ENERGY STAR Connected Thermostats

CT Metrics Stakeholder Meeting Slides

May 26, 2022
Attendees

Abigail Daken, EPA
Abhishek Jathar, ICF for EPA
Alan Meier, LBNL
Leo Rainer, LBNL
Craig Maloney, Intellovations
Michael Blasnik, Google/Nest
Kevin Trinh, Ecobee
Yufeng Deng, Ecobee
Brad Powell, Carrier
Jason Thomas, Carrier
Theresa Gillette, JCI
Rohit Udavant, JCI
Diane Jakobs, Rheem
Carson Burrus, Rheem
Chris Puranen, Rheem
Glen Okita, EcoFactor
John Sartain, Emerson
Eric Ko, Emerson
Albert Chung, Emerson
James Jackson, Emerson
Daniel Stephan, Emerson
Mike Lubliner, Wash State U
Charles Kim, SCE
Michael Fournier, Hydro Quebec
Sylvain Constant, Hydro Quebec
Robert Weber, BPA
Phillip Kelsven, BPA
Wade Ferkey, AprilAire
Kristin Heinemeier, Frontier Energy
Ulysses Grundler, Trane
John Hughes, Trane
Michael Morey, Trane
Mike Caneja, Bosch
Sarathy Palaykar, Bosch
Mike Clapper, UL
Alex Boesenberg, NEMA
Ethan Goldman
Jon Koliner, Apex Analytics
Michael Siemann, Resideo
Arnie Meyer, Resideo
Aniruddh Roy, Energy Solutions for CA IOUs
Claire Miziolek, Energy Solutions for CA IOUs
Jia Tao, Daikin
Dave Winningham, Lennox
Dan Poplawski, Braeburn
Aidan Girard, Mysa
Peter Gifford, Mysa
Vrushali Mendon, Resource Refocus
Caroline Cote, Natural Resources Canada
Riana Johnson, Illume Advising
Agenda

• Software updates
• Heat map, Missing data updates and proposed solutions
• Updates on V2.0 timeline
  – Tau friendly regression
Software Updates: V2.0

- Met w/ vendors about the Appendix A code and how they're using it (thank you!)
  - Dropping natsort from the requirements.
    - (you can still use natsort if that works for you, but we're not requiring it).
  - Just document what you have for sorting and ensure that it is repeatable.
- More to come on this front. (Stay tuned!)
Software Updates: V2.0

- Extra logging
  - We've added extra logging for when a thermostat doesn't map to a climate zone, weather station, or known ZIP code.
- Added more logging if an equipment type is not recognized.
- Now throwing exceptions if there are exceptional cases (see above) instead of just quietly dropping the thermostat.
- Cleaned up warnings so we only warn about zero cooling / heating days if the thermostat has cooling / heating.
- Updated the driver script to have the date when the files are run.
  - Recommend that vendors use the driver script (multi_thermostat_tutorial.py under the scripts directory) for running using V2.0.
- Changed the name of the "output" file to "metrics" to make it clear what it is.
Discussion: Software Updates: V2.0

• At some point we were talking about a fallback for zipcodes, grabbing a nearby zipcode – what happened to that?
  – Yes, we decided not to do that.
  – Vendor tried it and concluded it would be a viable way to avoid losing thermostats.
  – Vendors can do their own clean-up before running the EPA code.
  – Now using EE weather for zip code mapping.
  – Such errors now logged – vendor says it’s a cause for attrition.
• Version 2 will also propose a larger maximum sample size.
• Can we list off what the “cleaning run” would do?
  – Not a developed proposal, but it would be a way of finding out which thermostats will survive getting weather data.
  – May create a problem for reproducibility/auditability – please hold off if you can.
Missing data updates and proposed solutions

**Graph 1:**
- Title: Mixed-Dry/Hot-Dry
- Axes:
  - y-axis: n_core_heating_days
  - x-axis: n_days_insufficient_data
- Data points: Scattered dots
- Highlighted area: Rectangular box

**Graph 2:**
- Title: Mixed-Dry/Hot-Dry
- Axes:
  - x-axis: max_allowed_days_insufficient_data
  - y-axis: min_required_core_days
- Color scale: Gradient from 0.00 to 0.40
- Data representation: Heatmap
Missing data updates and proposed solutions
Missing data updates and proposed solutions

T’stat Distribution - Cooling
Missing data updates and proposed solutions

Excluded T-stats - Heating
Missing data updates and proposed solutions

Excluded T’stats - Cooling
Missing data updates and proposed solutions

- Proposed criteria: thermostats will be included from aggregate results if they have either:
  - Less than 20 days missing due to insufficient data, or
  - More than 50 core days in the relevant season
- Thermostats that do not meet either threshold will be flagged for further review in the metrics file and excluded from the statistics calculations
Missing data updates and proposed solutions

• ENERGY STAR subscription rate

\[
\text{ENERGY STAR Subscription Rate} = \frac{\text{ENERGY STAR CTs Shipped and Registered to ENERGY STAR service}}{\text{ENERGY STAR CTs Shipped}}
\]
Discussion: Missing data updates and proposed solutions

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Discussion: Missing data updates and proposed solutions

• Discussion of thermostats (for some vendors a significant number) that had NO core days in some climates – we were going to lose those anyway. We couldn’t tell if they were just not experiencing the need for heating/cooling, or not connected to a system, or the data were missing.

• Do we know if the thermostat brand is the same as the equipment brand? We don’t know for sure but have no reason to think that any of these thermostats are communicating with equipment with anything other than standard 24V relays.

• Reiteration: some thermostats are designed such that short losses of connection do not result in data loss; others are not. In the case of sophisticated equipment, the equipment itself.

• Is this the proposal or are we still exploring?
  – Both: this will be the Draft 1 proposal, but we look forward to hearing on this (and other) topics from stakeholders.
Discussion: Missing data updates and proposed solutions

- Note that there is a delay between shipping a thermostat and connecting it (particularly for new product launches that need to fill the supply chain), and they may not happen in the same year. Thus, for growing sales you would never expect to see 100%.
- Could address by comparing the previous year’s as well.
- Do vendors know the lag between shipment and connection?
  - Depends on the sales channel.
- Data from the field: 10% of units in an incentive program were installed after the program year, and a smaller fraction waited a year or more. (These were among users who had filled out the forms for a rebate; has nothing to say about devices in the distribution chain.)
- Sales upticks around holiday, and installations of those were be in January.
- In COVID, a lot of distributors have been piling up inventory to buffer supply chain issues.
Discussion: Missing data updates and proposed solutions

• In the HARDI data, you can see equipment sales – would be interesting to compare to thermostat sales. The most prevalent time to get a new thermostat is when purchasing HVAC equipment, so there may be some relationship.

• There is no single repository that has reliable total thermostat sales volume data, nor on smart thermostat sales volume. There are market research companies with estimates of both (more prevalent for smart thermostat sales volume) but none based on a tight relationship with vendors as the AHRI numbers are.
ENERGY STAR V2.0 specification updates

• Draft 1 expected in June 2022.
• Brief pause in work due to budget constraints, will resume work in the Fall
• Encourage vendors to explore the ideas proposed and provide feedback
• Tau friendly regression:
  – As we've discussed, EPA has started development of alternate methods to fit the linear model to data, to understand if they bring better tau results with decent fit
  – However, this work is not at a point where we can propose any updates
  – Given budget constraints, EPA has put a hold on this work
  – We welcome stakeholder effort on this, and would be pleased to coordinate
Discussion: ENERGY STAR V2.0 specification updates

- Have you given thought to allowing tau slightly below zero in the statistical analysis?
  - We did consider it, but we feel we don’t know enough about what’s going on to do so.
Topics from the floor?

• ACEEE summer study: does it make sense to have an informal session?
  – How many people will be there? A couple, not from vendors.
  – Looks like not a lot of use will be there.