



**NYSERDA**

# **Energy Efficiency Portfolio Standard (EEPS-2) Program Quarterly Report to the Public Service Commission**

**Quarter Ending December 31, 2017**

**Final Report**

March 2018

## **NYSERDA's Promise to New Yorkers:**

NYSERDA provides resources, expertise, and objective information so New Yorkers can make confident, informed energy decisions.

### **Mission Statement:**

Advance innovative energy solutions in ways that improve New York's economy and environment.

### **Vision Statement:**

Serve as a catalyst – advancing energy innovation, technology, and investment; transforming New York's economy; and empowering people to choose clean and efficient energy as part of their everyday lives.

# **NYSERDA Record of Revision**

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<b>Document Title</b>
Energy Efficiency Portfolio Standard (EEPS-2) Program Quarterly Report to the Public Service Commission Quarter Ending December 31, 2017 March 2018

<b>Revision Date</b>	<b>Description of Changes</b>	<b>Revision on Page(s)</b>
	Original Issue	Original Issue

**Energy Efficiency Portfolio Standard  
(EEPS-2) Program**  
**Quarterly Report to the Public Service Commission**  
**Quarter Ending December 31, 2017**

*Final Report*

Prepared by:

**New York State Energy Research and Development Authority**

Albany, NY

March 2018

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# 1 Introduction

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This quarterly report reflects progress on Energy Efficiency Portfolio Standard (EEPS-2) Program evaluation activities administered by the New York State Energy Research and Development Authority (NYSERDA). This report contains the anticipated schedule and status of current and upcoming evaluation studies, summaries of recently completed evaluations, and the status of evaluation recommendations through December 31, 2017. Information contained within this report corresponds with the guidance received from the New York State Department of Public Service (DPS) and discussed with the Evaluation Advisory Group in July 2012 and the E2 Working Group in March 2014.

## **2 Evaluation Reports Completed**

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NYSERDA finalized the Residential Net Zero Energy Impact Evaluation in the fourth quarter of 2017.

### 3 Evaluation Status Update

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Tables 3-1 and 3-2 provide the anticipated schedule and status of current and upcoming impact, process, and market evaluation activities by program. As applicable, table notes further clarify information about study timing. Planned evaluation projects and timing may change based on input from stakeholders, the EEPS-2 evaluation review, and program progress. Likewise, evaluation project schedules are subject to change based on progress in administering the evaluation studies themselves. Future quarterly reports will highlight any timeline revisions. Timeline revisions made this quarter are designated by cell shading—PY denotes program year and Q denotes quarter.



**Table 3-1. Impact Evaluation Schedule and Status**

EEPS Program	Impact Evaluation Schedule					
	Workplan Submittal	Project Kickoff	Data Collection Complete	Draft Report	Final Report	Notes
Industrial & Process Efficiency	Completed	Completed	Completed	Q2 2018	Q3 2018	EEPS-2 closeout Impact Evaluation plan is underway and is expected to be completed in Q3 2018.
Existing Facilities	Completed	TBD	TBD	TBD	TBD	EEPS-2 closeout Impact Evaluation plans in development.
Agriculture	TBD	TBD	TBD	TBD	TBD	EEPS-2 closeout Impact Evaluation plans in development.
New Construction	TBD	TBD	TBD	TBD	TBD	EEPS-2 closeout Impact Evaluation plans in development.
Agriculture Disaster	Completed	Completed	Completed	Completed	Completed	Program closed. No further evaluations planned.
FlexTech	Completed	TBD	TBD	TBD	TBD	EEPS-2 closeout Impact Evaluation plans in development.
Commercial Existing Buildings Non-Participant Spillover Study	Completed	Completed	Completed	Completed	Completed	No future evaluation plans in this area.
Multifamily Performance Program	Completed	TBD	TBD	TBD	TBD	EEPS-2 closeout Impact Evaluation plans in development.

**Table 3-1 continued**

EEPS Program	Impact Evaluation Schedule					
	Workplan Submittal	Project Kick-off	Data Collection Complete	Draft Report	Final Report	
Point-of-Sale Lighting	Completed	Completed	Completed	Completed	Completed	Program closed. No further evaluations planned.
EmPower New York Closeout evaluation	Q1 2018	Q1 2018	Q1 2018	Q2 2018	Q3 2018	EEPS-2 closeout Impact Evaluation will be combined with the HPwES closeout evaluation. The workplan is currently under development.
Home Performance with ENERGY STAR® Closeout evaluation	Q1 2018	Q1 2018	Q1 2018	Q2 2018	Q3 2018	The HPwES Closeout evaluation will be combined with the EmPower closeout evaluation. The workplan is currently under development.
New York ENERGY STAR® Certified Homes	Completed	Completed	Completed	Completed	Completed	Report finalized, EEPS-2 Closeout evaluation planning is under development.

\* TBD indicates that final plans for EEPS-2 closeout evaluation are currently under development.

**Table 3-2. Process and Market Evaluation Schedule and Status**

EEPS Program	Process and Market Evaluation Schedule					
	Workplan Submittal	Project Kick-off	Data Collection Complete	Draft Report	Final Report	Notes
Existing Facilities	Completed	Completed	Completed	Completed	Completed	Future Market Evaluation plans are defined within NYSERDA's Clean Energy Fund (CEF) Investment Plan, both in the Market Characterization and Design Chapter (MCDC) and other sector-specific chapters.
Agriculture	n/a	n/a	n/a	n/a	n/a	Future Market Evaluation plans are defined within NYSERDA's CEF Investment Plan.
New Construction	Completed	Completed	Completed	Completed	Completed	Future Market Evaluation plans are defined within NYSERDA's CEF Investment Plan.
Agriculture Disaster	Completed	Completed	Completed	Completed	Completed	Program closed with no further evaluations planned.
FlexTech	Completed	Completed	Completed	Completed	Completed	Future Market Evaluation plans are defined within NYSERDA's CEF Investment Plan.
Multifamily Performance Program	Completed	Completed	Completed	Completed	Completed	Future Market Evaluation plans are defined within NYSERDA's CEF Investment Plan.
Point-of-Sale Lighting	Completed	Completed	Completed	Completed	Completed	Program closed with no future evaluations planned.

**Table 3-2 continue**

EEPS Program	Process and Market Evaluation Schedule					
	Workplan Submittal	Project Kick-off	Data Collection Complete	Draft Report	Final Report	Notes
EmPower New York	Completed	Completed	Completed	Completed	Completed	Future Market Evaluation plans for Low- to Moderate-Income are defined within NYSERDA's CEF Investment Plan: MCDC.
Home Performance with ENERGY STAR®	Completed	Completed	Completed	Completed	Completed	Future Market Evaluation plans are defined within NYSERDA's CEF Investment Plan.
New York ENERGY STAR® Certified Homes	n/a	n/a	n/a	n/a	n/a	NYSERDA's CEF Investment Plan: MCDC includes plans for a Net Zero Energy Homes market assessment in 2016 (complete), with updates in 2018 and 2020. This study takes the place of an EEPS Market Evaluation focused on ENERGY STAR® Homes.
C&I Natural Gas Market Characterization	Completed	Completed	Completed	Completed	Completed	No future evaluation plans in this area.

### 3.1 Recommendation Tracking

Recommendations generated from NYSERDA evaluation studies are tallied in Table 3-3 and categorized as follows:

- Total number of recommendations made to date:<sup>1</sup> cumulative number of recommendations contained in final NYSERDA evaluation reports.
- Total number of recommendations implemented to date: cumulative number of recommendations contained in final NYSERDA evaluation reports that have been implemented and incorporated into programs.
- Total number of recommendations rejected to date: cumulative number of recommendations contained in final NYSERDA evaluation reports that have been rejected.
- Total number of recommendations currently in progress: cumulative number of recommendations contained in final NYSERDA evaluation reports still under consideration.

**Table 3-3. Recommendation Tracking**

<b>Total Number of Recommendations</b>	<b>Through December 31, 2017</b>
Made to date	240
Implemented to date	201
Rejected to date	39
Currently in progress	0

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<sup>1</sup> The total number of recommendations made to date only includes recommendations made in final (not interim) evaluation reports.

## **4 Other Information**

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Per the DPS reporting guidance, this section provides an opportunity to report significant activities or events not already reflected in the report. There are no other significant activities requiring explanation for the third quarter of 2017.

## **Appendix A: Completed Evaluation Summaries**

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This appendix contains a high-level summary of each recently completed evaluation study. The full report on each evaluation study is available on the NYSERDA website. The Residential Net Zero Energy Impact Evaluation report was finalized in the fourth quarter of 2017.

# **NYSERDA Residential Net Zero Energy: Performance Assessments**

## **2008–2015 Evaluation Summary**

*Evaluation Conducted by:* Energy Resource Solutions (ERS) Impact Evaluation Team

ERS, Lead Investigators, March 2017

### **PROGRAM SUMMARY**

Since 2001, the New York ENERGY STAR<sup>®</sup> Homes Program (NYESH) goal is to implement and promote an enhanced version of the U.S. Environmental Protection Agency’s (EPA) ENERGY STAR Program in New York State. In 2012, the program changed its name to Low-rise Residential New Construction (LRNC) Program. LRNC encourages and supports the construction of new energy-efficient single-family and low-rise, multi-unit buildings (generally three stories or less) in New York State. LRNC supports the achievement of increased levels of performance, including homes designed and constructed to achieve net zero energy performance.

### **PURPOSE STATEMENT**

This evaluation effort describes the energy performance of a group of residential new construction homes in New York State, it does not determine realization rates.

### **EVALUATION OBJECTIVE**

This evaluation reviews performance of projects in the Net Zero<sup>2</sup> Tier of the LRNC and the New York ENERGY STAR<sup>®</sup> Homes (NYESH) programs installed from 2008 through 2015. Although the original work plan for this effort was to describe the energy performance baseline determination of residential new construction in New York State and provide the Program with in-situ performance information of

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<sup>2</sup> LRNC defines a NZE home as “a grid-connected home that is built to be highly energy efficient and is connected to renewable electric generation, so that the renewable generation offsets all the home’s average annual energy consumption. A NZE home also has a Home Energy Rating System (HERS) score of 10 or less. (Tiers were added to the Program in 2014.)



NZE-performing participant homes, the work scope was reduced.<sup>3,4</sup> Attrition reduced the number of projects that received site M&V; therefore, findings are only attributable to the distinct projects reviewed and baselines are not representative of a larger population of participant or NZE homes.

## DETAILED IMPACT EVALUATION FINDINGS

Table 1 provides an overview of Program tracking data on the population of single family projects, sorted by building area. This data was extracted from the REM/Rate models created as part of the LRNC program application process.

**Table A-1. Program tracking data**

Average participant home characteristics and estimated performance.<sup>a</sup>

Site	Year	Square feet	REMRate consumed - kWh	REMRate solar production - kWh	REMRate net - kWh	EUI - kBtu/s.f.	PV array nameplate rating	Tracking HERS index
ENERGY STAR	2011	2,892	12,975	(11,026)	1,950	15.5	9.1	6
Net Zero Tier	2014	2,403	9,878	(7,920)	1,958	15.7	6.5	8
All sites	2013	2,620	11,255	(9,300)	1,954	15.6	7.7	7

<sup>a</sup> Findings are distinct to the projects reviewed and are not representative of a larger population of NZE homes

Table 2 compares the average total on-site consumption as determined through the measurement and verification activities to the average total on-site consumption estimated in the REM/Rate models. On average, the homes performed approximately 9% better than anticipated.

<sup>3</sup> The work scope was reduced from the originally planned effort, (titled “NZE Performance Baselines”) to establish prototype energy use and energy use per square foot for four performance tiers of residential new construction. The primary objective was to establish energy performance and metrics for four general tiers of performance: 1) variations of both non-participant and NYSERDA Low-rise Residential New Construction (LRNC) program participant construction, specifically broken out by non-participant, 2) code design, 3) ENERGY STAR program participant, and 4) Net Zero Energy (NZE) program participant. for residential new construction of single-family homes.

<sup>4</sup> The proposed theory was performance of the tiers could be used when comparing efficient homes to a less efficient alternative; establishing performance for several tiers will allow for more nuanced comparisons within a spectrum of performance. The NZE home M&V could also provide Program with in-situ performance information of NZE participant homes. The information could be used to assess whether homes participating in the Program are achieving the performance levels anticipated and could inform the criteria on which the NZE designation is based.

**Table A-2. Comparison of average M&V total consumption to REM/Rate modeled total consumption**

Site	M&V consumed - kWh	REM/Rate consumed - kWh	Difference <sup>a</sup>
ENERGY STAR	11,824	12,975	-9%
Net Zero Tier	10,041	11,075	-9%
All sites	10,992	12,088	-9%

<sup>a</sup> Findings are distinct to the projects reviewed and are not representative of a larger population of NZE homes

Table 3 compares the average calculated annual solar output based on metered data and analysis to the average annual output estimated by REM/Rate.

**TableA-3. Average measured solar PV output vs. REM/Rate estimated solar PV output**

Site	M&V solar output - kWh	REM/Rate solar output - kWh	Difference <sup>a</sup>
ENERGY STAR	(10,647)	(11,026)	-3%
Net Zero Tier	(9,599)	(8,927)	8%
All sites	(10,158)	(10,046)	1%

<sup>a</sup> Findings are distinct to the projects reviewed and are not representative of a larger population of NZE homes

On average, the homes generated approximately 1% more electricity than anticipated by the REM/Rate models.

Seven of the 15 single family homes were performing at net zero levels.<sup>5</sup> Of those seven, two were part of the ENERGY STAR program, and five were part of the Net Zero Tier of the LRNC program. The original REM/Rate models predicted that two of the homes would perform at net zero levels. A less rigorous analysis was performed on the three-unit multifamily due to issues accessing sub-panels for metering, but a partial utility analysis performed on the available data strongly suggests the one multifamily building in the group is not achieving net zero performance levels.

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<sup>5</sup> A net zero home produces at least as much energy as it consumes over the course of a year using on-site renewables.

## Grid utilization

All the homes reviewed had photovoltaic systems installed. During daylight hours, these systems generate electricity to offset on-site use, and any excess generation is exported to the grid. These homes often generate more electricity than they consume during daylight hours.

All the homes reviewed except one are net exporters of energy during peak periods as defined by the New York State Technical Resource Manual (TRM).<sup>6</sup> Even homes that do not reach net zero levels of performance on an annual basis were found to be net exporters during peak demand periods.<sup>7</sup>

On average, the home demand during the peak period was -2.4 kW. In other words, during the peak period each home was contributing 2.4 kW of supply to the grid, in addition to offsetting the load consumed on-site, which was typically 1 kW during the peak period.

## Heat Pump Performance

Though successful data capture on heat pumps was limited, some observations can be made regarding the performance of the systems reviewed.

- Of the systems reviewed, 74% were geothermal source heat pump systems (GSHP). The remaining systems were air source heat pumps (ASHP).
- The GSHP systems provided the majority of domestic hot water (DHW) based on the metering of the DHW systems.
- The GSHP systems ran infrequently on an hourly basis and drew little power based on hourly averages. When outdoor temperatures were at their hot and cold extremes, both run time and power draw increased.

## Evaluation methods and sampling

Data collection consisted of program tracking data and REM/Rate files, the installation of metering equipment at the participant home, a survey of occupant characteristics and schedule, and a high-level plug load inventory.

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<sup>6</sup> [http://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/72c23decff52920a85257f1100671bdd/\\$FILE/ATTESQKL.pdf/TRM%20-%20Version%204.0-April%202016.pdf](http://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/72c23decff52920a85257f1100671bdd/$FILE/ATTESQKL.pdf/TRM%20-%20Version%204.0-April%202016.pdf)

<sup>7</sup> Peak demand describes a period of time when electrical power demand from the grid is expected to be notably higher than the average demand cycles.

This assessment consisted of two distinct efforts: 1) reviewing REM/Rate files from the statewide baseline study to determine market typical energy use and metrics; and 2) performing measurement and verification on a group of participant homes to determine as-built performance and energy metrics. NYSERDA transmitted 157 REM/Rate modeling files created as part of the 2014 Residential Statewide Baseline Study. The data in these files were manipulated and reviewed; pivot tables and graphing functions were used to examine various independent variables and their relationship to the dependent variables of energy consumption or energy intensity. The REM/Rate models themselves were not reviewed; the energy consumption estimated by the models was taken to be representative of the homes included in the statewide study.

The original number of homes in the study slated to receive measurement and verification was 27 (one three-unit multifamily and 24 single family). However, due to attrition, the number dropped to 18 (one three-unit-multifamily and 15 single family). Of the 18 homes, eight were New York Energy Star Certified Homes and 10 were participants in the Net Zero Tier of the LRNC program.

Metering was generally performed from the spring of 2016 through early winter of 2016. There were issues with data capture or reliability: 1) whole home net – two homes were only metered during the spring to early fall period; and 2) solar PV output – in some instances, a portion of the solar data came back corrupt. In these cases, sufficient data existed for the remaining portions of the data to model solar PV output across the full range of solar insolation experienced at a site; 3) end-use energy use – numerous metered end-uses experienced partial or full data loss.

## **PROGRAM FINDINGS**

The key findings are summarized below. However, the findings are distinct to the homes reviewed and are not representative of a larger population of participant or NZE homes. The participant homes in the group generally performed better than estimated in the REM/Rate models.

1. The reviewed homes completed under the Net Zero Tier, on average, perform at the net zero level. The reviewed homes completed under the ENERGY STAR program, on average, perform just above net zero performance.
2. The REM/Rate models reviewed, specifically the process that program uses to modify REM/Rate model for solar predictions to align with values calculated by the contractor for the NY-SUN Program, predict solar PV output well and serve as a good tool for predicating solar PV array generation.

3. In this group of homes, the REM/Rate models tended to overestimate energy use, and there is an apparent relationship between the difference between measured and modeled performance and the size of the home. As the homes get larger, the measured use goes down in relation to the modeled use. If this trend is representative, REM/Rate models will tend to understate the energy use of homes under 2,000 sf. and overestimate the energy use of homes greater than 2,000 sf.
4. Occupant density and behavior of the reviewed homes have an undeniable, though difficult to quantify, impact on energy use. As building envelopes and mechanical equipment efficiencies become asymptotic<sup>8</sup> in terms of performance, greater emphasis will need to be placed on educating owners on the use and operation of the home, including temperature set-points<sup>9</sup> and the impact of plug loads in order to achieve even greater levels of performance.
5. HERS index for NZE designation – Current Program rules use a HERS value of 10 as the threshold to qualify as an NZE project. A higher HERS Index indicates more energy use, a lower HERS index indicates less energy use. In theory, a HERS Index of 0 indicates a home that will perform at net zero levels. The review found the average modeled HERS value for the sampled homes that achieved net zero performance was 6.8. There were two homes originally modeled with a HERS index of 9 that achieved net zero performance. Based on these values, the current target HERS index of 10 is a reasonable threshold and predictor for NZE designation.
6. Grid utilization of reviewed homes – Although not all homes performed at net zero levels on an annual basis, all but one home were net exporters of electricity during peak demand periods. This is attributable in part because of the low cooling requirements of these homes due to their high-performance envelopes, and since peak demand periods coincide with times of the year where there is high solar insolation, and therefore, PV system output.

## RECOMMENDATIONS

There are no conclusion or recommendations to be made.

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<sup>8</sup> An asymptotic line is one that approaches a given limit, but never touches it. In this context, asymptotic refers to the diminishing returns of increased envelope performance or improved mechanical equipment efficiencies. The envelopes and mechanical systems in the participant homes are so efficient that further improvement of these systems will only generate minor improvements in performance.

<sup>9</sup> Temperature set-points refer to the thermostat settings of the homes.



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