ENERGY STAR Connected Thermostat Draft 2 Method to Demonstrate Savings

Topic	Subtopic	Comment Summary	EPA Response
Annual Reporting Requirements		One Stakeholder expressed support for on-going periodic data collection, noting that there may be circumstances where products save less energy in the field then anticipated, notably as a result of connectivity issues.	EPA appreciates the support for the periodic data update requirements, as this is a valuable tool for ensuring that product performance remains steady and/or improves over time with software and product updates.
Auditing		Two stakeholders recommended that EPA reserve the right to audit CT savings results for the V1.0 specification.	EPA acknowledges the value of auditing Connected Thermostat savings submissions, and has taken measures to ensure the process of assessing CT savings will support auditing. EPA looks forward to working with stakeholders to develop a suitable process for 3rd party auditing in the future.
Calculation of LB95		One stakeholder identified a flaw in the method EPA was using to calculate the lower bound of the 95th percentile confidence interval of nationally weighted CT savings. Through written comments and a subsequent call, the stakeholder described the technical details of this formula, which takes into account that the weighted national average is developed with more samples than the individual climate zone results.	EPA appreciates this feedback and will modify the Thermostat Software accordingly for the upcoming Version 1.0 Release, using a third method suggested by a statistics expert and similar to the one suggested by the commenter. EPA has also incorporated technical details regarding the calculation of this nationally weighted confidence interval into Appendix B of the Final Draft Method to Demonstrate Field Saving.
Sample Size	Input Requirement	Multiple stakeholders commented on the input and output requirements for number of thermostats per climate zone. All commenters recommended setting sample size requirements per Climate Zone only at the input to the CT Field Savings software, and removing the flexibility for CT providers to choose sample size freely. Differing methodologies and sample sizes were proposed. One stakeholder recommended a fixed minimum sample size per Climate Zone apply to all CT Service Providers, and further recommended at least 200 thermostats per zone for this minimum. This stakeholder suggested that if a zone does not have enough thermostats to meet this requirement, all available thermostats in this zone should be included. Another stakeholder agreed with requiring fixed sample sizes for all CT Service Providers, and recommended that these sample sizes could be tiered by the number of thermostats/customers associated with this company. This stakeholder did not recommend specific counts relating to these tiers. An additional stakeholder recommended a minimum input sample size of 150 thermostats per climate zone, and a requirement that vendors input 5% of their available homes in each climate zone, if this value is greater than 150 units.	EPA appreciates the stakeholder discussion regarding sampling requirements. The Savings Method has been revised to set a fixed sample size of 250 CTs per Climate Zone at the input to the CT Field Savings software tool. This sample size will ensure statistical significance of the assessed savings. Use of a fixed sample size will further reduce the opportunity for gaming. Finally, in the final draft EPA allows vendors who have less than 250 CTs in a climate zone to submit all available samples in that zone.

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Energy Claim Verification		A stakeholder recommended that EPA conduct independent verification of vendor data, with respect to completeness, representative sampling of devices, accuracy, and data integrity. This stakeholder recommended that EPA request to receive the raw data, or request that the raw data is sent to a third party for analysis and verification.	EPA appreciates this feedback, and seeks to establish a method to demonstrate savings that safeguards against and minimizes the impact of data incompleteness, measurement issues, data errors, and representativeness of sampling. Many of the Thermostat Software decisions around filtering and design of random sampling methods were based around mitigating these potential issues. Third party verification is a valuable tool in ensuring the metric integrity, but can not practically be implemented at this time, prior to program launch. This a conversation that EPA would like to continue in the future.
Filtering	Savings Filter (p01)	A stakeholder noted that the order of application of filters in the Thermostat Software was different then traditional statistical conventions: Tau and CVRMSE filtering may be performed at the same time, but filtering out CTs with savings that falls in the maximum and minimum 1% should only be applied on the remaining sample set after Tau and CVRMSE filtering is applied.	EPA appreciates this feedback and has modified the filtering sections of the Thermostat Software accordingly for the upcoming Version 1.0 Release.
Random Sampling	Define Thermostat ID	One stakeholder recommended that vendors could use the current lack of a detailed definition for Thermostat ID to define an ID that would present an advantage for savings calculations, if they know the sampling seeds in advance. Thus, this stakeholder recommending creating a specific Thermostat ID definition, for example, defining as the thermostat serial number or a direct mapping of serial number to new id numbers.	EPA appreciates this feedback, and in order to guard against optimization of sample selection, EPA has proposed that the thermostat IDs must either be a preexisting unique ID associated with the CT device, such as a serial number or MAC address, or directly mapped from it.
Savings Model	Baseline	One stakeholder recommends that EPA clearly express their intent to effectively implement the CT ENERGY STAR program as pass/fail, where CT Product savings scores or a ranking of qualified CT Products is not available. This stakeholder expressed concerns on the use of 90/10 baselines, noting that these baseline do not capture previous occupant behavior, and that the choice of the 90th and 10th percentiles are both arbitrary and correlate with estimated savings. This stakeholder also noted that there could be benefits under 90/10 baselines to running a home in an inefficient manner that encourages temperature drift.	EPA appreciates this feedback, and seeks to continue conversations with stakeholders on potential improvements to the Thermostat Software Savings Models and Baselines.
Savings Model	Missing Data	Two stakeholders commented on the handling of missing data. One recommended that missing data interpolation should be discouraged, instead ensuring that these periods are given zero savings. This stakeholder further recommended that this missing data penalty would discourage consumer facing frustrations, including poor product connectivity. Connectivity loss due to external issues, such as power blackouts, could be handled on a case by case basis. The other stakeholder indicated that some CT service providers collect data in sub-hour intervals, but no process has been defined for dealing with missing sub-hour data, e.g. ignore or interpolate.	EPA appreciates this feedback, but does not agree with assessing zero savings in cases where data may be effectively interpolated, for instance 15 minutes of missing indoor temperature data. EPA also notes that the architecture of the software cannot enable zero savings to be assigned in periods with missing data. In regards to missing sub-hour data, CT service providers must develop and use interval data files that accurately represent data collected from CTs. Insofar as missing sub-hour data is concerned, EPA believes that CT service providers are best positioned to develop sensible rules that interpolate/discard as appropriate. For example, the decision to interpolate/discard missing sub-hour run time data could take into account the delta between indoor and set temps. Should these judgements become problematic, EPA is open to adding such guidance in the future.

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Savings Model	Hourly	One thermostat vendor provided physical and statistical arguments in favor of the hourly CTD/HTD method for calculating runtime savings. This vendor demonstrated that in their data, the hourly CTD/HTD method eliminated fewer homes due to unphysical values of Tau, while improving the individual fits overall (CVRMSE), noting that this improvement was likely due to the use of hourly demand in the calculation. This vendor also noted that the Tau values for Heating and Cooling using the Daily and DeltaT Methods were as much as 4 Degrees F apart, whereas the hourly CTD/HTD method had values within 1 degree for heating and cooling. The vendor recommended EPA implement the hourly CTD/HTD method for assessing CT field savings.	EPA appreciates this feedback, and has conducted additional analysis on Data call 3, which confirmed claims for superior results for Filtering Attrition, Tau, CVRMSE, and Savings. EPA agrees with the logic and will solely use the Hourly HTD/CTD method in the Version 1.0 ENERGY STAR CT Field Savings Software. Appendix A has been updated to reflect this choice.
Savings Model Validation		One stakeholder recommended that EPA conduct studies to validate the accuracy of the proposed modeling approach, including a sensitivity analysis on model assumptions impact to product savings. This stakeholder further recommended that EPA involve utilities and 3rd party research entities to conduct additional pilot studies, providing these groups with anonymized data when aligned with research needs.	EPA agrees with the value of independent confirmation of modelled savings, and seeks to engage stakeholders on this topic after launch. Such research will provide additional motivation for vendors to avoid gaming, and we hope it will lead to rapid improvement of the metric.
Software	Filtering Report	One stakeholder recommended that EPA modify the Thermostat Software to generate a report on the number of thermostats filtered in each Climate Zone.	EPA appreciates this feedback, and notes that this information is available in the data files output by the Thermostat Software that will be provided to CBs for initial product certification and to EPA for periodic reporting. Due to data privacy and confidentiality concerns, this information will not be included in the Qualified Product List. However, EPA intends to monitor attrition rates in order to assess the efficacy of data filtering.
Software	Automated Data Submission to EPA	Two stakeholders recommended that EPA modify the Thermostat Software to automatically send the output file to Certification Bodies and/or EPA, protecting the data from modification and attempts to refine the score incrementally by reordering data.	EPA recognizes potential value in implementing automatic software submissions, but notes that data security concerns and software development and maintenance make this idea impractical for this current software release.
Manufacturer Data	Attrition Report	Two stakeholders recommended that EPA request a summary report from manufacturers about the number of thermostats removed from the dataset prior to random sampling as part of the Savings Method. One of these stakeholders further recommended that this report should contain information on data integrity and completeness, thermostat quality control issues, and the total number of thermostat customers in the raw sample, or given as percentages to protect vendor data.	EPA recognizes the value in this vendor market and attrition data, but notes that it may be misleading to end users, and extremely difficult to interpret the resulting percentages without significant context provided from each vendor, on product design, target markets, target equipment type, market penetration, and climate zone distribution. Many of these items would potentially be company confidential, so this attrition report would not likely provide its intended value to stakeholders or end users.
Manufacturer Data	More guidance on data exclusion	A stakeholder requested more specific rules on excluding data prior to random sampling, which would improve consistency between vendors, and could provide added data quality benefits.	EPA appreciates this feedback and has added additional clarity into the Savings Method regarding data exclusion, based on equipment type, primary vs auxiliary equipment, and has updated Thermostat Software documentation accordingly.