of life or new system incentive	$150 for first system, $50 thereafter	$200 / system	$0	$375	N/A	$0	$50 / system	$0
	Maximum early replacement incentive	$200 for first system, $50 thereafter	N/A	N/A	$850	$0	$0	N/A	$0
Ductwork Program		Full replacement	Sealing	No ductwork program	Leakage reduction	No ductwork program	Sealing	Sealing	No ductwork program

Program Feature		LIPA Cool Homes (NY)	Con Edison	COOLAdvantage (NJ)	Mass Save (MA & RI)	KCP&L Cool Homes (MO)	Gulf Power (FL)	Pacific Power (WA)	ActOnEnergy (IL)
Other Incented Measures	Furnace Fan	With installation of ER system	✓	No	No	No	✓	No	No
	Tune-Up	No	No	No	No	✓	No	✓	No
	Thermostat	No	✓	No	No	No	No	No	No
	Hurricane Sandy Incentive	No	No	✓	No	No	No	No	No
Minimum Efficiency Levels		15 SEER	15 SEER	16 SEER	14.5 SEER	14 SEER	14 SEER	15 SEER	14.5 SEER
Installation Types Incented	New Installation	✓	✓	No	✓	No	✓	✓	✓
	Retrofit	✓	✓	✓	✓	No	✓	✓	✓
	Early Retirement	✓	No	No	✓	✓	✓	No	✓
Participation of Contractor	Program Affiliated	✓	✓	No program affiliated contractors	✓	✓	✓	✓	✓
	Non-Program Affiliated	No	✓	✓	✓	No	No	✓	No

Program Feature		LIPA Cool Homes (NY)	Con Edison	COOLAdvantage (NJ)	Mass Save (MA & RI)	KCP&L Cool Homes (MO)	Gulf Power (FL)	Pacific Power (WA)	ActOnEnergy (IL)
Benefit of Program Affiliation to Contractor (if Non-Program Affiliated Can Participate)		N/A	Name on website	N/A	Contractor Incentive available to participating contractors only	N/A	N/A	Identified as "Quality Contractor" on website	N/A
Process to Become an Affiliated Contractor		Application, documentation, references, purchase of equipment, and training	Must submit a certain number of applications	There are no program affiliated contractors, anyone can participate	Attend training, purchase tools, meet with program staff	Attend training and purchase required tools	Attend training and purchase required tools	Must agree to terms and conditions; Qualified Contractors also attend trainings.	Application, provide proof of insurance, and completed W-9
Number of Applications Required for Partial Reimbursement of Upfront Costs		20 successful applications in one year	N/A	N/A	5 passing QIV tests in one year	Undetermined	10 jobs completed within 30 days of training	Undetermined	N/A
System Types eligible for incentives	Traditional Central Air Conditioning	✓	✓	✓	✓	✓	✓	✓	✓
	Ductless Mini-Split	✓	No	✓	✓	No	No	✓	No
	Air Source Heat Pump	✓	✓	✓	✓	✓	✓	✓	✓
	Geothermal Heat Pump	✓	No	✓	No	✓	✓	✓	✓

Program Feature		LIPA Cool Homes (NY)	Con Edison	COOLAdvantage (NJ)	Mass Save (MA & RI)	KCP&L Cool Homes (MO)	Gulf Power (FL)	Pacific Power (WA)	ActOnEnergy (IL)
Installation Requirements	Manual J	✓	Required for contractor incentive only	✓	✓	✓	No	No	No
	Airflow	✓	No	No	Required for contractor incentive only	✓	✓	✓	No
	Refrigerant	✓	No	No	Required for contractor incentive only	✓	✓	✓	No
	Equipment Matching	✓	✓	✓	✓	✓	✓	✓	✓
	Other Requirements	None	none	Manual S	Manual S highly recommended	None	None	None	None

12.4 ENERGY STAR® Labeled Homes

LIPA'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. In addition, the program uses marketing and outreach to educate both homeowners and builders about the program and the benefits of participating.

In 2012, the program transitioned its efficiency standard from ENERGY STAR Version 2.0 to ENERGY STAR Version 3.0. A total of 429 ENERGY STAR homes were completed through the program. Program staff note that many builders decided to no longer participate in the program due to the increased requirements associated with ENERGY STAR Version 3.0, including additional checklists, new HVAC contractor training and certification, and non-energy-related requirements. However, citing the program's influence on local building practices, the program also claimed incremental savings above code on 301 non-ENERGY STAR homes with a HERS score below 70 (referred to as "HERS Index homes"). The Evaluation Team has assigned partial savings for these homes and categorized these savings as program spillover. The program worked with raters to identify the homes and provided a $100 incentive to submit the REM/rate file. Program staff note that this effort also helped to inform future program design and document the levels of HERS scores being achieved on Long Island.

In 2013, the program revised its incentive structure and now offers incentives on homes that are not ENERGY STAR-qualified but have reached a HERS score below 70, along with other program requirements. Program staff believe that this will increase program participation and allow builders who do not wish to build to the ENERGY STAR platform to still take part in the program.

Process Assessment

Due to the size of the program and the limited contribution to the overall portfolio savings, the process evaluation of the Residential New Construction program in 2012 was limited to interviewing program staff and reviewing the program database and materials. Topics explored during the interview included a discussion of program goals, strengths, challenges, and opportunities. Findings are summarized below.

The goals of the ESLH program are to encourage local builders to incorporate higher levels of energy efficiency in their building practices to meet program requirements, and to assist home buyers in easily identifying homes that are more energy-efficient than a standard market practice home. The primary barriers in 2012 included a lack of interest on the part of many builders in continuing to meet increasingly stringent ENERGY STAR standards, and customer awareness of the benefits of purchasing a program-qualified home.

Program Participation and Incentives

The program relies on an existing infrastructure of Home Energy Raters (HERS raters) to work with builders during the construction of qualified homes in LIPA's service territory. To participate in the program, builders and raters must sign a participation agreement and become an ENERGY STAR partner with the Environmental Protection Agency (EPA).

In 2012, LIPA paid incentives for 429 ENERGY STAR labeled homes completed through the program. As previously noted, the program reached out to raters and provided a $100 incentive to submit the REM/rate files of non-ENERGY STAR-qualified homes with a HERS score below 70. LIPA claimed savings for a total of 301 HERS Index homes that met these requirements, citing the program's influence on building practices in the local market. Table 12-27 below shows that 22 builders who previously participated in the ESLH program accounted for 103 of the 301 HERS index homes, or 34%. Builders with no prior experience with the program built the remaining 198 homes.

Table 12-27. 2012 HERS Index Builders*

Builder Type	Number of Builders	Number of HERS Index Homes
Previously Participating Builder	22	103
Non-Participating Builder	103	198
Total	**125**	**301**

*HERS Index builder names were compared to 2010-2012 program data to determine whether they had participated in the ESLH program in the past.

The Evaluation Team assigned savings associated with the 103 HERS Index homes built by previously participating builders as program spillover, as it is likely that their building practices have been influenced by the program.[48] As shown in Table 12-28 below, with added spillover from HERS Index homes, the program exceeded its unit goal by 4%.

Table 12-28. Program Participation in 2012

Builder Type	Unit Goal	Actual Units	Percent of Goal
ENERGY STAR Labeled Homes	514	429	83%
Spillover (HERS Index homes)	-	103	-
Total	**514**	**532**	**104%**

Program staff note that builder participation dropped in 2012 as ENERGY STAR Version 3.0 went into effect. Many builders decided not to participate in the program due to added requirements of meeting ENERGY STAR Version 3.0 standards. This is consistent with many other ENERGY STAR New Homes programs across the country. Challenges mentioned include the myriad of checklist items that must be tracked, additional training required for HVAC contractors, and other non-energy-related requirements that must be met. These requirements add to the complexity of the program and can increase the cost of building an ENERGY STAR home.

To qualify for incentives a home must be an ENERGY STAR labeled home, meet specific energy saving requirements for lighting and appliances, and other technical requirements as required by LIPA. The program provided free CFLs to participating builders in 2012 in an effort to assist them in

[48] As previously noted, without additional research we do not have a basis for apportioning spillover savings to the 198 homes built by non-participating builders. Additional research will be conducted in 2013 to explore LIPA's influence on local building practices.

meeting energy-savings requirements. Lighting orders are placed by the builder, rater, or electrician, and the program implementer, CSG, receives, tracks, and fulfills orders.

In 2012, four tiers of incentives were offered, as shown in Table 12-29. Supplemental incentives were also offered for prescriptive measures, such as ENERGY STAR fixtures, exterior doors, or central air upgrades to SEER 18.

Table 12-29. 2012 Program Incentives

Tier	Required HERS Index*	Energy Savings Target (kWh)**	Incentive Amount
Tier 1	Target Index to -14	500	$2,000
Tier 2	Target -15 to -24	1,000	$3,000
Tier 3	Target -25 to -54	1,500	$4,000
Tier 4	Target -55 or better	2,000	$5,000

*HERS Index rating is based on the actual rating index's improvement relative to the target index.
**Homes that cannot meet energy targets must install 90% ENERGY STAR lighting, and all builder-installed appliances must be ENERGY STAR.

Program Marketing and Outreach

Program marketing and outreach efforts in 2012 did not change significantly from previous years. Marketing and outreach efforts are primarily focused on working through participating raters and builders to reach potential homebuyers, rather than direct marketing to consumers.

The program promotes the benefits of qualified homes through print advertising, trade shows, the Long Island Builder's Institute, customer brochures and fact sheets, and home branding kits (including a plaque, real estate signs, a welcome mat, and educational materials). The program also offers cooperative advertising dollars to builders to market program-qualified homes.

Conclusions and Future Considerations

The transition of the program in 2012 to ENERGY STAR Version 3.0 resulted in a drop in participating builders. However, claiming spillover savings for homes that did not meet ENERGY STAR standards but achieved a HERS score below 70 allowed the program to reach 104% of its unit goal. This effort also served to inform the program's revised incentive design going forward.

In 2013, LIPA reports that the program began offering builder incentives for non-ENERGY STAR homes that achieve a HERS score below 70, along with other requirements. This will allow builders who do not want to build to ENERGY STAR Version 3.0 standards to participate in the program. Additionally, it will allow the program to continue to have a presence in the market and influence building practices for different types of builders.

Additional research in 2013 may be required by the Evaluation Team to determine the influence of the new program structure on participants' building practices, and explore process-related questions, as appropriate, in order to provide feedback to LIPA on the program's design and operations, and to validate the program's claim of savings associated with HERS Index homes. In addition, ODC will investigate whether LIPA's training and education programs, and prior influence on town building codes can be credited with increasing efficiency of new homes.

13. Additional 2013 Evaluation and Research Activities

13.1 Commercial Efficiency Program

Non-Participant Spillover

Reliable estimation of non-participant spillover in the commercial sector is a challenging and oftentimes costly endeavor. Establishing reliable and causal links between program activity and the energy-saving actions taken by non-participants is difficult, as there are a broad range of influencing factors in addition to program interventions, such as other energy efficiency initiatives, changes in codes and standards, naturally occurring efficiency, and other factors.

Table 13-1 below shows the activities that will be undertaken as a part of non-participant spillover research; each activity is discussed in further detail below.

Table 13-1. Non-Participant Spillover Activities

Activity	Description
Phase 1 Research	
Documentation Review	Review of program design, training, and marketing to investigate market-transformative elements of the program design and delivery.
Focus Group	Focus group with both participating and non-participating market actors (e.g., contractors, distributors, equipment vendors, etc).
Phase 2 Research	
Drop-Out Survey	Survey of customers who started but did not complete the application process.

The Phase 1 activities will be focused on exploring and documenting causal links that might lead to non-participant spillover effects.

- **Documentation review.** This research activity will include review of program design, program training, and program marketing materials as well as up to three in-depth interviews with program staff. It will allow us to understand and document whether program theory contains non-program effects, and understand the magnitude thereof. This task will build on research efforts to document program theory and implementation processes conducted to-date, but will place greater focus on investigating market-transformative elements of the program design and delivery.
- **A focus group with market actors.** We will conduct the focus group with both participating and non-participating market actors (e.g., contractors, distributors, equipment vendors, etc). Through the focus group discussion we will 1) establish the state of the market, 2) understand drivers to any change in adoption of energy efficiency, and 3) test the plausibility of causal links and market-transformative activities identified as part of the document review, and assess LIPA's role as opposed to the role of other influencers (trade associations, equipment manufacturers, other energy efficiency programs around the nation, etc.) in bringing about market transformation. The results will provide an

understanding of the share of high-efficiency equipment sales and installations, program vs. non-program sales and installations, and non-program sales and installations attributable to the CEP activity in the market. Having this information will allow us to assess the realm of presence of non-participant spillover and attempt to qualitatively describe its magnitude, but will not quantify it.

This focus group will also be an excellent opportunity to gather forward-looking information on the market trends expected in the next few years, and will provide important information regarding effective program design. The assessment will include, but not be limited to, future savings opportunities, gaps in current programming, and innovative approaches to program design.

The Phase 2 activity will focus on quantifying these efforts by gathering additional technical information about projects completed without direct program assistance.

- Survey with customers who started the application process ("closed cancelled" projects) but did not complete it due to a variety of reasons, such as equipment not meeting the efficiency criteria but still being more efficient than the standard, customers opting out of the participation process, and other reasons. This research effort will involve customer surveys similar to those that we have used to estimate participant spillover, and might include follow-up engineering callbacks. During the interviews we will confirm the completion of the project, collect information on the scope and efficiency of the completed project, understand the reasons for why the project was not completed through LIPA, and understand the influence of LIPA's Commercial Efficiency program and its various components (audits, technical assistance, interactions with program staff, etc.) on the decision to perform the project. We will also explore the influence of market actors on customer decisions, collect market actor information, and enhance customer interviews—where applicable and needed—with market actor interviews to understand how the program influences market actor sales and stocking practices.

13.2 Energy-Efficient Products Program

In 2013, we plan to conduct additional research for the Residential Lighting, Room Air Conditioner, and Dehumidifier, Pool Pump, and Appliance Recycling components of the Energy-Efficient Products (EEP) program. These studies are briefly discussed below by program area.

Residential Lighting research will explore customer response-related changes enacted by the Energy Independence and Security Act of 2007 (EISA). The studies listed below will inform possible revisions to relevant program planning assumptions, assist in optimizing lighting measure mix, and update the lighting baseline as necessary.

- Focus groups with residential customers. These discussions will probe into customer awareness of and response to EISA, familiarity with and perceptions of lighting product options (i.e., incandescent bulbs, halogen bulbs, standard and specialty CFLs, LEDs), and qualitative information regarding lighting purchase decision-making.

- In-home lighting audit combined with an in-home quantitative survey.[49] These tasks will gather information on both past and expected future lighting purchase behaviors given the changes in lighting options as a result of EISA. While in the home, we will gather information on the types and quantity of lighting in use to determine the change in socket saturation to allow for the analysis of program spillover and remaining energy-efficient lighting potential in the home. Lighting spillover will be combined with the existing LIPA free ridership value to arrive at an updated NTGR.

- In-store stocking study. This effort will be combined with the stocking study for dehumidifiers and room air conditioners below. If the retailer also participates in the lighting program, we will explore the available lighting products on store shelves to understand changes in product mix and availability to inform the baseline values for high-wattage products.

Residential Room Air Conditioner and Dehumidifier research will assist in determining the percent of ENERGY STAR® stock available in the Long Island market. Two studies will be completed, which are described below.

- Retailer interviews. These interviews will capture the percent of ENERGY STAR products available through the retail manager's store over time. We will focus on room air conditioners and dehumidifiers, and ask about changes in units available over the past three years.

- In-store stocking study. This study will look into what types of room air conditioners and dehumidifiers are available to the residential market on Long Island, and determine the split between ENERGY STAR and non-ENERGY STAR units. Additionally, for ENERGY STAR units we will explore what percent of available products can be categorized as "most efficient," exceeding ENERGY STAR minimum requirements.

Pool Pump research will update the 2010 baseline study by determining the percentage of homes with in-ground pools and the type of pump in use.

- In-home study combined with in-home quantitative survey. While we are conducting lighting audits in customer homes, we will collect pool pump information for homes with in-ground pools. We will ask customers about the likelihood of replacing a functioning but less efficient pool pump with an energy-efficient pump, as well as ask customers about barriers to program participation.

Appliance Recycling research will estimate the number of remaining program-qualifying appliances in use for program planning.

- In-home study combined with in-home quantitative survey. While in homes conducting lighting audits, we will record the approximate age of all primary and secondary refrigerators and freezers in use. We will ask customers about their likelihood to dispose of secondary appliances through the LIPA program, and also the likelihood that their existing primary refrigerator may become a secondary appliance in the future. We will also discuss barriers to participation with customers who have qualifying appliances in their homes.

[49] At an April 2, 2013, meeting with LIPA, we discussed also taking an inventory of homes with pools and types of pool pumps while in the home for the lighting study.

13.3 COOL HOMES PROGRAM

In 2013, the Evaluation Team is conducting additional research for the Cool Homes program to further explore the influences and barriers to customer and contractor participation in the program, and to establish a market baseline efficiency for split central air conditioning systems.

- Participating Customer Survey. The Evaluation Team has already completed 409 interviews with customers who have participated in the Cool Homes program. The interviews are evenly split between early retirement and end-of-life participants. The large number of completed interviews will allow us to assess for each type of participant: program awareness, attitudes, purchasing behavior, contractor influence on purchasing decisions, and the condition of the systems being replaced. In the coming months Opinion Dynamics will analyze this data in conjunction with non-participant survey data to identify differences between these groups, the factors that lead to early replacement decisions, and any unique characteristics of participants and non-participants that will help LIPA market the program to contractors and customers.

- Non-Participating Customer Survey. This survey will target customers who purchased split-system central air conditioning equipment in the last three years and who have not participated in LIPA's Cool Homes program. It will address many of the same questions as the participant survey, such as program awareness and influence, purchasing behaviors, contractor influence, and the condition and efficiency levels of the previous and current systems.

- On-Site Audits of Residential Central Air Conditioning Equipment. As part of the non-participant survey, the Evaluation Team will recruit approximately 120 homeowners for on-site audits to collect equipment nameplate data, which will provide the SEER and size of the installed equipment. These data will be used to establish the market baseline of non-program split-system central air conditioners in LIPA's service territory.

- Non-Active Participating Contractors In-Depth Interviews. While many contractors are registered to participate in LIPA's Cool Homes program, some of them are not putting many or any systems through the program. These interviews will probe why these contractors are not regularly participating in the program, and what changes might make the Cool Homes program more attractive to these contractors.

The results of these research activities and those already carried out in 2013 (see Section 12) will be analyzed together and integrated into a report on the CAC market on Long Island to be completed in the summer of 2013.

14. Detailed Methods

14.1 Data Collection

14.1.1 Overview of Data Collection

This report documents the findings from the 2012 evaluation of LIPA's portfolio of ELI 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 measurement and verification (M&V) site visits. Table 14-1 lists the primary data collection efforts associated with the evaluation of each program.

Table 14-1. Primary Data-Collection Efforts in 2012 Evaluation

Program	Data Collection Type					
	In-Depth Interviews		Telephone Survey		On-Site M&V	Focus Group
	Program Managers	Retailers / Contractors	Participants	Non-Participants		
CEP – Custom	X	X	X		X	
CEP – SBDI	X		X	X		
CEP – Prescriptive / Retrofit Existing	X	X	X			
EEP – ARP	X					
Cool Homes	X	X				X
HPD / HPwES	X					
REAP	X					
ENERGY STAR New Homes	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 ELI 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 Measurement and Verification

To capture the impacts from the CEP Custom program that has significantly different measures across the projects, we performed on-site M&V. Our M&V follows the standards set out in the International Protocol for Measurement and Verification Performance (IPMVP). This protocol provides specific guidance on spot metering and short-term metering as well as how the Evaluation Team should use these types of data.

Focus Group

Data collection from a small group of market experts within a structured setting allows for exploration of themes and concepts not available through in-depth interviews. Participants can hear what their peers are saying and respond in real time. For PY2012, we used the focus group methods to obtain insights from Cool Homes contractors about application procedures and program designs.

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 M&V by program.

For 2012, we conducted surveys with program participants for only some of the programs evaluated. Because of the focus on the data flow, we performed surveys with only those programs where we were again capturing net-to-gross ratio (NTGR) values.

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).[50]

- 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.
- 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

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

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.

14.1.2 Commercial Efficiency Program

We performed five specific data collection activities for within the Commercial Efficiency program (CEP):

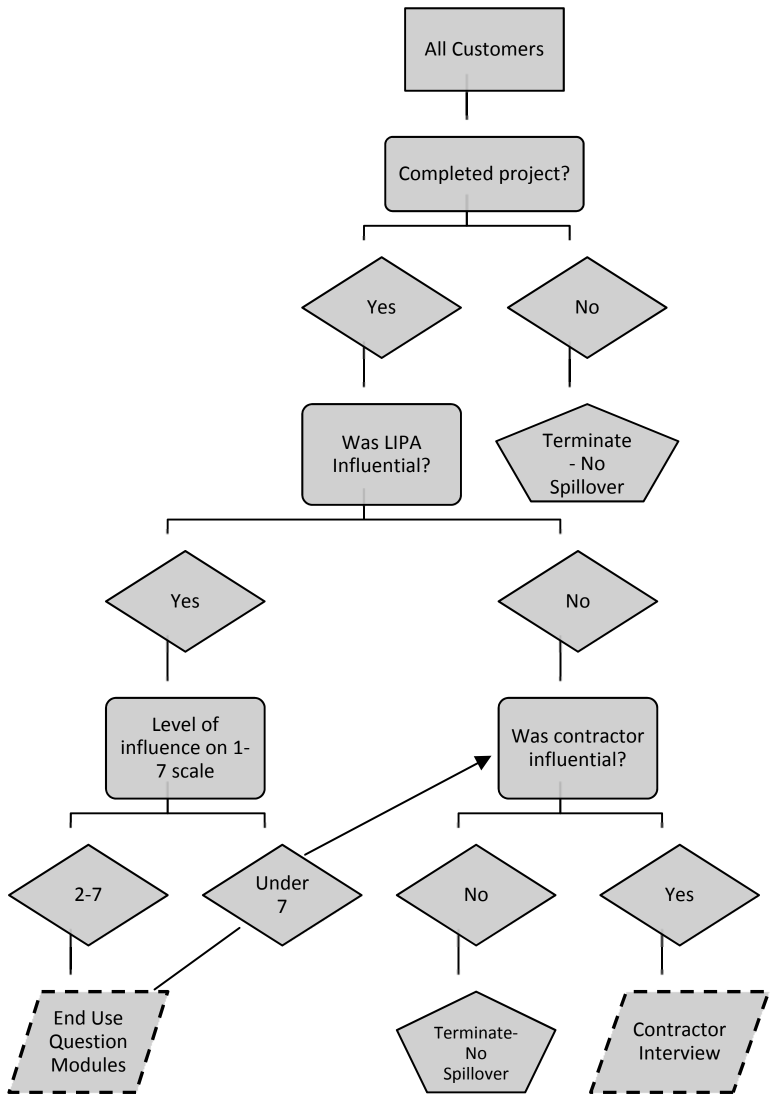
1. Quantitative telephone survey of past CEP participants to assess spillover
2. In-depth interviews with some trade allies to determine influence of program for spillover analysis
3. Quantitative telephone survey of SBDI non-participants to assess barriers to participation
4. In-depth interviews with program staff to understand programmatic changes
5. M&V site visits and engineering desk review to assess gross impacts

Next we describe the sample designs and response rates from each effort.

Spillover Participant Survey

We conducted a survey of past program participants to see if, since their participation in the program, they had completed additional efficiency projects for which they did not receive incentives and if the completion of those projects was influenced by their prior participation in the program. This survey was supplemented with contractor interviews when necessary and possible. We collected technical information about projects identified through the survey to quantify the resulting energy savings. A high-level schematic of the survey design is presented in Figure 14-1. The boxes with dotted lines indicate further research to collect technical project details, either through the survey or through contractor follow-up calls.

Figure 14-1. Survey Schematic



The sample frame included CEP customers that had completed projects in the 2011 program year, customers who completed projects in the first half of the 2012 program year, and customers that had been previously identified as spillover candidates in the 2011 survey. Many customers had completed more than one project through the program; the 2011 and 2012 databases were combined and duplicates were removed based on unique phone numbers. Table 14-2 below presents an overview of the sample design, and shows the response and cooperation rates for the participant survey.

Table 14-2. Commercial Efficiency Program Sample Design

Program Component	Sample Frame (Based on Unique Phone Numbers)		Complete d Interviews	Respons e Rate	Cooperation Rate
	n	%	n		
2011*	607	56%	139	27%	67%
2012	475	44%	138	32%	59%
Total	**1,082**	**100%**	**277**	**30%**	**66%**

*After identifying duplicates based on unique phone numbers, participants that participated in both 2011 and 2012 were included in the 2011 sample frame.

The SBDI sample was composed of participants from the first half of 2012. The SBDI sample was cross-checked with the CEP sample and duplicates were removed. The sample was then filtered by unique phone number, resulting in 475 unique contacts. Table 14-3 shows the response and cooperation rates for the SBDI sample.

Table 14-3. SBDI Sample Design

Program Component	Sample Frame (Based on Unique Phone Numbers)	Completed Interviews	Response Rate	Cooperation Rate
Total*	475	139	32%	58%

*All SBDI participants in the sample frame participated in 2012.

Trade Ally Interviews

Potentially influential contractors were identified through customer responses to spillover battery questions. If a customer reported completing a project but gave LIPA a score of between 2 and 7 for the program influence question[51] we asked if the contractor influenced the customer. If the contractor reported that LIPA had influenced them, we would then adjust the program influence score to account for LIPA's influence through contractors. Four customers responded positively to contractor influence, and the contractors' names and phone numbers were collected. However, we were able to talk with only two of them (and left multiple voicemails for the other two). We adjusted the energy and demand savings based on the details received during the follow-up calls. However, neither of the two contractors indicated LIPA influence, therefore influence scores were not adjusted.

SBDI Non-Participant Survey

The Commercial Efficiency program evaluation included a quantitative telephone survey with SBDI-eligible customers who did not install SBDI program-rebated equipment, including customers who received an audit through the program (partial participants) and program-eligible customers who did not (non-participants). The primary objective of the survey was to assess customer familiarity with LIPA's Small Business Direct Install program and gather insights into and feedback regarding customers' interactions with the program. The survey instrument included questions designed to measure program awareness and familiarity, assess customer satisfaction with the audit process, identify barriers to program participation, and gauge customer interest in future participation.

[51] A value of 1 on this scale indicated "no influence."

The sample frame was drawn from the database of account numbers for program-eligible customers provided by the program implementation contractor, Lime Energy. These data were cleaned to remove program participants, customer accounts associated with equipment or unoccupied facilities (such as cable boxes, pumps, and poles), accounts without phone numbers, and accounts with duplicate phone numbers.

As seen in Table 14-4, the resulting sample frame consisted of 20,351 unique customer accounts, consisting of 18,512 non-participants and 1,839 partial participants. As part of the sample design, we oversampled partial participants to assess barriers to following through with the installations of measures identified through the audit. We attempted to complete 70 interviews with partial participants and 100 with non-participants.

We fielded the surveys between March 20 and April 3 of 2013. Overall response rate was at 5% and overall cooperation rate was at 15%.

Table 14-4 below provides an overview of the sample frame, the expected and actual number of completed interviews, and the response and cooperation rates.

Table 14-4. SBDI Survey Sample Frame and Survey Statistics

Customer Type	Population of SBDI-Qualified Accounts		Sample Frame		Expected Number of Completed Interviews		Completed Interviews		Response Rate	Cooperation Rate
	#	%	#	%	#	%	#	%		
Non-Participant	24,409	91%	18,512	91%	100	59%	108	64%	5%	13%
Partial Participant	2,398	9%	1,839	9%	70	41%	62	36%	7%	15%
Total	**26,807**	**100%**	**20,351**	**100%**	**170**	**100%**	**170**	**100%**	**5%**	**15%**

Since we oversampled partial participants, for reporting purposes we applied the following weights.

Table 14-5. SBDI Survey Weights

Customer Type	Population of SBDI-Qualified Accounts		Completed Interviews		Weight
	#	#	#	%	
Non-Participant	24,409	91%	108	64%	0.25
Partial Participant	2,398	9%	62	36%	1.43
Total	**24,807**	**100%**	**170**	**100%**	

Program Staff Interviews

As part of the 2012 Commercial Efficiency program evaluation, we conducted in-depth interviews between January and February 2013 with a total of five program staff members at LIPA, National Grid, Solution Provider, and Lime Energy. The interviews were designed to understand programmatic changes made to the program in 2012 and understand the changes planned for 2013.

M&V Site Visits and Engineering Desk Reviews

The Evaluation Team used site visits to determine ex post savings estimates associated with Custom projects and engineering desk reviews of a sample of projects to determine ex post savings for four different components of CEP: 1) Small Business Direct Install (SBDI), 2) Retrofit Existing Lighting, 3) Retrofit Existing 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.[52]

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.[53] 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 stratified random sample design to draw samples for the Custom EM&V, SBDI, Prescriptive Lighting and Performance Lighting, Retrofit Existing Lighting, and Retrofit Existing Non-Lighting projects. In the case of the SBDI program component, we stratified the sample by the time frame within which the projects were completed. 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 CEP components.

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 Kish54 is to multiply the f(y) by the width the interval, take the square root of this value, and cumulate the values $\sqrt{d_y f(y)}$.

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[52] 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.

[53] 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).

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

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.[55]

$$n_h = n \frac{N_h s_h}{\sum N_h s_h} \tag{1}$$

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:

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

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:

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

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.

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

Custom M&V Sample Design

Custom projects, by their nature, cover a wide range of different measures with varied impacts. For this reason, we employed a stratified random sample design, which optimizes sampling by project size (ex ante impacts) to obtain 90/10 statistical precision. In 2011, despite a sample design that was expected to reach 90/10 precision, the final precision for demand was outside of LIPA's acceptable bounds. The reason for the larger-than-desired precision was thought to be due to the timing of last year's M&V. For 2011, to meet the timeline of the evaluation, our M&V took place in the last months of 2011 and the first few months of 2012. Since the peak demand occurs in the summer, our evaluation modeled demand impacts for weather-sensitive measures. This is standard practice, but may have led to higher-than-expected variation in the findings. Additionally, we pulled 2011 projects based on energy. LIPA's goals are capacity goals, so a sample design based on demand would be more appropriate. After conferring with LIPA, the Evaluation Team took a different approach to determine the Custom impacts for 2012.

For 2012, we chose to include 15 months of Custom projects across two program years and to perform the M&V in the summer of 2012. Through doing so, we gained added certainty that the peak demand impacts for weather-sensitive measures were accurate. In making this choice, we obviously did not have the full year of 2012 projects in our sample frame. However, after discussing this with LIPA, we determined that the projects completed during 2011 would be very similar to what may occur later in 2012, and would be a sufficient representation for our analysis and application of the results. We created our sample frame from all Custom projects in 2011 and through the end of March 2012, removing any projects from the frame that had already had M&V within our 2011 evaluation. We used a sample design based on demand to pull all 2012 samples.

The sample design indicated that 10 new M&V projects would be needed to obtain the desired statistical certainty. However, at LIPA's request we added two additional projects. Additionally, LIPA requested that we perform summer M&V on three projects from our 2011 M&V that were weather-dependent projects. We performed M&V on 15 sites in the summer of 2012. To improve the precision of the overall Custom analysis, we also included 12 projects from 2011 in the final determination of a gross realization rate. This final realization rate was applied to the population of 2012 Custom projects.

The sample design for the Custom component is shown in Table 14-6.

Table 14-6. CEP Custom Projects Sample Design

Stratum	Boundaries (kW)	Total Ex Ante Savings (kW)	Projects in Population	Projects in Sample	Expansion Weights for Realization Rates (Population / Projects in Sample)
Summer 2012 – M&V Sites (sample drawn from January 1, 2011, to May 31, 2012, participants)					
1	1-15	430	66	4	16.5
2	15.1-50	929	32	4	8.0
3	50.1-250	819	7	4	1.8
Total for Summer 2012		2,178	105	12	-
Previous 2011 M&V Sites		1,778	17	17	1
Total		3,956	122	29	-

After sample selection, we obtained project application documents to provide background information on the measure(s) installed within each Custom project application, as well as their ex ante savings calculations. For site visits, we sent selected customers notification letters and then contacted them by phone to recruit participation in the M&V process. We conducted 15 site visits between June 2012 and October 2012.

For site visits, before visiting each site, the Evaluation Team developed an M&V plan to outline the metering and analysis strategies needed to determine evaluated project savings. Senior staff internally reviewed and finalized the plans before each site visit. We documented the results from each site M&V in Appendix B.

As noted above, the Evaluation Team used site M&V and engineering desk reviews on the selected sample to develop ex post energy and demand savings estimates. We then compared the ex post savings estimates to the ex ante tracking estimates to develop a realization rate for the selected sample. We applied the realization rates back to the population of Custom projects, using case weights from the sample design. We then combined the results from the summer analysis and previous M&V to obtain a realization rate for the 2012 program.

We present the final precision value for the Custom M&V realization rate analysis below. Because of our sample design, the total kW and kWh seen in these tables are not the 2012 totals. However, as explained above, we are applying these realization rates to the 2012 population.

Table 14-7. Custom kW Realization Rate

Factor	N	Ex Ante Gross kW for Analysis	Realization Rate	Relative Precision
Previous 2011 M&V Site – Wave 1	6	473	0.72	0%
Previous 2011 M&V Site – Wave 2	11	1,305	0.68	0%
Summer 2012 M&V Site – Wave 3	105	2,178	0.89	22%
Total	122	3,956	**0.80**	**13%**

Note: Based on our sample design, the totals here are not the actual 2012 totals. We applied the realization rates to the total 2012 ex ante savings values.

Table 14-8. Custom kWh Realization Rate

Factor	N	Ex Ante kWh	Realization Rate	Relative Precision
Previous 2011 M&V Site – Wave 1	6	1,762,726	1.23	0%
Previous 2011 M&V Site – Wave 2	11	6,414,819	0.96	0%
Summer 2012 M&V Site – Wave 3	105	9,776,765	0.90	28%
Total	122	17,954,309	**0.95**	**15%**

Note: Based on our sample design, the totals here are not the actual 2012 totals. We applied the realization rates to the total 2012 ex ante savings values.

Engineering Review Sample Design

As previously mentioned, we used a stratified 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. We stratified the sample based on the date the projects were completed (January 2012 through the end of September 2012, and October 2012 through the end of December 2012). This decision was driven by the desire to account for any differences in data quality that may have occurred as a result of the new data import tool implemented in early October 2012.[56]

Table 14-9. CEP SBDI Engineering Review Sample Design

Phase	Date of Application	Projects in Population		Projects in Sample	
		#	%	#	%
1	January 1, 2012, to September 30, 2012	1,060	69%	13	65%
2	October 1, 2012, to December 31, 2012	468	31%	7	35%
Total		1,528	100%	20	100%

The sample design for the Prescriptive Lighting and Performance Lighting projects, Retrofit Existing Lighting, and Retrofit Existing Non-Lighting components is shown in Table 14-10. We used a stratified random sample design, split by kW demand savings to draw the samples for these three components. We further stratified Retrofit Existing Lighting projects based on the date the projects were completed to account for any differences in data quality that may have occurred as a result of the new data import tool implemented in early October 2012.

[56] The data import tool only affected the SBDI and Existing Retrofit Lighting program components. The data tool allowed for an automatic import of the core project inputs into Siebel (e.g., kW and kWh savings, incentives, etc.)

Table 14-10. CEP Prescriptive Lighting and Retrofit Existing Engineering Review Sample Design

Stratum	Boundaries (kW)	Total Ex Ante Savings (kW)	Projects in Population	Projects in Sample
Prescriptive Lighting				
1	1-40	611	105	14
2	41-401	1,055	11	11
Total		1,666	106	25
Retrofit Existing Non-Lighting Projects				
1	0-10	329	86	7
2	11-58	482	19	8
Total		811	105	15
Retrofit Existing Lighting Projects				
Phase 1 – Sample drawn from January through the end of September 2012 participants				
1	0-10	3,336	977	9
2	11-116	4,750	163	9
Total – Phase 1		8,086	1,140	18
Phase 2 – Sample drawn from October through December 2012 participants				
1	1-10	3,607	832	9
2	11-101	5,204	158	8
3	102-137	641	5	5
Total – Phase 2		9,453	995	22

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[57], 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[58] to extrapolate results for each site back to the overall 2012 component population. Figure 14-2 shows the algorithm we used to extrapolate to the population.

[57] LIPA includes line losses and coincident factor in their net values while our gross impacts include these two factors.

Figure 14-2. 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:

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

$$\text{Relative Precision Across Multiple Samples} = \frac{\sqrt{\text{Error Bound}_1 + \text{Error Bound}_2 + \text{Error Bound}_n}}{\sum_1^n \text{Ex Post Savings}_i}$$

14.1.3 Cool Homes

Non-Participating Contractor In-Depth Interviews

To identify contractors who are eligible but not participating in LIPA's Cool Homes program, the Evaluation Team obtained a list of all registered businesses in SIC 1711 (Plumbing, Heating, and Air Conditioning) located in LIPA's service territory. This effort produced 2,908 businesses that could be in scope, but also included businesses that do not install residential CAC systems. Through a series of questions prior to conducting an interview, we screened out ineligible businesses. Initially, businesses on the list were called randomly, but due to the number of businesses that were found to be ineligible, we later focused our calling efforts on businesses in the more specific SIC code 1711400, and businesses with identifiers such as Cooling or HVAC in the company name.

Contractor Focus Groups

The Evaluation Team convened a focus group of five participating contractors on the evening of April 2, 2013. To recruit contractors for the focus group, we called Cool Homes participating contractors and offered an incentive of $250. Cool Homes program-related activity levels among the contractors ranged from one contractor who submitted six projects in 2012 to a contractor who was responsible for 80 projects in 2012. Contractors were asked about the process for submitting a central air conditioner through LIPA's Cool Homes program, as well as residential HVAC program designs that are seen in other territories.

Literature Review

The Evaluation Team conducted an initial review of 24 residential HVAC programs across the U.S. From this list, we conducted a more-focused review of seven programs. We selected these programs based on their proximity to Long Island, or unique program design. We collected detailed information about these programs from their program websites and in-depth interviews with program managers or implementers from five of these programs.

14.1.4 Home Performance Programs

The Evaluation Team conducted an in-depth interview with the program manager for HPD and HPwES. In addition, we reviewed program materials and program-tracking data.

14.1.5 REAP

The Evaluation Team conducted an in-depth interview with the program manager for REAP. In addition, we reviewed program materials and program-tracking data.

14.1.6 EEP

The EEP program includes upstream incentives for lighting products, room air conditioners, and televisions; downstream rebates for energy-efficient appliances and pool pumps; an online catalogue program that provides discounted lighting and smart strips; and a refrigerator recycling program component. The Evaluation Team conducted in-depth interviews with program managers and reviewed program-tracking data. Additional research will be conducted in 2013, including focus groups, retailer interviews, a store stocking study, and in-home audits.

14.2 Analytical Methods

The Evaluation Team used a variety of analytical methods to generate the 2012 findings. Table 14-11 provides a summary of analytic methods used to evaluate program processes and impacts by program. We utilized an engineering review of deemed savings to determine ex post savings for all programs. For the Commercial Efficiency program, we augmented the impact assessment with engineering desk review and M&V site visit analysis of a statistically valid sample of Custom projects. For the REAP program, we validated our engineering results with a billing analysis. We relied heavily on the quantitative analysis of participant survey data and qualitative in-depth interviews to inform the market and process assessments for the CEP, Cool Homes, and EEP programs.

Table 14-11. Primary Analytical Methods Used in 2012 Evaluation

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

Note that this analytical method includes population analysis further described in the section below.

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

14.2.1 SBDI Population Analysis

To support the process evaluation of the SBDI program, the Evaluation Team obtained and analyzed a variety of data, including:

- LIPA's CIS data extract
- Data file with LIPA customers identified as eligible for the SBDI program
- Data file with marketing and outreach activities performed as part of the SBDI program outreach efforts
- Data file with SBDI audit and installation specifics.

We received the data from both LIPA and Lime Energy. We cleaned and prepared the data for analysis by performing the following steps:

- **Identifying and removing duplicate accounts.** We searched the data files for duplicate records and records with missing account numbers, and dropped them from analysis.
- **Identifying and removing non-retrofitable accounts.** We identified and removed accounts that cannot undergo a retrofit, such as pumps, poles, cable boxes, sewers, and homeowner associations.
- **Cleaning customer addresses.** We cleaned customer addresses to support customer geocoding and data mapping.
- **Cleaning and grouping SIC codes.** We cleaned and aggregated SIC codes into general categories to facilitate analysis of the customer data by business segment.

As a result of the data cleaning steps, the total number of LIPA commercial customers originally received from LIPA was reduced from 105,528 to 94,718 (90% remaining), while the total number of SBDI-eligible customers was reduced from 34,528 to 28,293 (82% remaining).

To support the analysis of the size and specifics of the SBDI-eligible population relative to LIPA's other commercial customers, we then merged LIPA customer data provided as part of the CIS data extract with the SBDI-eligible customer data. We were able to merge the data for 23,067 of 28,293 SBDI-eligible accounts, which represents an 82% success rate. Since we could not match a fairly high percentage of the SBDI-eligible accounts (18%), we investigated the reasons for it and how the inability to match the data might affect the accuracy of the results. Based on the results of the analysis, we believe that the core reasons for the inability to match the data include account deactivation for the winter season, and the aftermath of Hurricane Sandy.

To assess the biases caused by the inability to match the data, we compared the completion of audits as well as participation in the SBDI program across matched and unmatched accounts. The comparison showed that percent of customers who had an audit or installed SBDI-rebated equipment are skewing slightly higher among the accounts we were able to match. The differences, however, were not large enough to cause concerns about biasing the results. We also looked at the distribution of the matched and unmatched accounts across LIPA townships. There were no differences in the distribution of matched and unmatched accounts across townships. Based on the results of this analysis, the Evaluation Team concluded that bias, if any, is minimal, and included the results of the analysis in the report.

Data analysis included two major components:

- **Quantitative data analysis.** As part of this analysis, we analyzed the data in a variety of ways. We ran frequency distributions, means, and cross-tabulations, among other things.
- **Data mapping.** As part of this task, we generated a variety of maps to visually display the location of the SBDI customers, marketing and outreach activities performed, and audit and participation rates.

SBDI Literature Review

The Evaluation Team completed a comparative review of the design and implementation elements of LIPA's SBDI program to a variety of other Small Business Direct Install programs administered by utilities across the country. The goal of this effort was to provide LIPA program staff with insights on the SBDI program design and implementation practices and strategies that could potentially be integrated as part of LIPA's SBDI program design and implementation structure moving forward.

As part of this research effort, we reviewed recent evaluation reports, white papers, and other literature on the subject. Overall, we included 11 programs across the country, eight of which are administered in the northeastern United States, including New York State. The table below details the utilities whose Small Business Direct Install programs we included as part of our review.

Table 14-12. List of Programs Reviewed as Part of the Literature Review

Utility	State
Con Edison	NY
NYSEG	NY
Orange and Rockland	NY
RG&E	NY
PSE&G	NJ
Cape Light, National Grid, NSTAR, Unitil, WMECO	MA
Connecticut Light and Power	CT
National Grid	RI
Xcel Energy	MN
ComEd/Nicor, ComEd/People's Gas/North Shore Gas	IL
SDG&E	CA

Our review of literature on Small Business Direct Install programs included the following publications:

1. "Small Business Energy Efficiency: Roadmap to Program Design." Center for Energy and Environment, August 2012.

2. "Process Evaluation of One-Stop Efficiency Shop Program: Administered by Center for Energy and Environment as Part of the Xcel Energy Conservation Improvement Program." Frontier Associates, September 2010.

3. "San Diego Gas & Electric Non-Residential Process Evaluation Study: Attachment 2 – Program-Specific Evaluations." Heschong Mahone Group, Inc., March 2012.

4. "Massachusetts Non-Residential Small Business Direct Install Program: Multi-Tier Program Structure Assessment: 2010 Process Evaluation." Opinion Dynamics Corporation and Cadmus Group, July 2012.

5. "Energy Efficiency/Demand Response Plan: Plan Year (6/1/11-5/31/2012): Evaluation Report: Small Business Energy Savings Evaluation for Commonwealth Company /People's Gas and North Shore Gas." Opinion Dynamics Corporation and Navigant Consulting, December 2012.

6. Con Edison. "Small business direct installation." Accessed March 10, 2013. http://www.coned.com/energyefficiency/businessdirect.asp.

7. NYSEG. "Small Business Energy Efficiency Program." Accessed March 10, 2013. http://www.nyseg.com/UsageAndSafety/usingenergywisely/eeps/smallbusiness.html.

8. Orange and Rockland. "About the Lighten Up Program." Accessed March 10, 2013. http://lightenupnow.com/about-lighten-program.

9. RG&E. "Small Business Energy Efficiency Program." Accessed March 10, 2013. http://www.rge.com/UsageAndSafety/usingenergywisely/eeps/smallbusiness.html.

10. PSE&G. "PSE&G Direct Install Program for Government and Non-Profit Facilities." Accessed March 10, 2013. http://www.pseg.com/business/small_large_business/save_energy/gov_efficiency.jsp.

11. Connecticut Light & Power. "Energy Advantage." Accessed March 10, 2013. http://www.cl-p.com/business/saveenergy/services/energyadvantage.aspx.

12. National Grid. "Rhode Island Small Business Program." Accessed March 10, 2013. https://www1.nationalgridus.com/RISmallBusinessProgram.

14.2.2 Spillover from SBDI and CEP Programs (Method and Detailed Results)

Participant spillover refers to energy efficiency installations that took place without program assistance, but were influenced by participants' prior experience with the program. An example of participant spillover is a customer who installed equipment in one facility and received a rebate from the program and, as a result of the positive experience with the program, installed additional equipment at other facilities without a program incentive.

Customer Surveys

To quantify spillover attributable to the program, we asked past program participants about additional efficiency projects that they may have completed for which they did not receive a rebate, and how much LIPA influenced those projects. The survey questions used to identify potential spillover candidates are summarized in Table 14-13 below.

Table 14-13. Spillover Survey Question Detail

Question	Question Number	Answer	Result
Did respondent make qualified improvements outside of program?	SP1a and SP1b	Yes/No	– If "Yes" continue – If "No" terminate
Did respondent complete projects in specific end-use?	SP2a, SP3a, SP4a, SP5a, SP6a	Yes/No	– If "Yes" go through end-use module – If "No" continue to next end-use
Why did respondent complete project without a rebate from LIPA?	SP2b, SP3b, SP4b, SP5b, SP6b	Open Ended	– Record reason
Did respondent's experience with the LIPA program influence the decision to complete project?	SP2c, SP3c, SP4c, SP5c, SP6c	Yes/No	– If "Yes" ask how much and how – If "No" ask about contractor influence
How much did LIPA influence project?	SP2d, SP3d, SP4d, SP5d, SP6d	Scale 1-7	– If 2-6 ask about contractor influence and follow-up with contractor

Customers who reported that the program had an influence of 2 or greater on a 7-point scale are included in the spillover savings total.[59] Thirty-eight CEP participants out of the 277 who completed the survey, and 9 SBDI participants of the 139 who completed the survey, specified that the program influenced them to install different types of measures outside of the program without receiving a rebate. After potential spillover candidates were identified through the survey, we cross-checked program data to confirm that they had not received rebates for the indicated measures through the CEP or SBDI programs. This reduced the number of projects to 9 of the 38 CEP participants and 2 of the SBDI participants. Table 14-14 shows the reason for excluding projects from the analysis.

Table 14-14. Reasons for Exclusion from Spillover Analysis

Parameter		CEP	SBDI
Original Spillover Values from Survey		38	9
Reasons for Exclusion			
	Customer actually received incentives for this measure	10	3
	Participant indicated not influenced by the program or contractor	10	3
	Nothing indicated in survey for spillover equipment	8	1
	No information provided about measure (participant did not allow a callback back for additional information)	1	0
Total Possible for Spillover		9	2

The final count of projects included in the spillover analysis is summarized in Table 14-15.

Table 14-15. Number of Surveyed Participants with Spillover Savings

Program	Participants Surveyed	Spillover Participants	Spillover Participant Percentage
CEP	277	9	3.3%
SBDI	139	2	1.4%
Total	**416**	**11**	**2.6%**

The energy savings for these projects were quantified through an engineering analysis described in detail later in this section. The proportion of savings credited to the program was based on the scale question regarding LIPA's influence for questions SP2d, SP3d, SP4d, SP5d, and SP6d.

Contractor Interviews

Participants that reported completing projects but gave LIPA a score between 2 and 6 (on a scale of 1-7) for the level of program influence were then asked if the contractor was an influence. This addressed the fact that many of LIPA's program activities are aimed at changing contractor behavior and may not have been completely evident to end-users.

For participant influence scores that are smaller than the maximum influence score of 7, we looked to see if the contractor could have influenced the participant (and potentially LIPA through the

[59] A value of 1 was indicated to mean "No influence" when read to the respondent. As such, these responses were not included in our analysis.

contractor). There were four cases (across three contractors) where it was possible that the contractor influence score could increase the NTGR value. As stated earlier, we contacted the four contractors identified as being influential. We were only able to complete interviews with two, and based on the responses we did not make adjustments to the program influence score.

Engineering Analysis

We used the data collected through the surveys and the contractor follow-up calls to quantify the energy savings for the projects identified as spillover. The LIPA Technical Reference Manual (TRM), New York TRM[60] and the Mid-Atlantic TRM[61] were used to determine the energy savings for each measure identified through the survey. The New York and Mid-Atlantic TRMs were used to calculate savings for commercial case freezers, motors, and HVAC systems, as these measures are not included in the LIPA TRM. Table 14-16 shows the algorithms used to calculate the per-unit energy savings for the identified spillover measures.

Table 14-16. Algorithms Used to Calculate per-Unit Spillover Savings

Measure	Units	kWh Savings Equation	kW Savings Equation	Source
CFLs	Per lamp	$((W_{BASE} - W_{CFL})/1{,}000)$ * HVACe * Hours/yr	$((W_{BASE} - W_{CFL})/1{,}000)$ * HVACd * CF	LIPA TRM
LEDs	Per lamp	$((W_{BASE} - W_{LED})\ /1{,}000)$ * HVACe * Hours/yr	$((W_{BASE} - W_{LED})/1{,}000)$ * HVACd * CF	LIPA TRM
Linear Fluorescent T8s	Per lamp	$((W_{BASE} - W_{T8})/1{,}000)$ * WHFe * Hours/yr	$((W_{BASE} - W_{T8})/1{,}000)$ * HVACd * CF	LIPA TRM
Linear Fluorescent T5s	Per lamp (or per fixture based on response to question)	$((W_{BASE} - W_{T5})/1{,}000)$ * WHFe * Hours/yr	$((W_{BASE} - W_{T5})/1{,}000)$ * HVACd*CF	LIPA TRM
Occupancy Sensors	Per sensor	((Controlled Wattage * Hours/yr*HVACe)/1,000) * Savings Factor	((Controlled Wattage * CF * HVACd)/1,000) * Savings Factor	LIPA TRM
Glass Door Cooler	Per cooler (varies by size)	(kWhbase – kWhee) * HVACe	((kWhbase – kWhee)/8760) * HVACd * CF	NY TRM
Residential Solid Door Cooler	Per cooler (varies by size)	(kWhbase – kWhee) * HVACe	((kWhbase – kWhee)/8760) * HVACd * CF	NY TRM
Motors	Per motor	HP * 0.746 * ((1/ηbase)-(1/ηee)) * LF * Hours	HP * 0.746 * ((1/ηbase)-(1/ηee)) * LF * CF	Mid-Atlantic TRM
Split A/C	Per ton	((12/EERbase)-(12/EERee)) * EFLHclg	((12/EERbase)-(12/EERee)) * CF	Mid-Atlantic TRM

[60] New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs. October 2010.

[61] State of Illinois Energy Efficiency Technical Reference Manual. July 2012.

Additional resources were used when needed, and are indicated in Table 14-17. Below are the assumptions and per-unit values used to calculate spillover energy and demand savings associated with these measures per participant. Unless otherwise noted, all per-unit values in the following table include LIPA's line loss factors for kWh and kW of 1.0707 and 1.1013, respectively.

Table 14-17. Per-Participant Spillover Measure Assumptions and per-Unit Savings

Business Type	Spillover Measure	Savings kWh/unit	Savings kW/unit	Units	Quantity	Source	Assumptions
Elementary School	CFLs – 68W	482	0.20	Per lamp	100	– LIPA TRM	Participant indicated installing 100 CFLs; CFL wattage provided in survey as 68W and replaced 250W metal halide flood lamp. Annual hours of operation from the LIPA TRM of 2,187 for this building type; Coincidence factor of 0.75 was applied from LIPA TRM; Waste-heat factors of 1.13 for energy and 1.32 for demand were applied per LIPA TRM.
Indoor Tennis (Exercise Center)	LED - 33W (Exterior)	314	0.00	Per lamp	6	– LIPA TRM	Participant indicated installing 6 LEDs outside of facility; LED wattage provided in survey as 33W and replaced 100W incandescent lamps. Annual hours of operation based on assumption of 50% usage (on at night) per year (8760/2 = 4,380 hrs/yr) for exterior installation; Coincidence factor of 0 was applied as these are on at night (outside of peak hours); No waste-heat factors applied as measure installed outside of conditioned space.
Fire Department	LED - 30W (Exterior)	563	0.00	Per fixture	5	– LIPA TRM – 1000bulbs.com – Company website[1]	Participant indicated installing 5 exterior LED fixtures and replaced high-pressure sodium (HPS) fixtures. The LED and baseline wattage was unknown. We used the company website to refer to pictures of the facility to get a sense of the type of exterior fixtures installed (wall packs); The mean wattage for high-pressure sodium wall packs (per 1000bulbs.com) is 150W/fixture; we used this as our baseline wattage and the LED equivalent is 30W. Annual hours of operation based on assumption of 50% usage (on at night) per year (8760/2 = 4,380 hrs/yr) for exterior installation; Coincidence factor of 0 was applied as these are on at night (outside of peak hours); No waste-heat factors applied as measure installed outside of conditioned space.

Business Type	Spillover Measure	Savings kWh/unit	Savings kW/unit	Units	Quantity	Source	Assumptions
Marina	LED - 75W (Exterior)	821	0.00	Per fixture	6	– LIPA TRM – 1000bulbs.com	Participant indicated installing 6 LEDS outside of facility; LED wattage provided in survey as 75W and replaced metal halide. It was assumed these are wall pack fixtures. A metal halide equivalent for a 70W LED to 78W LED is 250W (per 1000bulbs.com) and this was used for baseline wattage; Annual hours of operation based on assumption of 50% usage (on at night) per year (8760/2 = 4,380hrs/yr) for exterior installation; Coincidence factor of 0 was applied as these are on at night (outside of peak hours); No waste-heat factors applied as measure installed outside of conditioned space.
Funeral Home	LED – 10W (Interior)	136	0.03	Per lamp	300	– LIPA TRM – ENERGY STAR Lighting Calculator	Participant indicated installing 300 10W LEDs inside of facility and were newly installed without replacing any type of lighting. It was assumed that the participant would have installed incandescent lamps, therefore we used 40W (lumen equivalent to 10W LED) incandescent lamp as the baseline; Annual hours of operation from the LIPA TRM of 3,750 were used for building type description "Small services"; Coincidence factor of 0.75 was applied from LIPA TRM; Waste-heat factors of 1.13 for energy and 1.32 for demand were applied per LIPA TRM.
Office/ Manufacturing	Linear Fluorescent T8	598	0.18	Per fixture	200	– LIPA TRM – NY Wattage Table[2] – 1000bulbs.com	Participant indicated installing 200 T8 fixtures, but did not know the wattage or type. We assumed 2 lamps/fixture, 4 foot, 32W/lamp T8s were installed, using 59W/fixture (accounting for 0.92 ballast factor); Participant indicated that halogen lighting was removed but wattage is unknown; Calculated halogen baseline based on average lumen output for the assumed T8s (average of 2795 for 10 different types of 4' 32W T8 lamps found on 1000bulbs.com); Halogen lamps output

Business Type	Spillover Measure	Savings kWh/unit	Savings kW/unit	Units	Quantity	Source	Assumptions
							25lumens/watt, therefore baseline wattage used is 225W (2 lamps * 2795)/25 lumens per watt = 223.6W); Annual hours of operation from the LIPA TRM of 2,979 (average for office and manufacturing building type) as this business is a mixture of facility types. Coincidence factor of 0.75 was applied from LIPA TRM; Waste-heat factors of 1.13 for energy and 1.32 for demand were applied per LIPA TRM.
Retail	Linear Fluorescent T8	133	0.03	Per fixture	60	– LIPA TRM – NY Wattage Table[2]	Participant indicated installing 64W T8 fixtures and replaced T12 fixtures; we used 59W/fixture for the T8s (account for 0.92 ballast factor) and used a baseline wattage of 86W for a 2 lamp, 4 foot F40T12; Annual hours of operation from the LIPA TRM of 4,057 were used for building type description “Retail”; Coincidence factor of 0.75 was applied from LIPA TRM; Waste-heat factors of 1.13 for energy and 1.32 for demand were applied per LIPA TRM.
Retail	Linear Fluorescent T5	137	0.03	Per fixture	12	– LIPA TRM – NY Wattage Table[2]	Participant indicated installing 12 54W T5 lamps, which are high-output F48T5 lamps according to NY Wattage table (after lookup for 54W lamp); We assumed 2 lamp fixtures with total wattage of 117W; the baseline wattage for a 2 lamp 4 foot F48T12HO (w/ magnetic ballast) @ 60W/lamp was used (total fixture wattage of 145W); Annual hours of operation from the LIPA TRM of 4,057 were used for building type description “Retail”; Coincidence factor of 0.75 was applied from LIPA TRM; Waste-heat factors of 1.13 for energy and 1.32 for demand were applied per LIPA TRM.
Office	Lighting Controls - Occupancy Sensors	66	0.02	Per sensor	10	– LIPA TRM – NY Wattage Table[2]	Participant indicated installing 10 occupancy sensors that control 2 to 4 lights each; Based on type of building, we assumed a 2 lamp 4 foot F32T8 (total fixture wattage of 54W) was being controlled per installed sensor. The 30%

Business Type	Spillover Measure	Savings kWh/unit	Savings kW/unit	Units	Quantity	Source	Assumptions
							savings of lighting consumption was used (per LIPA TRM); Annual hours of operation from the LIPA TRM of 3,100 were used for building type description "Office"; Coincidence factor of 0.75 was applied from LIPA TRM; Waste-heat factors of 1.13 for energy and 1.32 for demand were applied per LIPA TRM.
Restaurant	Glass Door Cooler	1,035	0.13	Per 15 cu. ft. cooler	1	– NY TRM – Company website[3]	Participant indicated installing cooler in facility; company website used to locate pictures of the cooler; it is a dessert cooler that is approximately 15 cu. ft.; Interactive factors used for energy and demand for "Restaurant" type building are 1.11 and 1.2 respectively per NY TRM; Coincident factor of 1.0.
Contractor	Residential Solid Door Cooler	463	0.06	Per 20 cu. ft. cooler	1	– NY TRM	Participant indicated installing a cooler; we assumed a residential sized unit was installed as building type is described as contractor; we are assuming a refrigerator for his office was installed; used average size (20 cu. ft.) found from previous work for recycled residential refrigerators using data from 564 participants. Interactive factors used for energy and demand for "Single-Family" building type are 1.077 and 1.085 respectively per NY TRM; Coincident factor of 1.0.
Office/ Manufacturing	Motors	1,688	0.29	Per 50hp motor	3	– Mid-Atlantic TRM	Participant indicated installing 3 new 50 horsepower motors; Assumed 4-pole motor for fan. Assumed motor efficiency of 94.5% and baseline efficiency of 93% per the Mid-Atlantic TRM. Annual hours of operation from Mid-Atlantic TRM of 3,303 (average for office and manufacturing building type) as this business is a mixture of facility types. Coincidence factor of 0.555 and motor load factor (LF) of 0.75 was applied.
Fire Department	Split A/C	136	0.20	Per ton	1 (20 ton unit)	– NY TRM	Participant indicated installing a new 20 ton split rooftop unit; Assumed the EER value is

Business Type	Spillover Measure	Savings kWh/unit	Savings kW/unit	Units	Quantity	Source	Assumptions
							11.2 (13 SEER) based on minimum code standards and replaced a 9.2 EER (10 SEER) unit as survey indicated it replaced a unit that is more than 20 years old. Effective full load cooling hours of 550 was used for low-rise multi family dwelling for an average aged building; because this building type is unique with live-in tenants we felt it was most appropriate to use multi-family variable assumptions; Coincidence factor of 0.8 as used per NY TRM.

[1] Sayville Fire District website used to obtain photos of exterior fixtures to identify the types of installed lighting; http://www.sayvillefd.org/images/gallery/4/100_2487.jpg.
[2] New York Fixture Wattage Table: this data comes from the New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs. Oct 2010.
[3] Company website used to obtain photos of inside of building to get a better idea of the size of the cooler that was installed.

The total calculated spillover savings by measure type for CEP and SBDI are shown below in Table 14-18 and Table 14-19 respectively.

Table 14-18. Total Spillover Savings per Measure for CEP Participants

Measure	kWh	kW
CFLs	32,105	13.23
LEDs	45,219	9.81
Linear Fluorescent T8s	107,653	31.93
Linear Fluorescent T5s	1,649	0.37
Occupancy Sensors	664	0.19
Glass Door Cooler	1,035	0.13
Split A/C	2,721	4.07
Motors	3,377	0.58
Total	**194,423**	**60.32**
Total Verified Savings for Surveyed Sample	**12,528,760**	**3,221.00**
% Spillover	**1.55%**	**1.87%**

Table 14-19. Total Spillover Savings per Measure for SBDI Participants

Measure	kWh	kW
LEDs	4,924	0.00
Residential Solid Door Cooler	425	0.05
Total	**5,349**	**0.05**
Total Verified Savings for Surveyed Sample	**2,009,381**	**502**
% Spillover	**0.27%**	**0.01%**

14.2.3 Cool Homes Program

The Evaluation Team did not perform a NTG assessment of HPD and HPwES for the 2012 evaluation. Please see the 2011 Program Guidance Report for the methodology used to develop the 2011 NTGRs for the program.

14.2.4 Home Performance Direct and Home Performance with ENERGY STAR

The Evaluation Team did not perform a NTG assessment of HPD and HPwES for the 2012 evaluation. Please see the 2011 Program Guidance Report for the methodology used to develop the 2011 NTGRs for the program.

14.2.5 REAP Estimation of Savings Using Billing Analysis

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

Data Preparation and Cleaning

LIPA provided participation and measure data for all customers who participated in REAP from 2011-2012. LIPA also provided a billing history going back 30 months from January 2013 for 2011 and 2012 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 2011 participant cohort, but retained 2012 participants as a comparison group, and cleaned 2012 participant and billing records to the same specifications as 2011 participants.

Cleaning Participation Data

We used Initial Site Visit records as the basis for our analysis sample, because these records had the LIPA customer account number associated with each job identifier (enrollment ID if Honeywell was the project implementer, site ID if CMC was the project implementer). If participant records tracked in participation data did not have an account number associated with the enrollment ID or site ID, we excluded them from analysis. We drew our analysis sample from Initial Site Visit records available in early February 2013, which included complete 2011 and 2012 participant data.

We cleaned participant and measure data separately for both 2011 and 2012 Program Years. 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 addresses but different apartment numbers and resident names, could be linked to the same LIPA customer account number.

When cleaning 2011 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 null savings, or where installation dates were missing, we removed the entire household from further analysis. Additionally, we looked at outliers by measure quantities and savings, and removed households with unfeasibly high lighting measure quantities (40 and above) and households with refrigeration removal measures (where savings were deemed unreasonable). We aggregated the remaining records into the four end-use categories, which we then rolled up to a unique household level (defined as unique enrollment ID – site ID). We also removed sites with multiple account numbers.

Finally, we merged the measure data set for 2011 participants into the project-level data set. We also merged in measure data for the first six months of 2012 to capture households with initial site visits in late 2011 which may have had measures installed in early 2012. After July 1, 2011, the program implementer changed from Honeywell to CMC. For analysis purposes, and to eliminate possible duplication issues, projects initiated by Honeywell but completed by CMC were identified as hybrid Honeywell-CMC projects. We retained for further analysis only those participants whose clean measure data matched cleaned 2011 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 REAP. We used these expected savings for the analysis population as the basis for realization rates. Further, we dropped 2011 records for projects that were continuations of 2010 projects, as they were included in the 2012 analysis.

For 2012 participant data, we did not conduct any measure data cleaning, and retained all households regardless of improvements they made or savings associated with those improvements. We aggregated the data for 2012 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 2012 participant billing records, as this group serves as the comparison group for analysis.

Matching Participant Information with LIPA Account Information

REAP tracks LIPA 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 2011 and 2012 participants' 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 insufficient data for analysis. 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. For participants who participated in 2012 only, we dropped all billing periods occurring after their first installation date, as these 2012 participants were prepared to serve as the control group.

- Non-fulltime residents: We restricted our analysis to customers without long periods of very low or zero consumption, 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 0.5 kWh/day for four or more months per year, on average (across their billing history).

- Inadequate billing history before program participation: The primary savings measures in the REAP program (lights 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 240 billing days before the first day of program participation.

- Inadequate billing history after program participation: We also required 2011 participants to have a minimum number of billing days after program participation. We dropped 2011 participants who did not have, at a minimum, 240 days of billing data after each participant's last installation date.

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 two weather stations on Long Island: Brookhaven and Republic. For analysis purposes, we averaged together daily data from these two stations.

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 LIPA forecasting.[62] 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.

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 the constant term 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 dummy variables for each year-month period. This allows monthly changes in base usage that could be seen in all customers (participants and the control 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

[62] *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.

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 2012. This model allows us to compare the post-installation billing records of the first group to its own pre-participation records and to the first-year (i.e., 2011) billing records of the second group. Those two periods (pre-participation for participants and 2011 for later participants) 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.

Note that the billing analysis, using a good comparison group, incorporates the effects of both free ridership and spillover. For example, the energy use patterns of the comparison group during 2011-2012 (up to the point of their participation) reflects equipment installations and behavioral changes that treatment group participants (2011 participants) might have performed in the absence of the program. In addition, any additional measures evaluation-period participants installed 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 end-use. We fit a number of possible models, and selected the one with the most robust coefficients for the variables of interest. The following equation represents the final model:

$$y_{it}=a_i + c_t + B_1X_1 + B_2X_2 + B_3X_3 + B_4X_4 +B_5X_5 +B_6X_6 + \varepsilon_{it}$$

where:

y_{it}	=	Average energy consumption per day for home i during month t (ADC)
a_i	=	Constant term for home i
c_t	=	Constant term for month t
B_1	=	Coefficient for lighting installation
B_2	=	Coefficient for refrigerator installation
B_3	=	Coefficient for HVAC installation
B_4	=	Coefficient for domestic hot water (DHW) installation
B_5	=	Coefficient for cooling degree-days[63]
B_6	=	Coefficient for heating degree-days (base 65)
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

[63] 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)

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.

Electric Savings Results

Before doing any modeling, we determined the overall average baseline kWh consumption for the program and comparison groups, and the average daily kWh and CDDs and HDDs for pre- and post-participation time periods for the program group. These figures provide context for further analyses. Table 14-20 shows the comparison of the pre and post kWh and weather variables for the program group. It shows that consumption dropped significantly in the post-installation period compared to the pre-installation period. This drop could reflect program impacts, but may also be associated with weather. The post-participation period included a milder winter and a slightly 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 14-20. REAP Analysis – Average Values of Key Variables by Time Period for 2011 Participant Group

Variable	Statistic	Period		Significantly Different
		Pre	Post	
Daily kWh	Mean	21.68	19.63	Yes
	SD	17.45	15.65	
CDD	Mean	3.11	4.72	Yes
	SD	4.17	4.67	
HDD	Mean	15.77	9.34	Yes
	SD	13.21	9.87	

Also of interest is the difference between the program and the comparison group during the baseline period (i.e., the pre-installation period for participants and the same months of 2010 for non-participants, which is roughly the same period for the two groups). Table 14-21 reveals slightly lower baseline consumption for the comparison group versus the program group.

Table 14-21. REAP Analysis – Baseline kWh by Sample Group in Analysis

Variable	Statistic	Treatment	Comparison Group	Significantly Different
Baseline kWh	Mean	21.79	20.79	Yes (p-value of 0.081)
	SD	14.97	15.57	

Table 14-22 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 14-22, the program effects coefficients are all negative, making it likely that each of the 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. Further, HVAC savings are significant at the 0.10 alpha level. This indicates that there is a very high probability that these measures create measurable savings.

Table 14-22. REAP Billing Analysis – Final Model

Predictor	Coefficient	Robust Std. Err.	t	P>|t|	90% Confidence Interval	
					Lower Bound	Upper Bound
Lighting	-1.391	0.283	-4.91	<.001	-1.94	-0.83
Refrigerators	-1.025	0.386	-2.65	0.008	-1.78	-0.27
HVAC	-1.692	2.258	-0.75	0.454	-6.11	2.73
Domestic Hot Water	-2.081	1.236	-1.68	0.092	-4.50	0.34
CDD	0.996	0.067	14.86	<.001	0.86	1.13
HDD	0.308	0.024	13.08	<.001	0.26	0.35
Constant	17.530	1.125	15.59	<.001	15.32	19.74

Evaluating the model, we calculated estimated average daily electricity use and percent electricity savings. As shown in Table 14-23, the average daily electricity use across studied participating homes dropped approximately 1.8 kWh per day after measures were installed, representing a 7.3% decrease in electricity usage overall. There is a 90% probability, or confidence, that overall program savings are within plus or minus 21% of this estimate, meaning that they could range from 1.4 kWh per day to 2.2 kWh per day.

The table also shows the measure-level savings estimates for lighting and refrigeration, the major program measures. Lighting savings contributed 1.3 kWh of savings per day (weighted) to the overall drop of 1.8 kWh per day for the average household, with a relative precision level of 34%. Refrigerators contributed another 0.4 kWh per day to the overall savings of 1.8 kWh (weighted), with wider relative precision at 62%. Both of these precision numbers are estimated at the 90% confidence level. 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 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 29 HVAC participants and 35 DWH participants in the final analysis sample.

All of the estimates in Table 14-23 are shown for historical weather conditions, using a normal calculated from weather data for 2000-2009. This is appropriate for developing observed savings estimates that can be compared to the weather-normalized savings estimates used in program planning.

Table 14-23. REAP Analysis – Relative Precision of Observed Savings from Billing Analysis[64]

End Use	Weighted Average Household Daily Savings	90% Confidence Interval		% Savings	Relative Precision of Estimated Savings at 90% CI
		Lower Bound	Upper Bound		
Overall	1.84	1.45	2.23	7.3%	21%
Lighting	1.29	0.86	1.72	5.1%	34%
Refrigerators	0.43	0.16	0.70	1.7%	62%

Billing Analysis Compared to Expected Savings

Table 14-24 compares the observed savings from the billing analysis to the expected savings for these participants based on LIPA's program-planning estimates. The results of the comparisons are the associated realization rates. The overall realization rate for the program is 44%. The realization rate for lighting measures is equally high at 44%, while the realization rate for refrigeration is lower at 35%.

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 14-24. Savings from REAP Billing Analysis Compared to Savings Expected from Program-Planning Estimates

End Use	N (Participants in Billing Analysis)[65]	Observed Savings		Program-Planning Savings[66]		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	986	1.84	673	4.21	1,648	44%
Lighting	922	1.39	508	3.26	1,276	44%
Refrigerators	470	1.03	374	2.99	1,168	35%

64 These values exclude line losses.

65 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.

66 Excludes line losses.

14.2.6 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

LIPA provided participation and measure data for all customers who participated in the HPD and HPwES programs from 2011-2012. In addition, LIPA provided a billing history covering 30 months up to January 2013 for 2011 and 2012 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 2011 participants, but retained 2012 participants as a comparison group. We have cleaned 2012 participant and billing records to the same specifications as 2011 participants.

Cleaning Participation Data

We used Initial Site Visit records as the basis for our analysis sample, because these records had the LIPA 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 analysis sample from Initial Site Visit records available in early February 2013, which included complete 2011 and 2012 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. For any records associated with master-metered accounts (based on the presence of duplicate account numbers associated with more than one participant household), we combined all site data for each master-metered account. For example, two or more site identifiers, with similar street addresses but different apartment numbers and resident names, could be linked to the same LIPA customer account number.

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 2011 and 2012 participants into the project-level data set. We used the first installation date as the cut-off for retaining 2012 participant billing records, as this group serves as the comparison group for analysis.

Matching Participant Information with LIPA Account Information

HPD and HPwES track LIPA 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

We took a two-step approach to cleaning customer billing data. First, we removed individual billing periods—i.e., meter reads—that contained insufficient data for analysis. 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. For participants who participated in 2012 only, we dropped all billing periods occurring after their first installation date, as these 2012 participants were available to serve as the control group.
- **Non-fulltime residents:** We restricted our analysis to customers without long periods of very low or zero consumption, 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 0.5 kWh/day for four or more months per year, on average (across their billing history).
- **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.[67]
- **Inadequate billing history after program participation:** We also required 2011 participants to have a minimum number of billing days in heating and cooling months after program participation. We dropped 2011 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.

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

[67] 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.

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

In the previous analyses that were completed, daily weather data for the Long Island MacArthur (Islip) Airport in Suffolk County from the Northeast Regional Climate Center (NRCC) was used. We chose Islip Airport as the basis for weather analysis based on its central location in LIPA service territory. A complete set of weather data from this station was not available for 2011-2012, so weather data from the two nearest stations, Republic and Brookhaven, was averaged together and used.

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 LIPA forecasting.[68] 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 84,111 monthly and bimonthly billing records, reflecting electricity use for 4,009 participants, 1,710 of whom participated in the 2011 program year. About 90% of the 2011 participant population was available for analysis after data preparation and cleaning.

Statistical Method Used

We conducted a billing analysis to determine ex post gross program savings. We evaluated a number of possible models, including statistically adjusted engineering estimates (SAE model), but ended up using a conditional demand analysis (CDA) model (utilizing individual "dummy" variables to indicate the presence of any major measure installation). As we discuss in Section 7, changes in program targeting from 2011-2012—toward (more) homes with central air conditioning and away from electric space heat—present challenges for applying the results in this section for the 2012 program. Therefore the results of the billing analysis are provided to describe 2011, and are not incorporated into 2012 impacts—i.e., the realization rates below are not applied to 2012 ex ante program savings.

[68] *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.

We cleaned the data to address two potential issues. First, there was a change in data quality and availability beginning on October 29, 2012, which was landfall for Hurricane Sandy in the LIPA service territory. Consequently, all data from October 29, 2012, through the end of the year was removed from analysis. It was important that reduced electric usage from the storm not be considered a program effect. Second, there were significant differences in the baseline energy use patterns of the 2011 participants (the treatment group) and the 2012 participants (the potential comparison group).[69] 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. Program targeting changed from 2011-2012, which resulted in different types of homes and participants in 2011 vs. 2012, rendering the 2012 participants an inappropriate comparison for energy use of the 2011 participants.[70] Therefore this analysis does not employ a comparison group, and therefore realization rates reflect gross ex post savings.

The final billing analysis model was run for all 2011 Home Performance participants combined. The variables included in the model differentiate by whether or not the participant had electric space heat (ESH), since this factor has a significant impact on the level of savings expected from these customers (based on the measures that are typically installed in each type of home, and the relatively smaller size of some electric space heat participant homes). 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.[71] 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

[69] The 2011 participants showed much greater consumption during winter months (in the baseline period) than was seen for 2012 participants (the potential comparison group) in the same baseline months. This is likely related to higher penetration of electric space heat among 2011 participants.

[70] Targeting in 2012 focused more on central air conditioning than electric space heat homes.

[71] 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.

X_3 = Ave daily cooling degree-days (CDD)[72] for home *i* during month *t*

X_4 = Interaction of ESH dummy with X_3

X_5 = Participation variable** for home *i* during month *t*

X_6 = Interaction of ESH dummy with X_5

X_7 = Duct sealing installed dummy interacted with ESH and HDD

X_8 = Insulation installed dummy interacted with ESH and HDD

X_9 = Lighting installed dummy for home *i* during month *t*

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.

Electric Savings Results

Table 14-25 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 2011 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).

[72] 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)

Table 14-25. Home Performance Billing Analysis – Final Model

Predictor	Coefficient	Robust Std. Err.	t	P>|t|	90% Confidence Interval	
					Lower Bound	Upper Bound
CDD	2.75	0.08	34.47	0.00	2.59	2.91
ESH Cust x CDD	-0.43	0.10	-4.26	0.00	-0.63	-0.23
HDD	0.29	0.02	16.45	0.00	0.26	0.33
ESH Cust x HDD	2.01	0.05	40.83	0.00	1.91	2.11
Post Period	-0.40	0.50	-0.79	0.43	-1.38	0.59
ESH Cust x Post	1.88	0.45	4.14	0.00	0.99	2.77
DuctSeal x ESH x HDD	-0.20	0.04	-4.91	0.00	-0.28	-0.12
Insulation x ESH x HDD	-0.40	0.04	-10.25	0.00	-0.48	-0.32
Lighting	-1.67	0.61	-2.75	0.01	-2.87	-0.48
Constant	12.64	0.49	25.99	0.00	11.68	13.59

The model results can be used to estimate gross savings for several types of customers and measures, as shown in Table 14-26 below. As shown in Table 14-26, the average daily electricity use across studied participating homes dropped approximately 3.3 kWh per day after measures were installed, representing a 7.6% decrease in electricity usage overall. There is a 90% probability, or confidence, that overall program savings are within plus or minus 11% of this estimate, meaning that savings could range from 2.9 kWh per day to 3.3 kWh per day. Electric space heat customers who participated in the program saved 8.0%, while participants with other fuels saved an average of 5.8%.

The table also shows the measure-level annual savings estimates for lighting, and heating season savings estimates for duct sealing and insulation (in electric-heated homes only). Lighting savings contributed 1.2 kWh of savings per day to the overall drop of 3.3 kWh per day for the average household, with a relative precision level of 60% (at the 90% confidence level). Duct sealing and insulation savings contribute a sizable share of savings among electric space heat homes.[73]

All of the estimates in Table 14-26 are shown for historical weather conditions, using a normal calculated from weather data for 2000-2009. This is appropriate for developing observed savings estimates that can be compared to the weather-normalized savings estimates used in program planning.

[73] Observed overall savings for ESH customers are slightly less than the sum of savings estimates for the duct sealing and insulation measures. This happens because some increased use occurs in the post-period for all ESH customers. Without a comparison group, it is difficult to ascertain how much of the increased use is really a program effect. Given that uncertainty, the observed savings are reported without adjustment and the reader should keep in mind that there may be overall changes in use offsetting the reported measure savings.

Table 14-26. Home Performance Analysis – Relative Precision of Observed Savings from Billing Analysis[74]

Category	Weighted Average Household Daily Savings	90% Confidence Interval		% Savings	Relative Precision of Estimated Savings at 90% CI
		Lower Bound	Upper Bound		
All Program Participants	3.31	2.93	3.69	7.6%	11%
Lighting, All Part.	*1.17*	*0.47*	*1.87*		*60%*
Electric Space Heat Participants[73]	4.25	3.72	4.78	8.0%	12%
Duct Sealing	*1.36*	*0.90*	*1.82*		*34%*
Insulation	*3.16*	*2.65*	*3.67*		*16%*
Other Fuel Participants[75]	1.48	1.05	1.91	5.8%	29%

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 14-27 below shows that the 2011 Home Performance programs realized 62% of their expected gross savings. The realization rate is higher for electric space heat customers at 67%, and lower for other heat customers at 42%.

[74] These values exclude line losses.

[75] Defined as not having electric space heat.

Table 14-27. Savings from Home Performance Billing Analysis Compared to Savings Expected from Program-Planning Estimates

End Use	N (Participants in billing analysis)[76]	Observed Savings		Program Planning Savings[77]		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	
All Program Participants	1710	3.31	1,210	5.38	1,964	62%
Lighting, All Part.	1245	1.67	611	3.19	1,165	52%
Electric Space Heat Participants	855	4.25	1,552	6.35	2,318	67%
Duct Sealing	417	2.94	1,073	1.93	703	152%
Insulation	486	5.82	2,124	4.56	1,663	128%
Other Fuel Participants[78]	855	1.48	540	3.48	1,272	42%

A review of realization results for the individual measures provides some explanation of why the realization rate was higher for electric space heat customers compared to non-electric space heat. The primary source of savings for other fuel participants was lighting (Table 14-28), and lighting has a relatively lower realization rate of 52%. Insulation (for heating purposes) and duct sealing (for heating purposes) contribute a relatively larger share of savings for electric space heat customers, and these two heating-related measures realized savings greater than 100% of what was expected based on program-tracking data, meaning more energy was saved than had been expected.

[76] 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.

[77] Excludes line losses.

[78] Defined as not having electric space heat.

Table 14-28. Ex Ante Savings Distribution among Electric Space Heat and Other Fuel Space Heat Program Participants, 2011-2012

Measure Category	2011 Combined Programs			2012 Combined Programs		
	Electric Space Heat	Other Fuel Space Heat	% Ex Ante Savings	Electric Space Heat	Other Fuel Space Heat	% Ex Ante Savings
Lighting	30%	87%	49%	14%	80%	61%
Insulation	40%	3%	28%	48%	3%	16%
HVAC	15%	9%	13%	22%	1%	15%
Air Sealing	15%	1%	10%	22%	1%	7%
All Other[79]	1%	~0%	~0%	~0%	~0%	~0%
Total	100%	100%	100%	100%	100%	100%

14.2.7 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 LIPA's 2012 Year End Expenditure Report and the evaluation results. We used three metrics to assess the cost-effectiveness of LIPA's ELI and Renewable Energy programs: the Program Administrator (PA) test, the Total Resource Cost (TRC) test, and the levelized cost of capacity and energy. LIPA considers the ELI and Renewable Energy portfolios as alternative supply-side resources. To allow for direct comparison with LIPA'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 LIPA'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. The PA Cost Test excludes any net costs incurred by the participant, such as the actual measure cost, and reviews 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%.[80]

$$PA\ Cost = \frac{NPV\ of\ Benefits\ [\ MCE*NRG*EUL+mAD*DR]}{2012\ Costs\ [PA]} \quad \text{(Eq. 1)}$$

[79] Window/Door, Domestic Hot Water, Refrigerator.

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

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

Table 14-29 presents the sources for inputs used to calculate cost-effectiveness using the PA Cost Test.

Table 14-29. 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	LIPA	Benefit	
NRG	Energy Reductions by Measure	kWh	Net Ex Post kWh, includes transmission losses	Benefit	First year annual value[81]
EUL	Effective Useful Life by Measure	Years	LIPA (From AEG) Averaged by end use	Benefit	
mAD	Marginal Utility Avoided Cost of Demand	$/kW	LIPA	Benefit	
DR	Demand Reductions by Measure	kW	Net Evaluated kW, includes transmission losses	Benefit	First year value – coincident peak estimate
PA	Program Administrator Cost	$ or % of incentives	LIPA (December 2012 Expenditure Report)	Cost	
DR	Discount Rate	%	LIPA (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

[81] 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 82.31% of first year annual value for CFLs installed in 2012.

transfers at the societal level. A Benefit/Cost ratio greater than 1 indicates a cost-effective investment of funds from the perspective of the utility and its ratepayers.

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. LIPA'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 14-29.

$$Levelized\ Costs\ = \frac{2012\ Total\ Utility\ Expenditures}{NPV\ (Lifecycle\ kW\ or\ kWh\ Savings\ from\ 2012\ Installs)} \qquad \text{(Eq. 2)}$$

14.2.8 Economic Impact Method

As part of the 2012 ELI & Renewable Energy Portfolio Evaluation, the Evaluation Team conducted an economic impact analysis to quantify the benefits of LIPA's 2012 program spending on economic output and employment on Long Island. The economic impact analysis quantifies the 10-year impact of LIPA's 2012 ELI portfolio and 2012 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 LIPA 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 LIPA'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 LIPA'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 LIPA 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 LIPA, we identified two main program effects (and associated costs) to quantify in the 2012 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 14-30. 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 14-30.

Table 14-30. 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[82]** Participant co-payments that are incrementally higher than what they may have been in the absence of LIPA programs, due to purchase of higher-efficiency equipment
Program & Measure Spending	**Program Spending** Increased sales of goods & services and increased employment, due to LIPA'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 2012 due to small efficiency and renewables charge(s) and riders leveraged to fund LIPA 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 2012. 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 LIPA'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), containing information on how spending is

[82] 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.

"multiplied" to multiple local sectors, as well as what portion of spending may extend beyond the local economy.[83]

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 14-30.

We performed all steps for the ELI 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 2012, 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 LIPA'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.

[83] 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 LIPA 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.[84] 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—LIPA provided program-level actual 2012 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 2012 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 2012 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—LIPA provided actual expenditures on program delivery and administration spending, broken out by the following categories:

- **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

[84] 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.

each program-level spending category. For a few expenditures, we developed sector assumptions (both sector assignment and proportion) based on discussions with LIPA 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 LIPA, 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.[85]

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 2012 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 2012 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 LIPA'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.[86] 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 proportional to available rebates). Program-induced non-sale-related cash flows—specifically rebates, savings, incremental cost, and ELI charge—were modeled as change in proprietor income.

Efficiency and Renewables Charges

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[85] Sum of rebates, incentives, customer services, contractors, marketing, advertising, and evaluation.

[86] Source: U.S. Census Bureau's American Community Survey (2011).

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 2012 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, LIPA provided a breakdown of 2012 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 2012 CAS data.

A. SURVEY FREQUENCIES

2012 Program
Guidance Document -

B. Measurement and Verification Results

This appendix is included as separate PDF file due to size.

C. 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%	
Cool Homes	Central AC (kWh)	-29.00%	See Report, table 4-3 for data		61%	2%	0%	90.00%	
Cool Homes	Furnace Fan (kW)	6.00%	10%	0%	90%	16%	0%	84.00%	
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%	
Cool Homes	Geothermal Heat Pump (kWh)	0.00%	2%	0%	98%	2%	0%	98.00%	
Cool Homes	Unitary Heat Pump (kW)	12.00%	2%	0%	98%	14%	0%	86.00%	
Cool Homes	Unitary Heat Pump (kWh)	12.00%	2%	0%	98%	14%	0%	86.00%	

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%	
Cool Homes	Ductless Mini Split AC (kWh)	11.00%	2%	0%	98%	13%	0%	87.00%	
HPD	All Measures Except Lighting (kW)	2.60%	0%	2.60%	102.60%	0%	0%	100.00%	No evidence of NTGR applied in data received by Evaluation Team.
HPD	All Measures Except Lighting (kWh)	6.62%	0%	6.62%	106.62%	0%	0%	100.00%	No evidence of NTGR applied in data received by Evaluation Team.
HPD	Lighting (kW)	-48.40%	51%	1.60%	51.60%	0%	0%	100.00%	No evidence of NTGR applied in data received by Evaluation Team.
HPD	Lighting (kWh)	-44.38%	49%	6.62%	55.62%	0%	0%	100.00%	No evidence of NTGR applied in data received by Evaluation Team.
HPwES	All measures (kW)	1.91%	28%	1.91%	73.91%	28%	0%	72.00%	
HPwES	All measures (kWh)	2.80%	28%	2.80%	74.80%	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
EEP	ENERGY STAR Refrigerator	0.00%	20%	10%	90%	20%	10%	90.00%	NTGR values not sourced.
EEP	ENERGY STAR Dehumidifier	-52.00%	67%	0%	33%	30%	15%	85.00%	NTGR values not sourced.
EEP	Room A/C <=6kBtuh	0.00%	30%	25%	95%	30%	25%	95.00%	NTGR values not sourced.
EEP	Room A/C >6kBtuh <8kBtuh	0.00%	30%	25%	95%	30%	25%	95.00%	NTGR values not sourced.
EEP	Room A/C >=8kBtuh	0.00%	30%	25%	95%	30%	25%	95.00%	NTGR values not sourced.
EEP	ENERGY STAR Common CFLs	0.00%	30%	4%	74%	30%	4%	74.00%	NTGR values not sourced.
EEP	ENERGY STAR Specialty CFLs	0.00%	25%	20%	95%	25%	20%	95.00%	NTGR values not sourced.
EEP	SSL	0.00%	5%	25%	120%	5%	25%	120.00%	NTGR values not sourced.
EEP	ENERGY STAR Fixtures	0.00%	1.7%	3.2%	101.5%	1.7%	3.2%	101.50%	NTGR values not sourced.
EEP	Refrigerator recycle	-9.00%	52%	0%	48%	43%	0%	57.00%	NTGR values not sourced.

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	Pool pumps-two spd	0.00%	20%	10%	90%	20%	10%	90.00%	NTGR values not sourced.
EEP	Pool pumps-var spd	0.00%	20%	10%	90%	20%	10%	90.00%	NTGR values not sourced.
EEP	TVs - 30% above ES	0.00%	20%	10%	90%	20%	10%	90.00%	NTGR values not sourced.
EEP	Smart power strips	0.00%	0%	0%	100%	0%	0%	100.00%	NTGR values not sourced.
EEP	Room A/C recycle	-9.00%	52%	0%	48%	43%	0%	57.00%	NTGR values not sourced.
EEP	Dehumidifier recycle	-9.00%	52%	0%	48%	43%	0%	57.00%	NTGR values not sourced.
EEP	Ceiling fans	0.00%	30%	0%	70%	30%	0%	70.00%	NTGR values not sourced.
CEP Mid Market	All measures (kW)	-18.13%	30%	1.87%	71.87%	10%	0%	90.00%	
CEP Mid Market	All measures (kWh)	-18.45%	30%	1.55%	71.55%	10%	0%	90.00%	
CEP Solution Provider	All measures	-18.13%	30%	1.87%	71.87%	10%	0%	90.00%	
CEP Solution Provider	All measures	-18.45%	30%	1.55%	71.55%	10%	0%	90.00%	
SBDI	All measures (kW)	-12.99%	13%	0.01%	87.01%	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
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%	No evidence of NTGR applied in data received by Evaluation Team.
Solar Pioneer	All	0.00%	0%	0%	100%	0%	0%	100.00%	No evidence of NTGR applied in data received by Evaluation Team.
Solar Entrepreneur	All	0.00%	0%	0%	100%	0%	0%	100.00%	No evidence of NTGR applied in data received by Evaluation Team.
Backyard Wind	All	0.00%	0%	0%	100%	0%	0%	100.00%	No evidence of NTGR applied in data received by Evaluation Team.
Solar Hot Water	All	0.00%	0%	0%	100%	0%	0%	100.00%	No evidence of NTGR applied in data received by Evaluation Team.