

# Home Performance with ENERGY STAR Realization Rate Attribution Study

New York State Energy Research and Development Authority

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## Summary

This study, funded by the New York State Energy Research and Development Authority (NYSERDA) and performed by Performance Systems Development, identified the underlying causes of an energy savings prediction shortfall in the NYSERDA Home Performance with ENERGY STAR program for the years of 2007 to 2011 and assessed the potential impact on savings prediction accuracy of applying the ANSI/BPI-2400 standard for baseline energy model calibration to actual energy usage.

Whole building energy efficiency programs across the country have experienced shortfalls in the ratio of expected energy savings relative to predicted savings when undergoing formal evaluation of savings results. This ratio of expected to predicted savings is called the “realization rate”. The ANSI/BPI-2400 standard was developed based on best practices to provide energy efficiency incentive programs with a tool for improving the confidence in energy savings predictions from energy modeling tools when used as part of incentive approval in efficiency programs. This study tested the ability of the ANSI/BPI-2400 standard to improve prediction accuracy by retrospectively apply the standard to a group of over 2000 homes retrofitted in the NYSERDA Home Performance with ENERGY STAR program over five years. The study also evaluated a wide range of other factors that could be contributing to reductions in energy savings realization rates.

The study found that:

- The most significant variable contributing to the relative accuracy of the savings predictions was the degree to which the baseline simulation was calibrated to match the actual energy bills in the home.
- Programmatic application of the ANSI/BPI-2400 baseline energy model calibration standard will dramatically increase realization rates (energy savings prediction accuracy).
- Calibration according to the ANSI/BPI-2400 standard will allow reduced detail in energy models that undergo program review, reducing contractor effort and speeding up energy model review time, including integration of calibration with increased automation of review.
- The savings percentage predictions of the program’s energy models were accurate, with the realization rate error being driven by a shortfall in the absolute value of the savings prediction resulting from the inflated baseline models.
- Energy modeling tools complying with the RESNET simulation tests for existing residential buildings should produce similar results to the TREAT software used in the NYSERDA program when used in conjunction with the application of the ANSI/BPI-2400 standard.

These conclusions and others in the study are being used to help improve program realization rates, streamline program operations and automate incentive approval.

## Model Calibration Addressed Most of the Error

The application of an ex-post (synthetic) calibration, such as the ANSI/BPI-2400 standard, to the datasets showed how the realization rates and the predicted savings would have been adjusted if model calibration had been a requirement of the program. The results of this application of the standard improved the realization rates significantly with a corresponding reduction in the reported (predicted) savings for natural gas. This is in line with the hypothesis that un-calibrated models are typically over-predicting the baseline simulation model and therefore have over-predicted associated savings. The following charts show the functional basis of the impact of baseline energy model calibration according to the ANSI/BPI-2400 on the energy savings realization rate, shown as the X/Y ratio in the charts.

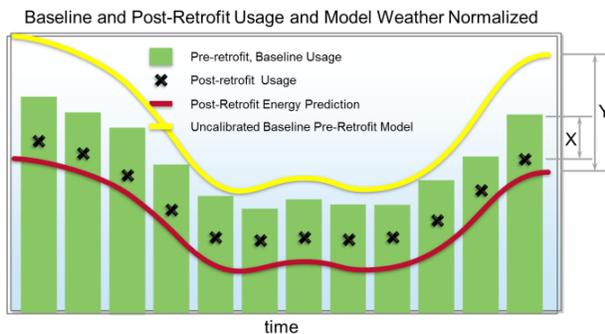


Figure 1. Predictions without Calibration

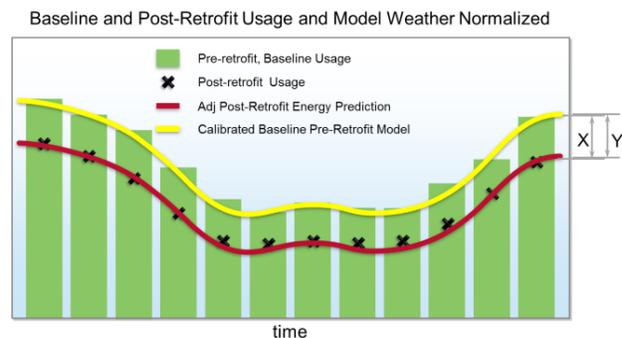


Figure 2. Predictions with Calibration

Calibration of the baseline simulation to match the actual energy bills in the home significantly increased the average accuracy in savings predictions (i.e. realization rates) across the dataset and significantly reduced the variation in individual savings prediction accuracy.

## Accredited software models should produce similar accurate percentage predictions

The energy simulation software used by the program was shown to produce predicted savings percentages, accurate within one to two percentage points of the actual savings percentages. Other software tools that comply with the requirement of the RESNET Existing Homes Tax Credit Software Accreditation (as referenced in the ANSI/BPI-2400 standard) and when used with quality assurance mechanisms, such as the ANSI/BPI-2400 calibration process, should produce similar savings results.

## Whole building energy efficiency incentive programs using modeling tools for saving prediction should require model calibration

Since the application of bounding the pre-retrofit energy usage of the simulation model by the actual energy usage of the home is such an effective method for trapping modeling errors as well as reducing the general tendency of models to over predict, the primary recommendation is to require a simple end-use calibration practice, such as the ANSI/BPI-2400 standard. At the same time that calibration is being introduced, the infrastructure for improving access to utility bill data should be improved. The Green Button Download My Data data file standard has been shown to be relatively easy for utilities to adopt and reduces the cost of data entry by establishing a consistent electronic data format. The Green Button Connect data transfer standard supports even greater process efficiency gains by improving the ability of a utility customer to pass data directly to a customer authorized program manager and/or contractor. This standard has been successfully implemented by utilities in California and can help programs achieve other market transformation goals by better integrating actual energy usage into the retrofit process.