



WEST HILL ENERGY AND COMPUTING

Vermont Home Performance with Energy Star, Post-Installation Inspection Report

Vermont Department of Public Service

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Prepared For

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The Department of Public Service commissioned a supplemental investigation of Efficiency Vermont’s (EVT’s) Home Performance with ENERGY STAR (HPwES) program, prompted by the results from a recent evaluation of the program.

Efficiency Vermont’s (EVT’s) HPwES program is a statewide program that provides incentives for weatherization measures and other energy improvements for single family homes. The objective of HPwES is to improve the thermal envelope, heating and ventilation systems of residential homes to advance the efficiency, comfort, and health of Vermont residences, in addition to lowering energy bills.

This supplemental evaluation was conducted to investigate the reasons for the unexpected performance of the program when reported energy savings were verified. The ratio of *verified* energy savings to *reported* (or claimed) energy savings is referred to as the realization rate (RR). The realization rates from the two most recent evaluations of the HPwES program are shown in Table 1-1 below.

TABLE ERROR! NO TEXT OF SPECIFIED STYLE IN DOCUMENT.-1: IMPACT EVALUATION RESULTS FOR EVT'S HPWES PROGRAM

Program	Program Year Evaluated	Average Pre-Install Use (MMBtu/yr)	Program-Reported Savings (% of Pre Install Use)	Evaluated Savings (% of Pre Install Use)	Overall Realization Rate
HPwES	2014-2016 ¹	92.0	25%	16%	65%
HPwES	2008-2010 ²	91.5	35%	18%	51%

¹West Hill Energy and Computing in partnership with GDS Associates, "Impact Evaluation of Efficiency Vermont’s Home Performance with ENERGYSTAR Program." September 10, 2018.

²West Hill Energy and Computing in partnership with GDS Associates, "Efficiency Vermont’s Home Performance with ENERGY STAR® Program Impact Evaluation Final Report." June 3, 2013.

An evaluation of HPwES 2008 to 2010 projects showed that the actual savings for oil and propane was about 50% of the savings estimated at the time the project was completed. This report finds that the accuracy of the estimated savings by contractors has not improved since the previous evaluation.

While the verified savings as a percent of home energy use is within the range of other, similar programs in the Northeast, the savings reported by contractors for HPwES projects are substantially overstated relative to the verified savings. While other factors could be influencing the RRs, this supplemental evaluation was focused on the contractors’ use of EVT’s energy estimating tool, the quality and performance of the insulation and air-sealing work, and site-specific factors that may have made estimation of savings more difficult. The study was not designed to provide statistically significant results, but rather to produce a high-level assessment of which issues may be contributing to the low HPwES realization rates.



Three possible contributors to the discrepancies between reported and actual savings that were examined were:

- Modeling Inputs: variation in the descriptions and measurements of the home used to estimate savings
- Performance Issues: the quality of installation and performance of improvements as well as other on-site issues
- Supplemental Heating Systems: changes in use of supplemental heating systems after the project was completed

The study found the following in these areas:

Modeling Inputs:

Data collected onsite during this study had numerous differences with the data that was entered by the contractor into EVT's energy estimator tool. These discrepancies included the square footage insulated, as well as the depth and the R-value (insulation effectiveness rating) of the insulation. Measurement error is a likely contributor to inaccuracies in savings estimates.

Invoices were available for one project which showed that the scope of work had changed between the savings estimate and the completion of the project. It appeared that the savings estimate was never updated to reflect these changes.

Performance Issues:

West Hill Energy conducted an extensive review of the data collection forms, inspection reports, photos and infrared images collected at each site to assess potential performance issues such as the integrity of the thermal shell, insulation quality and comprehensiveness, and areas with substantial heat loss.

The photos taken at each site provided evidence of potential performance issues. These issues were of two main types: (1) Difficulties with defining the thermal shell, and (2) Areas that were not properly insulated, either as part of the HPwES work or due to existing conditions prior to the HPwES work. As an example of #1, in one home, the basement ceiling had been insulated prior to the project, during which the basement walls were insulated. EVT's modeling and reporting tool does not have the capability to accurately reflect the impact of redefining the thermal envelope in this way which resulted in an inaccurate estimate of savings.

Supplemental Heating Systems:

Fuel savings may also be affected by changes in the use of supplemental heating systems. For example, installing a heat pump after the HPwES weatherization is likely to result in higher electric use and lower oil use during the winter months. Another example is participants who use



the wood stove substantially less or substantially more after the weatherization project is completed.

Relative Impact of the Three Contributors:

Of the three possible contributors to the discrepancies between estimated and actual fuel savings, (modeling inputs, performance issues, and change in use of supplemental heat), it was determined that the modeling inputs and performance issues were the largest contributors. The variation in supplemental heat is more likely to be random and create errors in both directions, resulting in both overstated and understated savings.

The report recommends that Efficiency Vermont add Quality Control (QC) protocols to the HPwES program to verify contractor inputs into the modeling software and ensure that contractors are performing effective installations. QC should include the following items at a minimum:

1. On site pre- and post-install inspections for a sample of homes
2. Thermal imaging to identify performance issues
3. Review of invoices and changes in work scope
4. Follow up with contractors to explain QC results

QC results could be used to develop additional contractor training materials and curriculum.

