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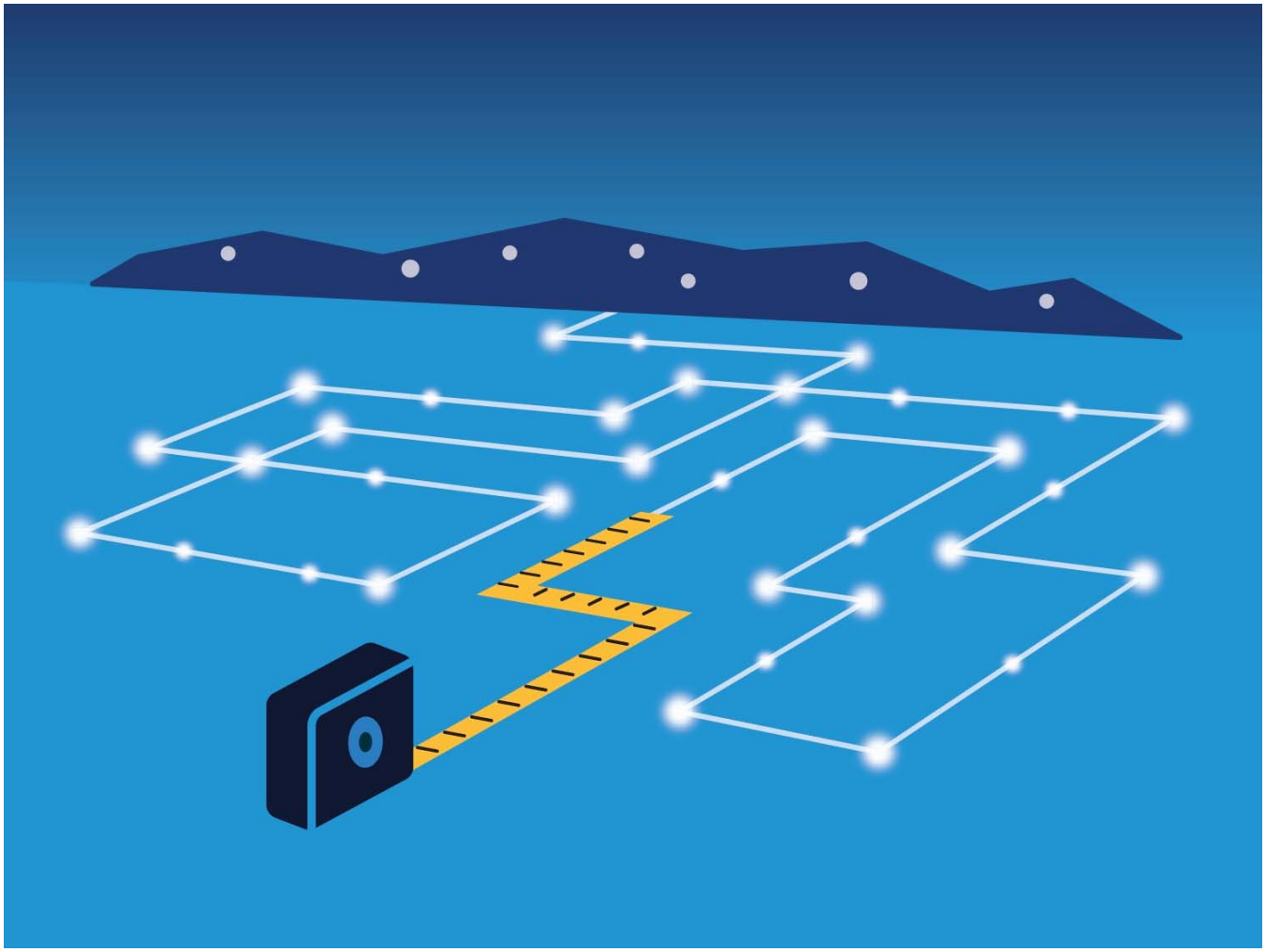

# Energy Efficiency and Renewable Energy Portfolios

## 2017 Annual Evaluation Report (Volume I – Executive Summary)

**June 25, 2018**

Prepared for:

PSEG LONG ISLAND
We make things work for you.

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# Table of Contents

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# Table of Tables

# Table of Figures

# 1. Introduction to the Annual Evaluation Report

This report presents the program evaluation results of PSEG Long Island's 2017 Energy Efficiency Portfolio and Renewable Energy Portfolio conducted by the Opinion Dynamics evaluation team. The Energy Efficiency and Renewable Energy portfolios were administered by the Long Island Power Authority (LIPA) from inception through 2013. Effective January 1, 2014, PSEG Long Island began a 12-year contract assuming all day-to-day management and operations of the electric system, including planning, administration, design, and implementation of the Energy Efficiency Portfolio and the Renewable Energy Portfolio. In March 2015, PSEG Long Island transitioned the implementation of the Energy Efficiency Portfolio to its subcontractor, Lockheed Martin. PSEG Long Island continues to implement the Renewable Energy Portfolio. In 2017, PSEG Long Island added the Home Energy Management program to the Energy Efficiency Portfolio, implemented by its subcontractor Tendril. This assessment covers the period from January 1, 2017 to December 31, 2017.

The Opinion Dynamics evaluation team produced two volumes that together comprise the entire Annual Evaluation Report. This document, the *2017 Annual Evaluation Report (Volume I)*, provides an overview of evaluation findings, including impact and process results for 2017. The *2017 Program Guidance Document (Volume II)* provides detailed program-by-program impact analysis results, process evaluation findings, and a discussion of data collection and analytic methods. The evaluation team developed the *Program Guidance Document* with the needs of PSEG Long Island's and Lockheed Martin's program planners and managers in mind, as the programs in the Energy Efficiency Portfolio and the Renewable Energy Portfolio continue to be important and cost-effective resources. In addition to the Annual Evaluation Report, each year in late January, the evaluation team provides Verified Ex Ante savings for the Energy Efficiency and Renewable Energy Portfolios, which PSEG Long Island and LIPA use to assess the performance of the programs in relation to the annual savings goals. The memorandum reporting the 2017 Verified Ex Ante savings is provided as an appendix to Volume II of the report.

## Key Definitions

Below we provide definitions for key terms used throughout the report.

- **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, coincidence factors (CFs) for demand, and waste-heat factors and installation rates for lighting. Gross impacts are the demand and energy that power plants do not generate due to program-related actions taken by participants.[1]
- **Net Impacts:** The change in energy consumption and/or demand at the generator that results directly from program-related actions taken by customers that 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 (Free-Ridership and Spillover):** The factor that, when multiplied by the gross impact, provides the net impacts for a program. The NTGR is defined as the savings that can be attributed to programmatic activity and is composed of free-ridership (FR) and spillover (SO). FR reduces the ratio to account for those customers who would have installed an energy-efficient measure without a program. The FR component of the NTGR can be viewed as a measure of naturally occurring energy

[1] While this evaluation includes line losses, coincidence factors, and installation rates when estimating gross impacts, PSEG Long Island does not include these factors in its gross impact estimates. Additionally, in some cases, such as Thermal Energy Storage projects, program-related activity may result in a decrease in demand while increasing energy generation.

efficiency, which may include efficiency gains associated with market transformation resulting from ongoing program efforts. SO increases the NTGR 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. The NTGR is generally expressed as a decimal and quantified through the following equation:

$$NTGR = 1 - FR + SO$$

- **Verified Ex Ante Savings:** The energy and demand savings calculated by the evaluation team using methods and assumptions consistent with those used by PSEG Long Island to develop annual savings goals. These savings estimates are used to determine if PSEG Long Island achieves its annual scorecard goals.
- **Evaluated Net Savings:** The net savings attributed to the program for purposes of tracking towards the original ELI goal of 520 MW by 2018. Evaluated net savings are determined by applying program planning assumptions for NTGR to the evaluated gross impact estimates determined by the evaluation team.
- **kW (Demand or Capacity):** The average level of power used over the course of an hour. Peak demand is the average power used across a 4-hour period when there is high use. For Long Island, peak demand may take place anytime from 2pm to 6pm, Monday through Friday (non-holiday), from June to August. System coincident demand is the level of demand at the hour of the day when there is the maximum demand on the system grid. Demand savings values in this report are system coincident demand impacts between 4pm and 5pm on non-holiday weekdays from June to August.
- **kWh (Energy Consumption):** The total power consumed over the course of an hour. Energy impacts are based on annual consumption.
- **Societal Cost Test (SCT):** A test that measures the net costs of an energy efficiency program as a resource option based on the total costs of the program, including both the participants' and the Program Administrator's costs. Rebate costs are not included in this test as they are assumed to be a societal transfer. To maintain consistency with the most current version of the New York Benefit-Cost Analysis (BCA) Handbook, we applied the SCT as a primary method of determining cost-effectiveness using the same assumptions as those used by PSEG Long Island's resource planning team.
- **Utility Cost Test (UCT):** A test that measures the net costs of an energy efficiency program as a resource option based on the costs incurred by the Program Administrator (including incentive costs) and excluding any net costs incurred by the participant. To allow for direct comparison with PSEG Long Island's assessment of all supply-side options, and consistent with previous evaluation reports, we continue to show the UCT as a secondary method of determining cost-effectiveness.
- **Discount Rate:** The interest rate used to calculate the present value of future payments (i.e., the avoided costs from energy and demand savings). PSEG Long Island uses a weighted average cost of capital (WACC) supplied by LIPA that represents the cost of borrowing to build additional capacity to meet the future supply needs of the service territory. Based on these factors, we used a nominal discount rate of 5.5% in the 2017 evaluation.
- **Levelized Cost of Capacity:** The equivalent cost of capacity (kW) to be incurred each year over the life of the equipment that would yield the same present value of total costs, using a nominal discount rate of 5.5% to be consistent with base load generation supply-side resources in the Long Island service territory. The levelized cost of capacity is a measure of the costs of the program to the Program Administrator in a form that can be compared to the cost of supply additions.
- **Levelized Cost of Energy:** The equivalent cost of energy (kWh) over the life of the equipment that would yield the same present value of costs, using a nominal discount rate of 5.5%. The levelized cost of

energy is a measure of the costs of the program to the Program Administrator in a form that can be compared to the cost of supply additions.

# 2. Executive Summary

In 2017, PSEG Long Island spent approximately $83.2 million implementing the Energy Efficiency and Renewable Energy portfolios, which was slightly less than was spent in 2016. While the 2017 evaluated energy savings from these portfolios exceeded established energy and demand savings goals by 2% and 44%, respectively, energy and demand savings for the portfolio were both significantly lower than in 2016. The evaluated energy savings decreased, from 375,485 MWh in 2016 to 262,427 MWh in 2017. Evaluated demand savings decreased from 84.3 MW in 2016 to 67.6 MW in 2017. Three key factors drove 2017 program performance in terms of overall savings and comparisons to goals, as described below.

**Lower Residential Solar Installations.** While the Renewable Energy Portfolio greatly exceeded its goals in 2017, it experienced a steep decline in new projects and generation capacity from the previous year. The decrease was due to the ending of New York State Energy Research and Development Authority's (NYSERDA) NY-Sun initiative rebates for residential solar systems on Long Island. Commercial PV installations remained relatively consistent from 2016 to 2017, from 95 to 103, respectively. However, PSEG Long Island provided rebates or financing for 1,417 residential solar PV systems in 2017, amounting to just 22% of the number of projects completed in 2016. PSEG Long Island's legacy programs (Solar Pioneer and Solar Entrepreneur), combined with rapidly falling costs of solar PV, were integral in building the robust solar photovoltaic (PV) market on Long Island by increasing consumer awareness and demand for solar energy while also fostering a knowledgeable trade ally base. As a result, despite the reductions in PSEG Long Island rebated projects in 2017, the solar PV market on Long Island remains strong with about three quarters of systems installed in 2017 receiving no program funding or financing. The continued rapid pace of solar PV installations without PSEG Long Island or NYSERDA rebates are a strong indication of the success of these programs in helping to transform the solar PV market on Long Island.

**Decrease in Energy Savings from Energy-Efficient Lighting Products:** In 2017, the Energy Efficient Products (EEP) program exceeded its savings goals, which it has done for each of the last 5 years. The program exceeded its energy and demand goals by 8% and 75%, respectively; however, program ex ante and evaluated savings decreased when compared to 2016. The lower savings compared to 2016 were largely due to updates in both program planning and evaluation assumptions with respect to savings from LEDs. Energy savings from LEDs have increased dramatically in recent years, growing from less than 1% of overall EEP savings in 2013 to 87% in 2017, as these products have gained widespread acceptance in the lighting market. Recognizing these market trends, PSEG Long Island worked with the evaluation team in 2016 to update the NTGR to a value that better reflects current market conditions. As such, the NTGR for LEDs was reduced from 1.2 to 0.55. The revised value is based on recent and relevant research conducted in other comparable jurisdictions. Savings from residential lighting is expected to continue to decline rapidly over the next several years as the market transforms to LEDs as the primary lighting choice for most applications, and as a result of new federal lighting efficiency standards (EISA 2020), which will go into effect in 2020.

**Home Energy Management Program:** In 2017, PSEG Long Island introduced the Home Energy Management (HEM) program. The program aims to motivate a targeted portion of PSEG Long Island residential customers to reduce their energy consumption, primarily by sending Home Energy Reports (HERs) that raise awareness and influence customers' energy use behaviors. The introduction of this program marks a positive step for PSEG Long Island's efforts to diversify its energy efficiency portfolio and its move toward maximizing energy savings. Due to administrative challenges in launching the program, the evaluation determined that the 2017 HEM program realized approximately 25% of its established energy savings goals. Two key factors drove these

results: (1) lower-than-expected numbers of participants and (2) shortened treatment windows—i.e., participants received reports later in the calendar year than planned, resulting in fewer months to make energy-saving changes to their behavior.

## 2.1 Summary of Portfolio Performance

The 2017 annual demand and energy savings goals were 46.8 MW and 258,285 MWh for the combined Energy Efficiency and Renewable Energy portfolios, as shown in Table 2-1. The verified ex ante savings, which are used for comparing to the annual scorecard goals, are 111% of the goal for energy and 131% of the goal for demand. Evaluated energy and demand savings are 102% and 144% of the goals, respectively. PSEG Long Island achieved these savings at a total cost of approximately $83.2 million, 1% below budget.

Table 2-1. Net Impacts: Energy Efficiency and Renewable Energy Portfolios Evaluated Impacts versus Goals

| Program | PSEG Long Island Annual Energy Efficiency and Renewable Energy Budget | Energy Efficiency and Renewable Energy Actual Cost | Coincident Demand Savings (MW) | | | Energy Savings (MWh) | | |
|---|---|---|---|---|---|---|---|---|
| | | | Goal | Verified Ex Ante | Evaluated | Goal | Verified Ex Ante | Evaluated |
| **Energy Efficiency Portfolio** | | | | | | | | |
| **Commercial Efficiency Program** | **$40,152,724** | **$37,298,732** | **23.0** | **25.6** | **25.5** | **95,005** | **101,985** | **100,011** |
| **Residential Programs** | | | | | | | | |
| EEP | $16,827,594 | $15,401,305 | 15.3 | 18.6 | 26.7 | 112,884 | 138,917 | 121,572 |
| Cool Homes | $5,965,372 | $7,005,211 | 1.65 | 2.81 | 2.81 | 2,693 | 2,705 | 2,728 |
| Residential Energy Affordability Partnership (REAP) | $2,850,913 | $3,054,333 | 0.337 | 0.276 | 0.380 | 905 | 645 | 1,380 |
| Home Performance Programs | $12,972,806 | $13,336,156 | 0.540 | 2.59 | 0.995 | 1,619 | 3,054 | 2,872 |
| Home Energy Management | $2,665,756 | $1,119,578 | N/A | N/A | N/A | 30,179 | 11,104 | 7,627 |
| **Subtotal Residential Programs** | **$41,282,441** | **$39,916,584** | **17.8** | **24.3** | **30.9** | **148,280** | **156,425** | **136,180** |
| **Total Energy Efficiency Portfolio (Commercial and Residential)** | **$81,435,165** | **$77,215,316** | **40.8** | **49.8** | **56.4** | **243,285** | **258,410** | **236,191** |
| **Renewable Energy Portfolio (including NYSERDA funds in Actual Cost)** | **$2,480,913** | **$5,941,037** | **5.98** | **11.4** | **11.2** | **15,000** | **27,995** | **26,236** |
| **Total Energy Efficiency and Renewable Energy Portfolios** | **$83,916,078** | **$83,156,354** | **46.8** | **61.3** | **67.6** | **258,285** | **286,405** | **262,427** |

**Notes:**
1. Costs and budget figures do not include line items not associated directly with the ELI or Renewables portfolio, including LIPAEdge REV, or Utility 2.0.
2. Actual costs are the expenditures necessary to obtain the energy and demand savings as reported in the Lockheed Martin LM Captures systems, and do not reflect PSEG Long Island accrual accounting.
3. Renewable Energy Portfolio impacts are expressed in terms of generation.
4. Solar PV benefits and costs (which are included in the Renewable Energy Portfolio) include $4.1 million in rebates from NYSERDA's NY-Sun Initiative.

PSEG Long Island tracks its performance against annual energy savings goals, which it derives 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 "verified ex ante net savings" estimates for each Energy Efficiency and Renewable Energy program. This comparison verifies that the methods and assumptions used by PSEG Long Island to develop their annual plan for program savings, were applied consistently throughout the year in developing the ex ante savings. The verified ex ante savings are used as a comparison to the established annual savings goals.

An important catalyst in LIPA's initial decision to invest in the Energy Efficiency and Renewable Energy portfolios was the need to offset approximately 520 MW of generating capacity on Long Island required to satisfy energy demand forecasted at that time. As such, performance relative to the annual capacity savings goals had been the primary performance metric for these programs since 2009. However, with the launch of New York's Reforming the Energy Vision (REV), the role of energy efficiency and renewable energy within New York's comprehensive energy strategy has changed. PSEG Long Island's strategies and goals for energy efficiency are now more closely aligned with REV principles. Beginning in 2017, the primary goal focused on electric energy savings, with demand savings and greenhouse gas reductions also measured. Over the past year, the evaluation team has worked with PSEG Long Island to conduct research on the future energy-saving opportunities to inform the development of revised savings goals.

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 program within the Energy Efficiency Portfolio and the Renewable Energy Portfolio, as shown in Table 2-1 and presented throughout this report, for purposes of tracking progress towards the original ELI goal of 520 MW by 2018.. We calculated evaluated net savings by applying PSEG Long Island's planning assumptions for the net-to-gross factor to the gross demand and energy savings estimates determined through our evaluation.

Among other inputs, the benefit/cost assessment requires an estimate of ex post net program savings. The best-practice approach to this assessment dictates that the net savings used to develop the benefit/cost ratio reflect current levels of naturally occurring energy efficiency, FR, and SO to provide an estimate of the benefits associated with the current year's investment in the programs. As such, the evaluation team used net-to-gross factors derived from primary data collection with customers to develop the net energy savings estimates included in the benefit/cost ratio calculation and for lifetime levelized costs.

## Cost Effectiveness Results

Based on our analysis of portfolio impacts and costs, the savings generated by the Energy Efficiency and Renewables portfolios are cost-effective. As shown in Table 2-2:

- Based on the UCT, the overall benefit/cost ratio is 2.3 for the combined portfolio savings (a UCT value greater than 1 indicates that portfolio benefits outweigh costs), and the levelized costs of the combined portfolio savings are $139.80/kW-yr or $0.038/kWh.[2]
- Based on the SCT, the overall benefit/cost ratio is 1.3 for the combined portfolio savings and the levelized costs are $330.45/kW-yr or $0.090/kWh.

[2] A levelized cost analysis is a way to quickly compare the cost of energy efficiency programs with energy or demand savings from other sources. Because levelized costs are expressed as $/kW-yr and/or $/kWh, they can be readily compared to the cost of alternative supply additions or the cost of generating electricity.

Table 2-2. Energy Efficiency and Renewable Energy Portfolios Benefit/Cost Ratio and Levelized Costs

| Program | Benefit/Cost Ratio | | UCT Levelized Costs | | SCT Levelized Costs | |
|---|---|---|---|---|---|---|
| | UCT | SCT | $/kW-yr | $/kWh | $/kW-yr | $/kWh |
| **Energy Efficiency Portfolio** | | | | | | |
| **Commercial Efficiency Programs** | **1.1** | **1.1** | **$255.22** | **$0.065** | **$342.88** | **$0.088** |
| **Residential Programs** | | | | | | |
| EEP | 6.1 | 3.2 | $62.05 | $0.013 | $152.06 | $0.033 |
| Cool Homes | 0.97 | 0.68 | $209.92 | $0.241 | $341.88 | $0.392 |
| REAP | 0.26 | 0.35 | $1,030.84 | $0.284 | $1,030.84 | $0.284 |
| HEM | 0.25 | 0.38 | N/A | $0.147 | N/A | $0.147 |
| HP | 0.18 | 0.46 | $1,586.90 | $0.529 | $1,520.28 | $0.507 |
| **Subtotal Residential Programs** | **2.6** | **2.1** | **$136.26** | **$0.032** | **$225.64** | **$0.054** |
| **Total Energy Efficiency Portfolio (Commercial and Residential Programs)** | **1.9** | **1.6** | **$175.86** | **$0.043** | **$264.67** | **$0.065** |
| **Renewable Energy Portfolio** | **8.7** | **0.79** | **$38.14** | **$0.016** | **$515.89** | **$0.216** |
| **Total Energy Efficiency and Renewable Energy Portfolios** | **2.3** | **1.3** | **$139.80** | **$0.038** | **$330.45** | **$0.090** |

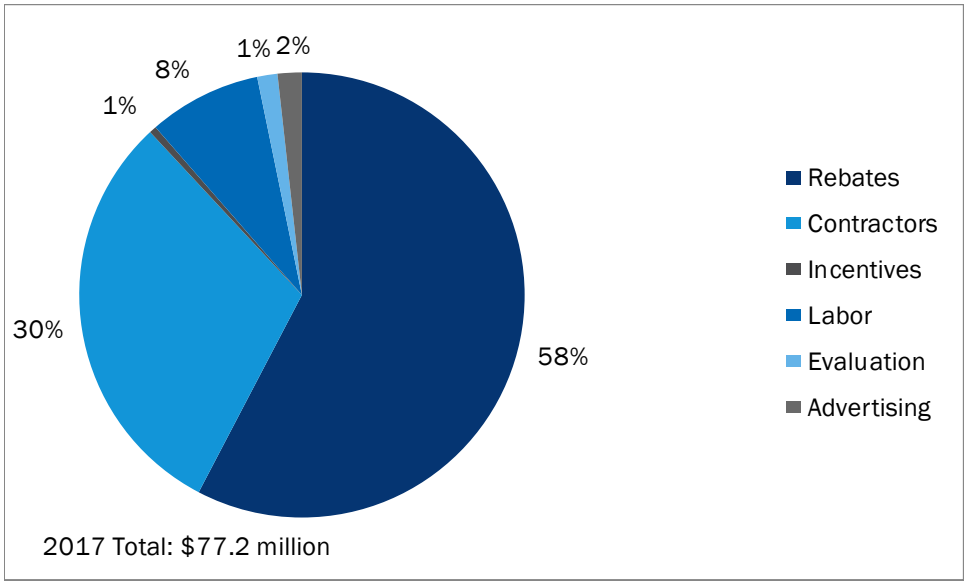
Notes:

1. Benefit/cost ratio from Utility Cost perspective using comparison to base load marginal supply costs. If ratio is greater than 1.0, program is cost-effective.
2. UCT does not consider lost revenues or net metering subsidies.
3. All levelized cost calculations use a discount rate of 5.5% to be consistent with supply-side alternatives.
4. Solar PV benefits and costs (which are included in the Renewable Energy Portfolio) include $4.1 million in rebates from NYSERDA's NY-Sun Initiative.

## 2017 Expenditure Summary

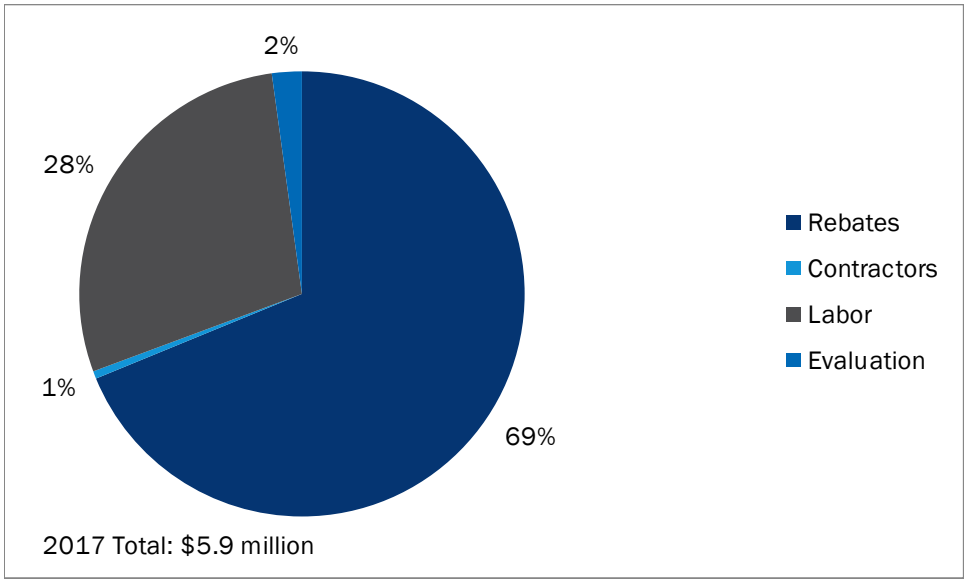
PSEG Long Island spent just under $83.2 million on the Energy Efficiency and Renewable Energy portfolios in 2017, slightly less than in 2016. This expenditure figure is inclusive of $4.1 million in solar PV rebates from NYSERDA that were passed through to customers. Overall, PSEG Long Island realized a 29% decrease in evaluated energy savings and a 20% decrease in evaluated demand savings compared to 2016. Most of these savings reductions were from lighting measures and solar PV, as described above. However, these reductions were anticipated and, given appropriate planning by PSEG Long Island, the Energy Efficiency and Renewable Energy portfolios together exceeded the established net energy savings goals by 2% and net demand savings goals by 44%. Figure 2-1 presents a summary of the $77.2 million spending related to implementation, management, and evaluation of energy efficiency programs in the Energy Efficiency Portfolio by type of expenditure. Figure 2-2 provides the detail for the $5.9 million investment of PSEG Long Island, which includes $4.1 million in rebate funding from NYSERDA, in the 2017 Renewable Energy Portfolio.

Figure 2-1. 2017 PSEG Long Island Expenditures for the Energy Efficiency Portfolio




"Rebates" consists of payments made to participating customers. "Incentives" consists of payments made to participating contractors (e.g., HVAC installers).

Figure 2-2. 2017 PSEG Long Island Expenditures for the Renewable Energy Portfolio

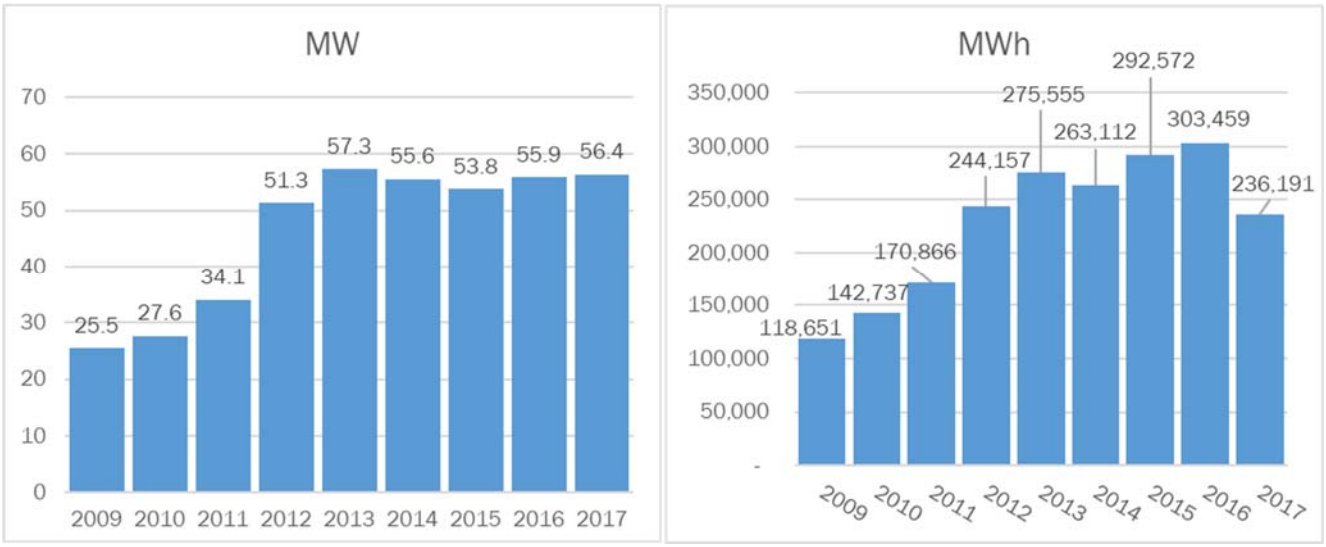



Solar expenditures shown in this figure include $4.1M of Solar PV rebates from NYSERDA funding that were passed through to PSEG Long Island customers.

## 2.2 Energy Efficiency Portfolio Evaluated Impacts

Overall, evaluated net savings from the Energy Efficiency Portfolio included 236,191 MWh of energy savings and 56.4 MW of demand savings. These energy savings resulted in the annual displacement of more than 142,225 tons of $CO_2$ equivalents,[3] 53 tons of $SO_2$, and 105 tons of NOx. The greenhouse gas reductions are equivalent to removing more than 27,600 cars from the road and a fuel savings of more than 298,700 barrels of oil.[4] Figure 2-3 presents the evaluated savings from the energy efficiency programs spanning the 9 years since the Energy Efficiency Portfolio's inception.

Figure 2-3. 2017 Energy Efficiency Portfolio Evaluated Net MW and MWh Savings




As noted previously, PSEG Long Island uses verified ex ante net savings estimates as one metric to track program performance against annual goals. According to this metric, in 2017 the Energy Efficiency Portfolio surpassed its energy savings goal by 6% and demand savings goal by 22%. Evaluated results for the Energy Efficiency Portfolio fell below energy savings goals by 3% and exceeded demand savings goals by 38%. The primary reason for the reduction in evaluated energy savings was due to 2017 research that showed about 12% of all residential LED lamps purchased through the program are placed in storage for later use. This research was not yet available when the 2017 savings goals were established. Similar to previous years, there were variances between evaluated results and the established savings goals across programs. While the Commercial Efficiency Program (CEP) exceeded its energy savings goal by 7%, the residential programs fell short, largely driven by the HEM program, which realized 25% of its energy savings goals (see Section 2.6 for additional detail). The residential and commercial programs exceeded their demand savings goals by 6.5 MW (37%) and 2.6 MW (11%) respectively.

The EEP program accounts for the largest share of demand and energy savings in the Energy Efficiency Portfolio. In 2017, the EEP program surpassed its annual savings goals, with evaluated net energy and demand savings equal to 108% and 175% of its goals, respectively. The CEP, the next largest program in the

[3] $CO_2$ equivalents includes carbon dioxide, methane, and nitrous oxide.

[4] Displacement savings values calculated using 2014 Long Island sub-regional emissions rates of the U.S. Environmental Protection Agency's (EPA) Emissions & Generation Resource Integrated Database (eGRID 2014 v2), released February 27, 2017. Equivalent savings values are based on the U.S. EPA's Greenhouse Gas Equivalencies Calculator (updated May 2017).

portfolio in terms of savings, realized 105% of the program's established energy savings goals and 111% of its demand goals.

## 2.3 Energy Efficiency Portfolio Economic Impacts

As part of the annual evaluation, the evaluation team assessed the economic impacts of the Energy Efficiency Portfolio investments on the economy of Long Island. Beginning in 2011, we developed an input-output (I-O) model of the Long Island regional economy using IMPLAN modeling software to estimate these impacts. Central to the I-O model approach is the development of a static model for the effects of program spending based on a matrix of relationships among economic sectors, including industries, households, government, and foreign trade. The model requires inputs on spending, avoided costs, electric rates, and other parameters from PSEG Long Island, and draws on the net savings information included in the benefit/cost assessment. The evaluation team updated this model and its inputs for this 2017 evaluation.

As in previous years, we estimated 1-year and 10-year economic impacts associated with the 2017 Energy Efficiency Portfolio investment, where the 10-year economic impacts accrue from measures installed in 2017 over their effective useful life. We then add these 1-year and 10-year economic impacts to the 2009–2016 estimates to develop a portfolio-to-date estimate (adjusted to 2017 dollars).[5]

As shown in Table 2-3, our analysis of economic benefits found that PSEG Long Island's $77.2 million investment in the Energy Efficiency Portfolio in 2017 returned $73.5 million in total economic benefits to the Long Island regional economy in 2017, including an additional 557 full-time equivalent (FTE) employees.[6] Over 10 years, these 2017 investments are expected to return $154.2 million in total economic benefits to the regional economy (in 2017 dollars[7]), with an employment benefit of 1,211 new FTEs over the time period.

Extrapolating these results over the 9-year life of the portfolio, the $550.3 million invested to date in Energy Efficiency ($663.2 million in 2017 dollars) produced approximately $754.1 million[8] in cumulative annual economic benefits, with an employment benefit of 4,407 FTE employees. Over the 10 years following each program year investment, these 9-years of investments are expected to return $1.6 billion[9] to the Long Island regional economy, and result in 9,791 additional FTEs between 2009 and 2026.

[5] We estimated the economic impact of the portfolio for the first 2 years of Energy Efficiency Portfolio implementation by extrapolating the economic impacts from 2011 (assuming similar multipliers of economic impact) to arrive at a portfolio-to-date estimate.

[6] FTEs 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 1 year, but could be done, for example, by one person working full-time for a year, two people both working half-time for the year, or two people both working full-time for 6 months.

[7] Using the energy supply discount rate assumption of 5.50%.

[8] In 2017 dollars.

[9] In 2017 dollars.

Table 2-3. Economic Impact of 2009–2016 Energy Efficiency Portfolio Investments

| Effect | Impact of 2017 Program Investment | | Impact of 2009–2017 Program Investment | |
|---|---|---|---|---|
| | First-Year Impact | Impact over 10 years[a] | First-Year Impact | Impact over 10 years[a] |
| Total Economic Output[b] (2017 $1M) | $73.5 | $154.2 | $754.1 | $1,600.5 |
| FTE Employees | 557 | 1,211 | 4,407 | 9,791 |

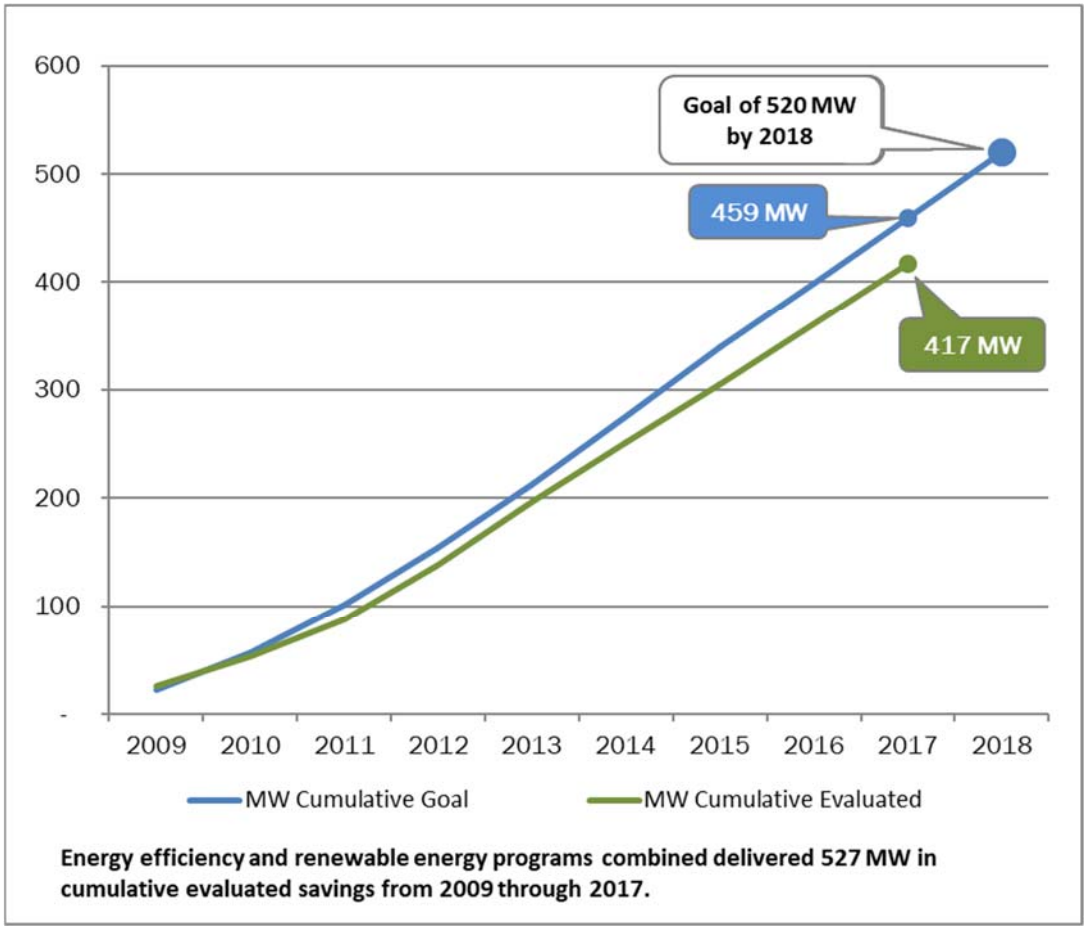
[a] Includes the 10-year impacts for each program year beginning in that year.

[b] Total economic output is the value of industry production. In IMPLAN, these are annual production estimates in producer prices.

## 2.4 Progress toward Long-Range Energy Efficiency Portfolio Goals

In 2009, LIPA set aggressive annual and cumulative demand savings goals for the Energy Efficiency Portfolio. These goals, established for the Energy Efficiency Portfolio, called for a cumulative reduction of 520 MW in system coincident peak demand by 2018, as shown in Figure 2-4. In 2017, PSEG Long Island's goals shifted from demand to energy due to the lack of need for additional capacity and the drive at the state-level to focus more on greenhouse gas reduction. The evaluation team notes that long-term goals will change moving forward, but have included this discussion for the purposes of recounting the portfolio's cumulative performance over the past 9 years.

Figure 2-4. Energy Efficiency Portfolio Progress toward Demand Goal (MW)




PSEG Long Island's latest long-range plan does not show a need for any new capacity until 2035.

Since establishing these goals, Energy Efficiency Portfolio investments have made steady progress toward the long-range goal. The Energy Efficiency Portfolio has achieved 92% of the cumulative demand savings goal as of 2017, a slightly higher percentage than achieved in 2016.[10] (It should be noted that LIPA's Electric Resource Plan used an expected value set conservatively to 79% of the long-range goal for the Energy Efficiency Portfolio in its capacity planning models to account for the possibility of falling short of the goal.) In 2017, based on our evaluated savings results, the Energy Efficiency Portfolio realized 138% of its annual demand savings goals and spent approximately 95% of its budget. Beginning in 2017, PSEG Long Island placed greater emphasis on energy savings to help the State of New York meet its goal of 40% greenhouse gas reductions by 2030. In 2017, the portfolio realized 97% of its goal of 243,285 MWh of energy savings.

## 2.5 Renewable Energy Portfolio Evaluated Impacts

PSEG Long Island spent $1.8 million of its operating budget on the Renewable Energy Portfolio in 2017. Overall, our evaluation showed that the portfolio lowered coincident demand by 11.2 MW and generated 26,236 MWh of energy. The Renewable Energy Portfolio provided an annual displacement of approximately 15,800 tons of $CO_2$ equivalents,[11] 6 tons of $SO_2$, and 12 tons of NOx. These greenhouse gas reductions are equivalent to removing more than 3,000 cars from the road and a fuel savings of approximately 33,200 barrels of oil.[12]

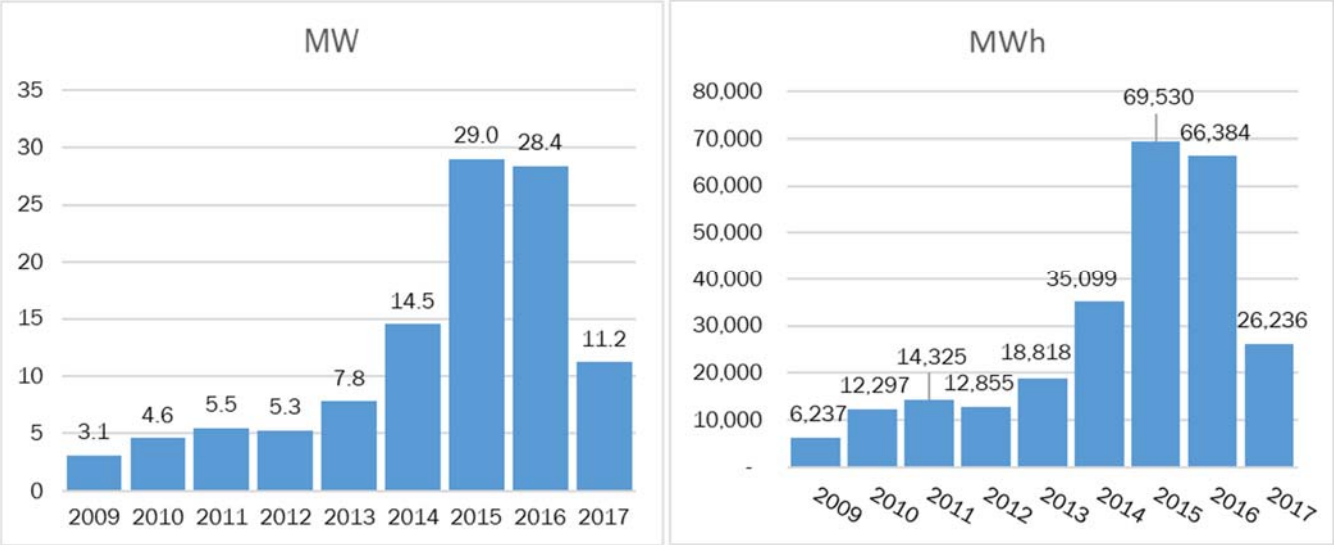
The Renewable Energy Portfolio greatly exceeded its goals in 2017, achieving verified ex ante savings of nearly twice its goals for both energy and demand savings (187% and 191%, respectively). However, energy and demand savings from the Renewable Energy Portfolio dropped steeply from 2016, which program staff attribute primarily to the lack of new residential projects following the exhaustion of NYSERDA residential incentives in April 2016. In 2017, PSEG Long Island provided rebates or financing for 1,512 solar PV systems, amounting to just 23% of the number of projects completed in 2016. Figure 2-5 outlines historical program achievement of demand and energy savings. Note that although the number of rebated residential systems decreased, the total number of systems installed on Long Island in 2017 is about the same as in 2016. About 37% of residential systems installed in 2017 received no LIPA, PSEG Long Island, or NYSERDA rebates.

[10] When the cumulative evaluated demand savings associated with the Renewable Energy Portfolio programs since 2009 are added to Energy Efficiency Portfolio savings, the total cumulative evaluated demand savings increases to 529 MW.

[11] $CO_2$ equivalents includes carbon dioxide, methane, and nitrous oxide.

[12] Displacement savings values calculated using 2014 Long Island sub-regional emissions rates of the EPA's eGRID 2014 v2, released February 27, 2017. Equivalent savings values are based on the U.S. EPA's Greenhouse Gas Equivalencies Calculator (updated May 2017).

Figure 2-5. 2017 Renewable Energy Portfolio Evaluated Net MW and MWh Savings




Since 2014, PSEG Long Island has facilitated the NYSERDA-funded NY-Sun Residential and Small Commercial initiatives for Long Island customers. After August 12, 2014, PSEG Long Island accepted only NY-Sun applications, and the NY-Sun program absorbed the incentive costs for all ongoing projects. Through the initiative, NYSERDA committed $65 million in total incentives for Long Island, to support 149 MW in residential systems and 65 MW in small, nonresidential systems (under 200 kW).[13] The ultimate goal of the initiative is to promote market transformation in the state by creating a sustainable market not dependent on subsidies. To accomplish this, NYSERDA created blocks of MW targets at specific incentive levels for each region of the state based on the maturity of the region's solar PV market. As each MW block becomes fully subscribed, it is closed, and new blocks with lower rebate levels are opened. The final residential MW block was fully subscribed in April 2016, meaning no new residential rebate applications were accepted in 2017. However, a number of rebated residential projects begun in 2016 were not completed until 2017. PSEG Long Island continues to accept applications for solar PV installations for the On-Bill Recovery Finance Program offered by Green Jobs – Green New York. NYSERDA funding for nonresidential installations is still currently available.

## 2.6 Renewable Energy Portfolio Economic Impacts

The 2017 evaluation also includes an assessment of the economic impact of investments in the Renewable Energy Portfolio on the economy of Long Island. The Evaluation Team developed an I-O model of the Long Island regional economy for the 2011 evaluation and updated the model inputs in each subsequent year. We estimated economic impacts associated with the PSEG Long Island's 2017 investments, and then combined those results with our assessments of the prior 8 years of implementation of the Renewable Energy Portfolio programs to arrive at a portfolio-to-date estimate.

As shown in Table 2-4, our analysis of economic benefits found that the combination of PSEG Long Island's $1.9 million budget in the Renewable Energy Portfolio in 2017, plus the additional $4.1 million in funding through NYSERDA's NY-Sun Initiative, returned $37.7 million in total economic benefits to the Long Island regional economy in 2017, including an additional 216 FTEs. Over the 10-year period, these 2017 investments

[13] In early 2017, the NY-Sun program increased the maximum rebated nonresidential system size from 200 kW to 500 kW.

are expected to return $50.2 million in total economic benefits to the regional economy (2017 dollars), with an employment benefit of 318 new FTEs.

Extrapolating these results over the 9-year life of the portfolio, the $148.9 million investment in Renewable Energy programs to date ($201.5 million in 2017 dollars) produced approximately $435.5 million in cumulative annual economic benefits, with an employment benefit of 2,263 FTE employees. Over the 10 years following each program year investment, these 9-year investments are expected to return approximately $747.6 million to the Long Island regional economy and result in 4,403 additional FTEs between 2009 and 2026.

Table 2-4. Economic Impact of 2009–2017 Renewable Energy Portfolio Investments

| Effect | Impact of 2017 Program Investment | | Impact of 2009–2017 Program Investment | |
|---|---|---|---|---|
| | First-Year Impact | Impact over 10 Years[a] | First-Year Impact | Impact over 10 Years[a] |
| Total Economic Output[b] (2017 $1M) | $37.7 | $50.2 | $435.5 | $747.6 |
| FTE Employees | 216 | 318 | 2,263 | 4,403 |

[a] Includes the 10-year impacts for each program year beginning in that year.

[b] Total economic output is the value of industry production. In IMPLAN, these are annual production estimates in producer prices.

Similar to the 2016 results, 2017 spending on PSEG Long Island's Renewable Energy Portfolio resulted in greater benefits to the Long Island economy than in earlier program years, however economic impacts have declined since the peak in 2015, due to reduced funding availability through NYSERDA's NY-Sun program. This reduction in funding resulted in fewer systems installed in 2017 compared to the past two years. The renewables portfolio still realized positive economic impacts in 2017 because of the inclusion of $4.1 million in funding from the NY-Sun program, however NY-Sun funding has declined from $20 million in 2015. The NY-Sun funding had a large impact on the results because it positively contributed to the direct impact of the program, but did not incur a corresponding renewables charge to PSEG Long Island ratepayers.

## 2.7 Key Themes for Continued Success

The Energy Efficiency and Renewable Energy portfolios continued to demonstrate strong performance in 2017, providing substantial capacity and energy savings in a cost-effective manner. Combined, the portfolios met the established goals for energy savings and greatly exceeded demand savings goals. In 2017, PSEG Long Island offered new energy-saving measures and implemented new program designs in its efforts to continually improve and diversify the Energy Efficiency Portfolio. As the lighting market continues to evolve and move closer to transformation, identifying and investing in emerging solutions will be imperative to the portfolio's long-term success. To continue to make progress toward the long-range savings goals, to maintain overall portfolio performance, and to build on the historical success of the Energy Efficiency and Renewable Energy programs, PSEG Long Island must continue to identify and consider emerging issues and challenges during its planning, budgeting, implementation, and management decisions. Below we provide an overview of the performance of the Energy Efficiency and Renewable Energy programs for the 2017 evaluation cycle and identify challenges that warrant attention in the future.

# Energy Efficiency Portfolio

## Commercial Efficiency Programs

### Overview of Performance

PSEG Long Island's CEP continued to offer Long Island's commercial customers effective opportunities for energy savings through the Comprehensive Lighting, Fast Track Lighting, HVAC, Standard, and Custom program offerings. The 2017 CEP also included no-cost energy assessments, cost-shared technical assistance studies, building commissioning co-funding, Leadership in Energy and Environmental Design (LEED) certification incentives, and ENERGY STAR® Benchmarking certification.

PSEG Long Island's CEP performed well in 2017, achieving 107% of the energy savings goal and 111% of the peak demand goal. Beyond strong performance in terms of energy and demand savings, the CEP continued customer and trade ally engagement, rigorous data tracking and quality assurance/quality control, and exploration of alternative savings sources and technological improvements to the program participation process. Highlights include:

- Deploying the Prime Efficiency Partners (PEP) program, which encourages contractors to apply for an enhanced Efficiency Partner designation, allowing them to submit Fast Track Lighting applications and use PSEG Long Island's logo on approved materials (e.g., email signatures and co-branded marketing materials).
- Revisions to the CEP application structure and contractor quality control procedures, in an effort to improve CEP processes and ensure that all contractors participating in the CEP follow industry best practices and adhere to PSEG long Island policies.
- Similar to residential programs, PSEG Long Island sought to expand the array of measures offered by the CEP in 2017. While lighting measures still accounted for the largest share of the CEP's evaluated energy savings in 2017 (88%), this marked a decrease from their share in 2016 (94%). In 2017, the CEP enrolled several combined heat and power (CHP) projects and saw the completion of the first thermal energy storage (TES) project.

### Potential Challenges for the Future

While the CEP's heavy reliance on lighting will continue to be a challenge for PSEG Long Island, changes to program and incentive structures in 2017 mark positive movement toward more measure diversity. As noted in previous evaluations, PSEG Long Island should continue to monitor the rapidly changing LED market and adjust incentive levels where possible, and also continue to explore new offerings and emerging technologies.

The successful transition to LM Captures resulted in improved data quality and visibility into individual measure assumptions, both of which helped improve program planning and evaluation in 2017. Beginning with the 2018 program year, PSEG Long Island has developed a forward looking TRM document that relies upon Long Island-specific research whenever possible, and the latest version of the New York Technical Reference Manual (NY TRM), when appropriate. This document is updated each year prior to the planning period for the following year. Moving forward, PSEG Long Island should use the current version of the forward looking TRM document for individual measure assumptions wherever possible.

## Residential Efficiency Programs

### Overview of Performance

Collectively, the residential programs provided substantial demand and energy savings in 2017 that were largely driven by the EEP program. In 2017, based on evaluated savings, the EEP program exceeded its energy and demand goals by 8% and 75%, respectively. The Cool Homes program, next largest in terms of savings, also exceeded energy savings goals by 1% and demand goals by 70%. Together, the EEP and Cool Homes programs accounted for 91% of the evaluated energy savings from the residential programs in 2017. The remainder of the residential portfolio— REAP, the Home Performance Programs, and the HEM program — accounted for 9% of the residential programs' energy savings. Both REAP and the Home Performance Programs exceeded their 2017 energy and demand savings goals, while the HEM program fell short.

The HEM program performed well below expectations in 2017. As noted previously, this is primarily due to both a shorter-than-anticipated treatment period (i.e., participating PSEG Long Island customers began receiving HERs late in the calendar year) and lower-than-anticipated participation. In consultation with the evaluation team, PSEG Long Island initially developed savings goals based on targeting approximately 350,000 customers receiving six reports throughout the year and anticipated 1.5% savings relative to total energy consumption. When it became evident that the HEM program would not be launched until sometime in the latter half of the year, program staff revised their goals to about 1/3 of their original goals based on the assumption that the same number of participants would receive two reports in 2017 instead of six. Customers targeted by the implementation team did not actually begin receiving HERs until September 2017, with the average participant receiving their first report in early November. Further, program implementers sent at least one paper report to 261,747 customers, fewer than PSEG Long Island originally planned. Combined, these two factors led to the HEM program realizing only 25% of its 2017 goal.

### Potential Challenges for the Future: New Measures and Emerging Technology

In 2017, PSEG Long Island residential program staff made several changes to program design, both due to the shift in focus from demand to energy reduction and in an effort to increase the share of savings contributed from non-lighting measures. Excluding the HEM program, all other residential programs met or exceeded their established energy savings goals. However, evaluated energy savings decreased by just under 30% relative to 2016. This reduction is largely a result of the program's diminishing ability to influence the lighting purchasing behaviors of customers through rebates in a lighting market that is rapidly transitioning to efficient LEDs. Even as PSEG Long Island continues to work toward diversifying its suite of residential efficiency offerings, overall energy savings may continue to fall in the short term.

The EEP program largely drives the overall energy and demand performance of the residential portfolio, and savings from lighting products still accounted for the largest share of EEP savings in 2017 (92% of energy and 77% of demand savings). However, EEP's program staff decreased LED rebates in 2017 in accordance with changing market trends, increased rebates for ENERGY STAR refrigerators, and reinstated rebates for dehumidifiers and room air conditioners. Additionally, PSEG Long Island invested in a new pilot program for heat pump water heaters. The Cool Homes program staff also made adjustments to the program's design to shift resources toward cooling equipment with higher energy-saving potential. In 2017, PSEG Long Island decreased rebates for traditional split central air conditioning systems to focus program resources on highly efficient ground source heat pumps.

These changes in program design are encouraging, as savings from LEDs will continue to decrease in coming years. As such, PSEG Long Island staff should continue to monitor emerging technologies and invest in new offerings. Additionally, program staff should maintain their efforts to conduct careful planning and set appropriate goals that are consistent with the rapidly changing markets for energy-efficient products.

## Renewable Energy Portfolio

### Overview of Performance

The Renewable Energy Portfolio greatly exceeded its goals in 2017, despite the steep decline in projects from the previous year. Program staff reduced savings goals for 2017 in recognition of the lack of funding available for new residential projects. Past research conducted by the evaluation team credited the legacy Solar Pioneer and Solar Entrepreneur programs with promoting the development of a renewable energy industry on Long Island, helping increase consumer awareness of and demand for solar energy while also increasing the technology's availability. Together, the legacy and NY-Sun programs have contributed to a strong PV market infrastructure on Long Island and a knowledgeable trade ally base. The program's implementation of the NY-Sun Initiative, with its $65 million allocated to the Long Island electric service territory, as well as financing offerings through the Green Jobs – Green New York initiative, also fostered growth in the market. Through these efforts, PSEG Long Island continues to drive the transition to a sustainable solar PV market on Long Island.

### Potential Challenges for the Future

PSEG Long Island has implemented NYSERDA's NY-Sun Initiative since August 2014, providing many benefits to Long Island's electric customers (including the $65 million in funding provided by NYSERDA). The NY-Sun Initiative has a goal of providing long-term confidence to the marketplace and incrementally reduces rebates as the market grows and prices decrease. The NY-Sun Incentive Program was responsible for funding all new and nearly all completed projects in 2017.[14]

By design, the NY-Sun program is winding down on Long Island: As of April 2016, PSEG Long Island had allocated 100% of the 149 MW of residential solar PV funding and, as of January 2018, nearly two-thirds of the 65 MW available for small, nonresidential customers had been allocated. Without funding available for new residential projects, the total number of rebated projects dropped by more than 75%, from 6,531 in 2016 to just 1,512 in 2017.

Given the phasing out of the NY-Sun incentives and the advanced state of the solar PV market on Long Island, PSEG Long Island will need to determine the actual level of market transformation that has occurred on Long Island and in what form the program should continue. Currently, program staff expect that commercial participation will remain relatively consistent in the upcoming couple of years until the remaining small, nonresidential funding blocks are exhausted.

[14] A single project completed in 2017 was initiated and incented by the legacy Solar Pioneer program.

# 3. Impact Results

This section presents the evaluated net energy and demand impacts for the Energy Efficiency and Renewable Energy portfolios.

## 3.1 Energy Efficiency Portfolio Impacts

The portfolio of Energy Efficiency programs performed well in 2017 and delivered considerable energy and demand savings to electric customers on Long Island. The portfolio's verified ex ante net energy and demand savings, which are used for determining if PSEG Long Island achieves its annual scorecard goals, came in above its stated goals for the year. Specifically, the Energy Efficiency Portfolio accounted for 258,410 MWh and 49.8 MW of verified ex ante savings for 2017. This represents 106% of net energy and 122% net demand savings compared to goals, as shown in Table 3-1. The evaluated net energy savings and demand savings reached 97% and 138% of the goals, respectively.

Table 3-1. Net Impacts: Energy Efficiency Portfolio Evaluated and Verified Ex Ante Savings versus Goals

| | 2017 Net Savings Goals | | Verified Ex Ante Net Savings | | | | 2017 Evaluated Net Savings | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Program | MW | MWh | MW | % Goal | MWh | % Goal | MW | % Goal | MWh | % Goal |
| **Commercial Efficiency Programs** | **23.0** | **95,005** | **25.6** | **111%** | **101,985** | **107%** | **25.5** | **111%** | **100,011** | **105%** |
| **Residential Efficiency Programs** | | | | | | | | | | |
| EEP | 15.3 | 112,884 | 18.6 | 122% | 138,917 | 123% | 26.7 | 175% | 121,572 | 108% |
| Cool Homes | 1.65 | 2,639 | 2.81 | 170% | 2,705 | 103% | 2.81 | 170% | 2,728 | 101% |
| REAP | 0.337 | 905 | 0.276 | 82% | 645 | 71% | 0.380 | 113% | 1,380 | 153% |
| Home Performance Programs | 0.540 | 1,619 | 2.59 | 479% | 3,054 | 189% | 0.995 | 184% | 2,872 | 177% |
| HEM | N/A | 30,179 | N/A | N/A | 11,104 | 37% | N/A | N/A | 7,627 | 25% |
| **Subtotal Residential** | **17.8** | **148,280** | **24.3** | **137%** | **156,425** | **105%** | **30.9** | **173%** | **136,180** | **92%** |
| **Total Energy Efficiency Portfolio** | **40.8** | **243,285** | **49.8** | **122%** | **258,410** | **106%** | **56.4** | **138%** | **236,191** | **97%** |

The CEP accounted for about 42% of the Energy Efficiency Portfolio evaluated energy savings in 2017. The CEP achieved verified ex ante savings of 107% of its 2017 net energy savings goal and 111% of its net energy demand goal and evaluated savings of 105% and 111% of its energy and demand savings goals, respectively. With the exception of the REAP and HEM programs, all residential programs meet or exceeded their energy savings goals in 2017. Overall, residential programs achieved verified ex ante savings of 105% of energy and 137% of demand savings goals; and evaluated savings of 92% of energy and 173% of demand savings goals. For additional detail about the lower than anticipated energy savings from the HEM program, see Section 2.7.

The EEP program continues to account for the largest portion of energy and demand savings within the residential programs, and performance of this program has a substantial impact on the ability of the portfolio to achieve savings goals. The continued success of the EEP program significantly contributed to the strong overall performance of the residential programs in 2017.

## 3.2 Renewable Energy Portfolio Impacts

The Renewable Energy Portfolio continued its strong performance in 2017, with verified ex ante savings exceeding the net energy and demand generation goals by 87% and 91%, respectively, as shown in Table 3-2.

Table 3-2. Net Impacts: Renewable Energy Portfolio Evaluated Savings versus Goals

| | 2017 Net Savings Goals | | Verified Ex Ante Net Savings | | | | 2017 Evaluated Net Savings | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Program | MW | MWh | MW | % Goal | MWh | % Goal | MW | % Goal | MWh | % Goal |
| Solar PV | 5.98 | 15,000 | 11.4 | 191% | 27,995 | 187% | 11.2 | 188% | 26,236 | 175% |

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