

Smart Thermostat Analytics Toolkit

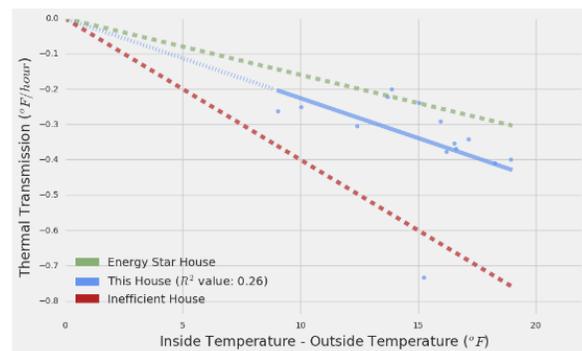
VEIC’s Smart Thermostat Analysis Toolkit (STAT) uses indoor temperature data to generate a building thermal envelope performance metric and savings estimate, as well as a total cost savings estimate based on utility bill weather modeling. This savings estimate is independent of HVAC equipment efficiency and weather effects. The analysis also produces a report with charts and tables to help expert users interpret the results. VEIC is committed to releasing STAT as open source software so that program implementers, evaluators, and researchers can both use and improve these tools and metrics. We believe that transparent, independently validated software such as this can help energy programs and service providers use data to deliver additional value to customers.

Building Envelope Thermal Performance

VEIC’s patented algorithm generates a metric for assessing the rate of thermal transmission through the building envelope, first described in a peer-reviewed paper presented at the 2014 Association of Energy Service Professionals National Conference. The metric captures, for a given house, what the rate of temperature change is for a given temperature difference between the inside and outside of the home. This describes a linear relationship of degrees per hour of passive heat gain/loss per degree of delta-T. This metric is not the same as a UA value, both because it is independent of home size (akin to an average U-value) and also because it includes not only insulation but also infiltration. Accordingly, when measured at the location of a thermostat it will directly relate to HVAC runtime and hence energy savings opportunities.

Thermal Transmission Benchmarks

Each point represents a period of passive temperature drift. The rate of temperature change is plotted against the indoor-outdoor delta-T at that time. The linear regression model for this house is compared to benchmarks.



Metrics Generated

Envelope Rate of Thermal Transmission	deg F/hr/delta-T
Thermal Transmission Rate Confidence Level	R ²
Current annual energy consumption - heating / cooling / other	kWh/yr and \$/yr
Predicted annual energy savings – heating / cooling / other	kWh/yr and \$/yr
Trend of indoor and outdoor temperature (chart)	deg F over time

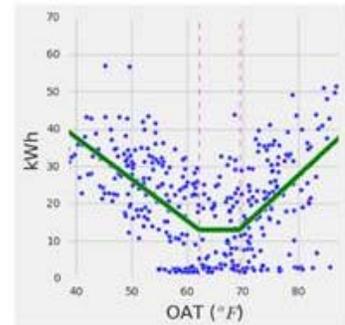
Toolkit Features

- Calculates energy use and thermal performance metrics from thermostat or temperature data-logger data and weather data, plus AMI data if available.
- Generates web-based reports with group-level charts and tables with links to detailed individual reports.
- Launches full metric and report generation process with a single command.
- Automatically imports batches of data from standard formats.
- Stores all calculated metrics and source data in a database for further analysis or integration with other systems (easily configured for any common SQL database).
- Includes official Energy STAR smart thermostat run-time savings metric.
- Allows coding of additional metrics that can easily be incorporated in analysis pipeline.
- Compatible with Linux or Windows; requires only Python 3 and available libraries.

Web-based Reports

To help make these analysis results more useful to the program staff that will be delivering recommendations to customers, VEIC provides web-based reports for all homes that were analyzed. These reports can help to target the homes with the most potential and also to better understand the results for each home.

The interface enables utility program staff to explore different subsets of homes, identify outliers, and drill down to details of individual homes in order to better understand the results and the opportunities. The report includes insights about the temperature deltas at which the temperature drift periods were identified and how well they fit the temperature drift rate vs delta-T model. The weather model for the electric interval data is similarly displayed for verification.



Applications

- Home weatherization pre-audits for program screening.
- Customer engagement using data visualization and actionable information.
- Customized savings estimates for improved payback calculations or tiered incentives.
- Weatherization project verification for contractor feedback or program evaluation.
- Supports new program models such as DIY weatherization or pay-for-performance.
- Augment EE/DR program impact evaluation using shell efficiency or Energy STAR metrics as explanatory factors for understanding variance in savings outcomes.

For more information, contact Nick Lange: nlange@veic.org