

NYSERDA Residential Retrofit Impact Evaluation Report (PY2012—2016)

Executive Summary

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1 Executive Summary

This report presents the findings from the impact evaluation of NYSERDA’s home retrofit programs: Home Performance with ENERGY STAR® (HPwES) and EmPower New York (EmPower), as well as National Fuel Gas Distribution Corporation’s (NFGDC) Low Income Usage Reduction Program (LIURP) administered by NYSERDA. The analysis incorporates residential electricity and natural gas consumption data and NYSERDA and NFGDC Program tracking data of participating program homes to estimate first year energy savings using a billing analysis. This evaluation spans program years (PY) 2012 through 2016 and focuses on residential retrofit programs funded by the Energy Efficiency Portfolio Standard (EEPS2) and supplemented by Regional Green House Gas Initiative (RGGI).¹

The Impact Evaluation Contractor cleaned both the program tracking received from NYSERDA and billing data received from the utilities through NYSERDA. The analysis requires that certain criteria be met in both the program tracking and billing data. Application of these criteria led to very high attrition rates. **Table 1** reports the percentage of participating homes with non-zero savings that were retained or excluded from the analysis by program and fuel. The attrition rate is the same as the percentage of households excluded from the analysis. The main report provides attrition rates by year and by utility. The top four reasons for attrition included: 1) Inability to match projects / accounts across the project and measure program tracking databases, 2) Inadequate pre-post billing data, and 3) More than 50% estimated meter reads.

Table 1: Summary of Program Attrition

	Number of Homes with Non-Zero Savings	% of Homes Retained	% of Homes Excluded
EmPower Electric	39,957	29%	71%
EmPower Natural Gas	23,253	24%	76%
LIURP	3,869	59%	41%
HPwES Electric ^a	13,203	28%	72%
HPwES Natural Gas ^a	19,077	27%	73%

^a Includes AHPwES.

¹ Measures that did not qualify for funding under EEPS2 Electric or Gas were funded by RGGI. More information on RGGI can be found <https://www.nyserdanv.gov/Researchers-and-Policymakers/Regional-Greenhouse-Gas-Initiative>

1.1 Key Results

1.1.1 EmPower Program

The EmPower Program under the EEPS2 funding period provided income-eligible participants with first-step home energy assessments conducted by qualified Building Performance Institute (BPI)-Gold Star (accredited) contractors. Along with the home energy assessments, participants were provided with in-home energy education on ways to manage their energy use and costs. EmPower also provided no-cost electric and natural gas energy efficient measures such as high-efficiency lighting and showerheads, air sealing, attic and wall insulation, and replacement of old inefficient refrigerators, freezers, and dryers.

The results indicate that the EmPower program achieved energy savings for participants. On average, customers reduced their electricity consumption by 547 kWh and natural gas by 12 MMBtu (**Table 2**). The electric and natural gas results account for ancillary savings (electric savings resulting from EEPS2 Gas funded measure or gas savings from EEPS2 Electric funded measures), which NYSERDA filed separately to the DPS. Since RGGI predominantly funded fuel oil projects, RGGI electric and natural gas savings were less than one kWh and one MMBtu, respectively.

Although EmPower EEPS2- and RGGI-funded projects reduced participants' energy usage and energy bills, the realized electric and natural gas savings fall short of the deemed program savings (**Table 2**). For the 2012 to 2016 time period, evaluated electricity savings are 58% of the program-reported savings. Evaluated natural gas savings are 44% of the program-reported savings.

Table 2: Summary of Reported and Evaluated Energy Savings for EEPS2 funded EmPower Projects Installed in PY 2012-2016

	Annual Electric Savings (MWh)^a	Annual Natural Gas Savings (MMBtu)^b
Funding	EEPS2 Electric	EEPS2 Gas
Program-reported savings	40,765	638,436
Realization Rate	0.58	0.44
Realization Rate 90/10 confidence interval	0.49 – 0.68	0.42 – 0.47
Evaluated gross savings	23,644	280,912
Evaluated savings per participant	574 (kWh)	12

^a NYSERDA program-reported savings to the DPS were 43,392 MWh. Applying the realization rate resulted in evaluated gross savings of 25,167 MWh.

^b NYSERDA program-reported savings to the DPS were 700,030 MMBtu. Applying the realization rate resulted in evaluated gross savings of 308,013 MMBtu.

NYSERDA asked the Impact Evaluation Contractor to consider possible reasons for the lower than anticipated realization rates. Some of the potential explanations included the following:

- Bias created by high attrition rates
- Evaluator practice in preparing and conducting the billing analysis
- Inaccurate assumptions guiding deemed savings estimates
- Installations not of sufficient quality to achieve evaluated savings
- Customer behavior such as snapback (using efficient equipment more than estimates assume) or removal of items from service

The scope of the evaluation limited the exploration of the reasons behind the observed RRs. However, the Impact Evaluation Contractor examined the potential for bias created by attrition, evaluator practice, the sensitivity of the analysis to various weather datasets, and home performance contractor variation. While none of these factors played a large role in reducing EmPower RRs for either electricity or natural gas, the exploration suggests that attrition bias and weather data may have affected RRs for the HPwES Program. For EmPower, the Impact Evaluation Contractor believes that the assumptions underlying deemed energy estimates, customer behavior, and home and household characteristics may vary from actual conditions, ultimately explaining the differences in program reported versus evaluated estimates of energy savings.

The study findings yield the following recommendations and critical findings.

Recommendation 1: NYSERDA should apply a 0.58 RR to EmPower electric and 0.44 to EmPower Gas for the 2012 to 2016 period.

Recommendation 2: NYSERDA should streamline Program Database Tracking for the EmPower and HPwES Programs as well as make certain project- and measure-level tracking align, a process that is already underway.

While the EmPower and HPwES Programs are evaluated as separate programs, streamlining the datasets using common field names and practices where feasible may result in evaluator efficiency gains for future interim and full impact billing analyses. This is especially important because households taking part in AHPwES often take part in both EmPower and HPwES. Likewise, inability to link participants across the project- and measure-level databases served as one of the top four factors driving attrition. The main report offers specific points to consider.

Critical Finding 1: The DPS required NYSERDA to report ancillary EEPS2 savings separately, which fails to account for the full savings achieved by the program. CEF is being administered and reported on a fuel blind basis, which will provide a more complete accounting of its impacts

Critical Finding 2: This study reinforces other research conducted by NYSERDA that documents that TMY3 may no longer represent the current weather conditions in New York. NYSERDA and NFGDC program staff and Home Performance Contractors may want to explore updating engineering models to include a vetted replacement to TMY3.

Critical Finding 3: NYSERDA has recognized the importance of conducting frequent interim impact billing analyses to identify potential challenges and take corrective action as soon as possible. NYSERDA is in the process of conducting interim billing analyses of CEF funded projects in 2016 (nearly complete) and 2017 to 2018 (in progress).

Critical Finding 4: NYSERDA program staff should work with Home Performance Contractors to improve the frequency and accuracy of utility account number collection. This is especially true given the fuel blind nature of CEF-funded projects.

1.1.2 Low-Income Usage Reduction Program (LIURP)

The NFGDC LIURP, as operated under EEPS2, was consistent with and administered through NYSERDA's EmPower Program. Like EmPower, LIURP aimed to reduce natural gas consumption of high-use customers by providing them with home energy assessments, education on reducing energy use, and installation of energy efficient equipment such as heating systems and large appliances. To be eligible, customers must have had a household income that is 150%

or below the Federal poverty income level. Customers must also have had high gas usage, a considerable past due balance, and resided in the current residence longer than one year.²

The results indicate that the LIURP achieved an average of 22 MMBtu of natural-gas savings for participants (**Table 3**). The reduction in natural gas usage represents about one-half of the savings NFGDC filed with the DPS. Note that some LIURP measures also yielded electricity savings (e.g., variable speed drives, insulation in homes with mechanical cooling), but this study did not estimate those electricity savings.

Table 3: Summary of Reported and Evaluated Natural Gas Savings for LIURP Projects Installed in PY 2012-2015

	Annual Natural Gas Savings (MMBtu)
Funding	NFGDC
Program-reported savings	156,294
Realization Rate	0.52
Realization Rate 90/10 confidence interval	0.49 – 0.55
Evaluated gross savings	81,273
Evaluated savings per participant	22

^a NYSERDA program-reported savings to the DPS were 170,882 MMBtu. Applying the realization rate resulted in evaluated gross savings of 88,859 MMBtu.

NYSERDA asked the Impact Evaluation Contractor to consider possible reasons for the lower than anticipated realization rates. Some of the potential explanations included the following:

- Bias created by high attrition rates
- Evaluator practice in preparing and conducting the billing analysis
- Inaccurate assumptions guiding deemed savings estimates
- Installations not of sufficient quality to achieve evaluated savings

The scope of the evaluation limited the exploration of these reasons behind the observed RRs. However, the Impact Evaluation Contractor examined the potential for bias created by attrition, evaluator practice, the sensitivity of the analysis to various weather datasets, and contractor variation. While none of these factors played a large role in reducing the LIURP RR, the exploration suggests that attrition bias and weather data may have affected RRs for NYSERDA’s HPwES Program. For LIURP, the Impact Evaluation Contractor believes that the assumptions

² For more information on the LIURP, please refer to <http://www.rhls.org/utilities/pulp/pa-low-income-utility-assistance-programs/national-fuel-gas-nfg-corporations-universal-service-programs/#liurp>

underlying deemed energy estimates, customer behavior, and home and household characteristics may vary from actual conditions, ultimately explaining the differences in program reported versus evaluated estimates of energy savings.

The study yielded the following recommendation and critical finding:

Recommendation 1: NFGDC should apply a 0.52 RR to LIURP in the 2012 to 2015 period.

Critical Finding 1: To the extent that NFGDC funds its own program evaluations or influences when NYSERDA evaluates LIURP, NFGDC should advocate for continued interim billing analyses. Two such studies are currently underway for ETIP-funded projects in coordination with NYSERDA's CEF interim billing analyses for 2016 (nearly complete) and 2017 to 2018 (in progress).

1.1.3 Home Performance with ENERGY STAR® (HPwES)

The HPwES Program under EEPS2 provided homeowners with home energy assessments to identify ways to improve the energy efficiency of homes. Qualified BPI-Gold Star contractors used a whole-house approach to identify opportunities for energy efficiency improvement in the home. The HPwES Program also offered a 10% discount on eligible measures, including, but not limited to building envelope, primary heating and cooling, water heating, appliances, and lighting. To be eligible to participate in the HPwES Program, New York State residents must have owned a one- to four-unit family home. Renters participated through their landlords.

The program also offered additional financial assistance to moderate-income residents covering 50 percent of qualified energy efficiency improvements through the Assisted HPwES (AHPwES) component of the HPwES Program.³ To be eligible, residents must have a household income that was less than 80 percent of the median county income. Some AHPwES participants received program funding through both the HPwES and the EmPower programs.

The results indicate that the HPwES and AHPwES programs achieved energy savings for participants. On average, HPwES customers reduced their electricity consumption by 724 kWh and natural gas by 13 MMBtu (**Table 4**). AHPwES customers reduced their electricity consumption by 387 kWh and natural gas by 15 MMBtu (**Table 4**). The electric and natural gas

³ Up to \$4,000 per project for single-family homes and \$8,000 per project for two- to four- unit homes.

results account for ancillary savings (electric savings resulting from EEPS2 Gas funded measure or gas savings from EEPS2 Electric funded measures) and fuel switching (electric only), which NYSERDA filed separately to the DPS. RGGI predominantly funded fuel oil projects; RGGI electric and natural gas savings for HPwES and AHPwES were negligible.

Although HPwES and AHPwES EEPS2- and RGGI-funded projects reduced participants' energy usage and energy bills, the realized electric and natural gas savings fall short of the deemed program savings (**Table 2**). Electricity RRs based on the program-reported savings were 51% for HPwES and 43% for AHPwES, and for gas RRs were 42% for HPwES and 43% for AHPwES.

Table 4: Summary of Reported and Evaluated Electricity and Natural Gas Savings for EEPS2 funded HPwES and AHPwES Projects Installed in PY 2012-2016

Funding	Annual Electric Savings (MWh) ^a		Annual Natural Gas Savings (MMBtu) ^b	
	HPwES - EEPSE	AHPwES - EEPSE	HPwES - EEPSG	AHPwES - EEPSG
Program-reported savings	2,546	2,292	94,035	142,879
Realization Rate	0.51	0.43	0.42	0.43
Realization Rate 90/10 confidence interval	0.42 – 0.68	0.18 – 0.51	0.40 – 0.45	0.40 – 0.46
Evaluated gross savings	1,298	986	39,495	61,438
Evaluated savings per participant	724 (kWh)	387 (kWh)	13	15

^a NYSERDA program-reported savings to the DPS were 5,250 MWh for HPwES and 2,200 for AHPwES. Applying the realization rate resulted in evaluated gross savings of 2,678 MWh for HPwES and 946 MWh for AHPwES.

^b NYSERDA program-reported savings to the DPS were 354,409 MMBtu for HPwES and 192,995 MMBtu for AHPwES. Applying the realization rate resulted in evaluated gross savings of 148,852 MMBtu for HPwES and 82,988 MMBtu for AHPwES.

NYSERDA asked the Impact Evaluation Contractor to consider possible reasons for the lower than anticipated realization rates. Some of the potential explanations included the following:

- Bias created by high attrition rates
- Evaluator practice in preparing and conducting the billing analysis
- Inaccurate assumptions guiding deemed savings estimates
- Installations not of sufficient quality to achieve evaluated savings

The scope of the evaluation limited the exploration of these reasons behind the observed RRs. However the Impact Evaluation Contractor examined the potential for bias created by attrition, evaluator practice, the sensitivity of the analysis to various weather datasets, and contractor

variation. The exploration concluded that attrition bias (for natural gas) and the selection of weather data (for electricity) may have affected RRs for HPwES and AHPwES. These factors alone, however, do not fully explain the divergence between program reported savings and evaluated savings for the participant included in the analysis models. The Impact Evaluation Contractor believes that, in addition to attrition and weather-related bias, the assumptions underlying deemed energy estimates, customer behavior, and home and household characteristics may vary from actual conditions, further explaining the differences in program reported versus evaluated estimates of energy savings.

The study yielded the following recommendations:

Recommendation 1: NYSERDA should apply the following RRs to HPwES:

Program	Electric RR	Gas RR
HPwES	0.51	0.42
AHPwES	0.43	0.43

Recommendation 2: NYSERDA should streamline Program Database Tracking for the EmPower and HPwES Programs as well as make certain project- and measure-level tracking align, a process that is already underway.

While the EmPower and HPwES Programs are evaluated as separate programs, streamlining the datasets using common field names and practices where feasible may result in evaluator efficiency gains for future interim and full impact billing analyses. This is especially important because households taking part in AHPwES often take part in both EmPower and HPwES. Likewise, inability to link participants across the project- and measure-level databases served as one of the top four factors driving attrition. The main report offers specific points to consider.

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