



ENERGY STAR Connected Thermostats

CT Metrics Stakeholder Meeting Slides

May 26, 2021



Attendees

Abigail Daken, EPA

Abhishek Jathar, ICF for EPA

Alan Meier, LBNL

Leo Rainer, LBNL

Ethan Goldman, Resilient Edge

Craig Maloney, Intellovations

Michael Blasnik, Google/Nest

Kevin Trinh, Ecobee

Michael Sinclair, 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

 EPA Ko, Emerson

Phil Jensen, Emerson

James Jackson, Emerson

Daniel Stephan, Emerson

Mike Lubliner, Wash State U

Charles Kim, SCE

Michael Fournier, Hydro Quebec

Dan Fredman, VEIC

Robert Weber, BPA

Phillip Kelsven, BPA

Wade Ferkey, AprilAire

Kristin Heinemeier, Frontier Energy

Ulysses Grundler, Trane

John Hughes, Trane

Mike Caneja, Bosch

Sarathy Palaykar, Bosch

Mike Clapper, UL

Alex Boesenberg, NEMA

Jon Koliner, Apex Analytics

Hassan Shaban, Apex Analytics

Michael Siemann, Resideo

Arnie Meyer, Resideo

Aniruddh Roy, Goodman/Daikin

Jia Tao, Daikin

Dan Baldewicz, Energy Solutions for CA IOUs

Cassidee Kido, Energy Solutions for CA IOUs

Dave Winningham, Lennox

Dan Poplawski, Braeburn

Natasha Reid, Mysa

Mustafa Elsisy, Mysa

Peter Gifford, Mysa

Vrushali Mendon, Resource Refocus

Riana Johnson, Illume Advising

Sylvain Mayer, Sinope Technologies



Agenda

- Software updates
- Missing data updates
- Vendor anonymity stakeholder discussion updates
- Product family subset discussions
- Line Voltage Thermostat updates



Software Updates: V1.7 and 2.0

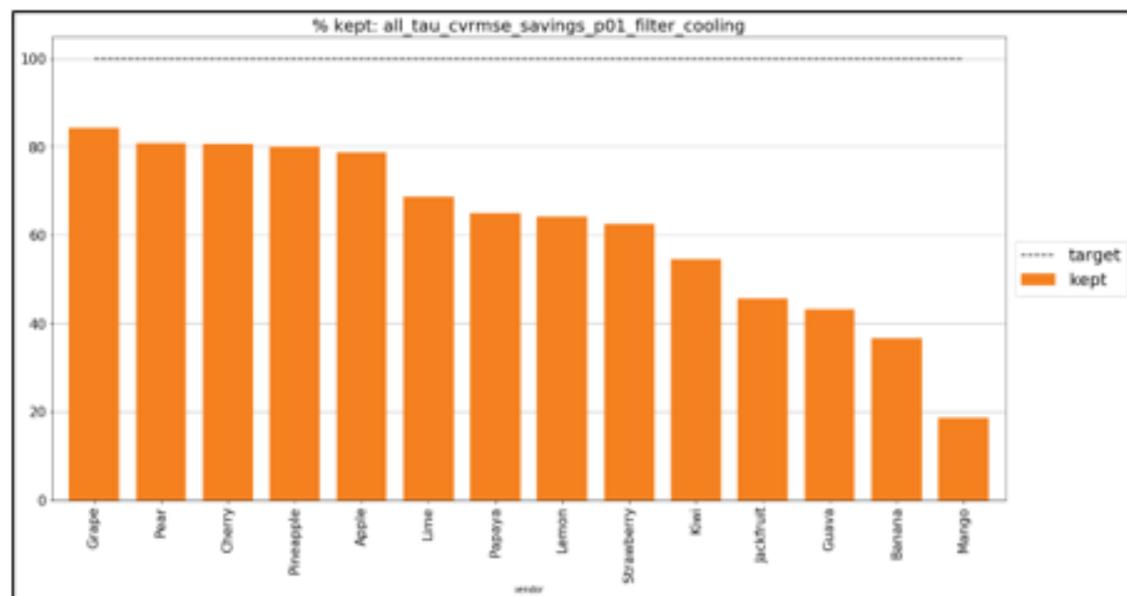
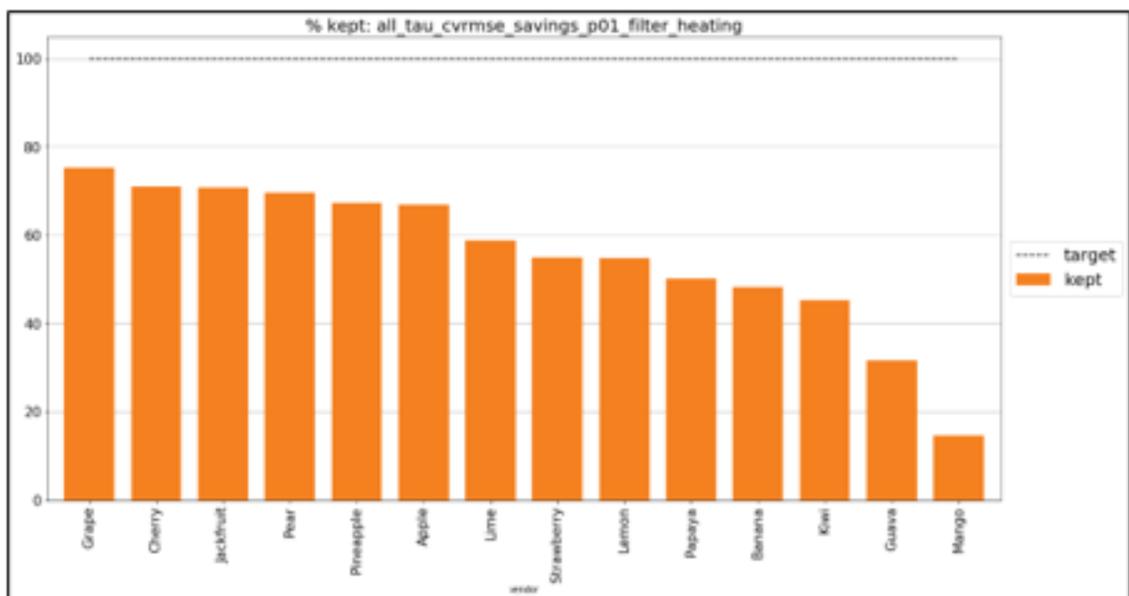
- Updated v1.7.2 to version v1.7.3
 - **Optional** update – changes are related to pinning numpy to 1.19.5
 - Current installations of v1.7.2 are fine (Don't fix it if it works)
- v2.0: Updated algorithm for missing hours:
 - If missing 2hrs or less in a given day, interpolate the missing hours
 - If missing more than 2hrs for that day, delete the day (set data for the day to None)
 - (will discuss this more in depth later in the next topic)
 - (changes are in the `feature/epathermosat_2.0` branch)
- Using GitHub actions for testing instead of TravisCI
 - Allows for more flexibility in testing
 - Allows us to test Conda installations under Windows
- Documentation updates



Missing data updates

- Current standard:
 - Thermostats with more than 5% of days (18 days) missing from indoor or outdoor temperature data are not included
 - Gaps of less than 2 hrs are interpolated; days with longer gaps are excluded.
- Concern:
 - Many statistics files show a significant portion of thermostats being excluded, perhaps due to missing data
- Proposed solution:
 - Can we expand the missing day threshold without sacrificing accuracy?
 - Should we distinguish between missing core days and shoulder days?

February Submission: Thermostats filtered



- Results for February 2021 submission only.
- 5 vendors have 50% or more thermostats discarded for heating on filtering.
- 4 vendors have 50% or more thermostats discarded for cooling on filtering.

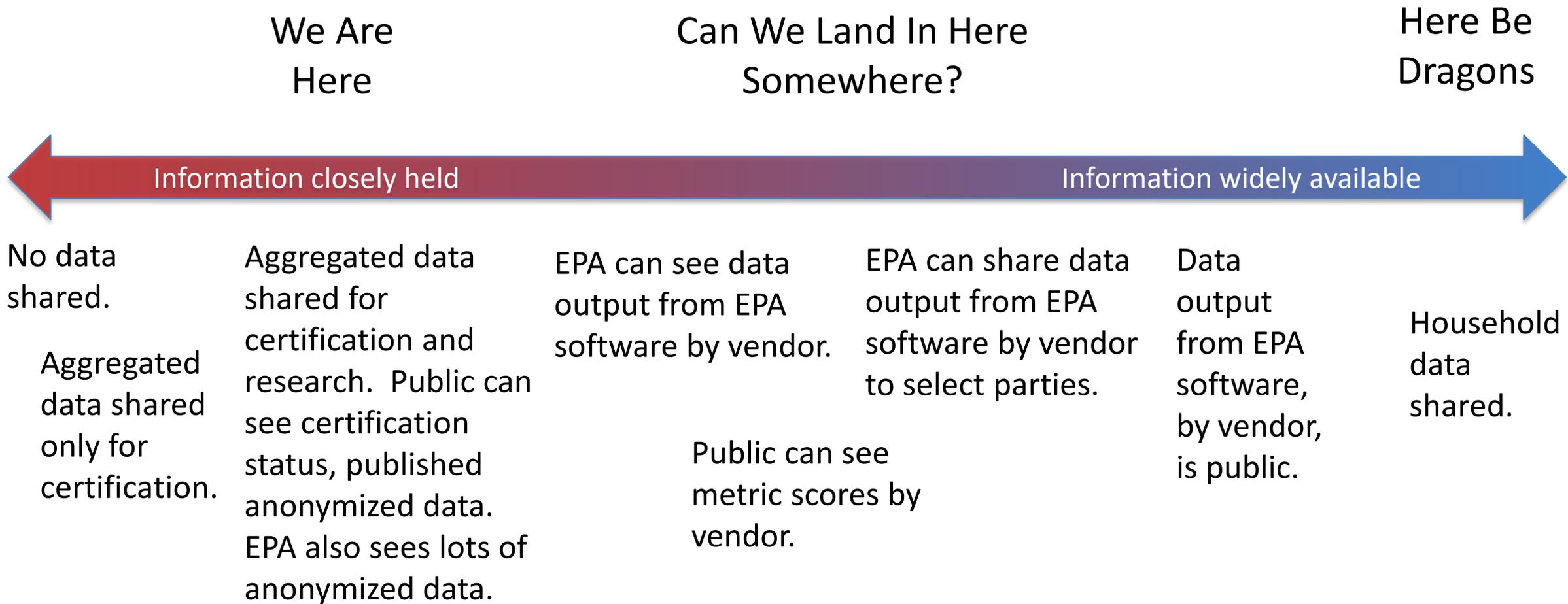


Discussion: Missing data

- Should manufacturers be excluding thermostats that don't meet a minimum threshold from the sample? Should only include products with data from the whole year but should not filter based on missing data within the year.
- One vendor. Some lost due to no matching whether data. 70-80% of those that were thrown out eliminated because tau values are slightly below zero (for both heating and cooling). Hypothesized to occur in houses with noisy data, perhaps because of having >1 tstat per home. 1/6 don't have model run, which might be because of missing data (other reasons too).
- Apex Analytics have done some poking around with this, will set up check-in meeting.
- Are we looking for score changes for individual thermostats or for the whole sample? At the moment, individual thermostats, likely to do whole groups later.
 - By the way, the "gremlin" code that puts holes in the data is on GitHub too if you want to play with it.
 - (https://github.com/EPAENERGYSTAR/epathermostat/blob/feature/epa2.0_gremlin/scripts/gremlin.py)
 - Not testing removing individual hours – currently removing 5 days at a time so it runs more quickly.



Vendor anonymity is a spectrum: WHAT can be seen by WHOM





Vendor anonymity discussion updates

- Discussion with most connected thermostat partners over the last 6 weeks.
- The more information is shared, the more progress we can make on the metric together, bringing it towards being more consistent, reliable, and representative.
- **Review:** in terms of the specific questions we discussed, **three types of information**
 - *Metrics results:* just the metrics used for certification (heating savings and cooling savings, lower confidence bound of the mean and 20th percentile)
 - *Statistics file:* Final software output submitted to ICF semi-annually; currently, content shared with EPA and LBL but anonymized by vendor
 - *Metrics file:* Intermediate software output; text file with analysis information (tau, alpha, heating savings, cooling savings, etc.) for each thermostat in the sample

Vendor anonymity discussion updates (continued)

- Question 1: Can EPA and LBL see the statistics file non-anonymized?
- This was the one our team is most interested in, to allow free discussion with individual vendors about unexpected metrics results.
- Some business risk from FOIA requests; though we would argue this information is confidential business information, there's no guarantee it would work
- Themes from Partner discussions
 - Some partners were unconcerned about this; others hesitated; most needed to have a detailed discussion with their lawyers and management, so we're waiting on answers in many cases.
 - In general, smaller vendors were more concerned, fearing the better-capitalized vendors might have the resources to do a FOIA request and back-engineer algorithms
- If you haven't gotten back to us, PLEASE DO – we'd like to make a decision shortly



Vendor anonymity discussion updates (continued)

- Question 2: Can any part of our team see metrics files?
- This would allow a better understanding of why particular thermostats were not making it into the statistics calculations, and help us make the software more useful and possibly give more consistent results
- We asked vendors, if they were not comfortable, to think about what might help
- Themes from Partner discussions
 - Removing the zip code for the thermostats from this file (as in V2.0) very helpful
 - Some vendors would need to use a different unique thermostat ID
 - A couple vendors thought it could be managed, most needed more time to think about it



Vendor anonymity discussion updates (continued)

- Question 3: Should the metric results be published on the list of certified products?
- Most ENERGY STAR product finders have efficiency metrics published
- EPA isn't sure we want to do this either: a higher metric score may not lead to higher savings; users would need to be educated on this. On the other hand, it would put pressure on us all to improve that situation.
- Themes from Partner discussions
 - All vendors felt that however we educate people about the scores, it was inevitable that they would influence purchasing
 - Most vendors cared where their score would fall in answering this; vendors with recently improved scores were interested in showing scores
 - A couple vendors were very concerned that the difference in scores might be more reflective of a difference in customer base rather than in products
- New idea: what if we included a measure of uncertainty, so that users would have a sense of whether scores were statistically distinguishable?



Product Family Subset

- Do product families represent an appropriate level of aggregation, considering both vendor effort and rating accuracy?
- Risks to current (liberal) definition:
 - Dissimilar products could be inaccurately grouped in a single family
 - Some products could receive certification that would not qualify on their own
 - More acute issue if specific metric scores are published for product families
- Risks to using more granular product families:
 - More time running model
 - Smaller sample sizes
 - Delays for new products entering the market
- Opportunities to achieve higher ratings for eco-targeted products



Product Family Subset

Have had discussions with several vendors so far

- Some do not feel there are any meaningful distinctions that would allow them to split into more granular product families, regardless of definition.
- Some possible ideas for subsets:
 - Retail / pro channels
 - Commercial market-oriented
 - Different default configurations, templates, or schedule settings
 - Remote sensors
 - De/humidification capability (if only available as a specialty model)
- Out of scope:
 - Different user types or user behavior (no way to distinguish with label)
- Request: run the metrics for two or more potential product sub-families



Discussion: Product family subsets

- Different segmenting produces a lot of possible subfamily – would be helpful if different vendors segmented in similar ways, so that we get more generalizable results
- Most vendors have 5 or fewer models – why not just submit each model separately? Avoids the problem of different vendors splitting on different feature sets. Clarified this is for the purposes of this test, not advocating for certification.
- One vendor: Retail vs. pro channel interesting – hypothesize less savings for pro channel.
- Connection to Alexa/voice assistant as a distinction? Interesting research question, but not relevant to labeling since it's a feature implemented or not after market. (Though at least one vendor can tell if commands come through Alexa or any other voice assistant)
- Knowing whether product is installed through a utility program make a difference? Depends how the marketing is done, and also whether that means a pro install.



Discussion: Product family subsets

- Also whether the utility is using the thermostat for load shifting – though again, that might not be a difference that we could address with labeling.
- 20% of utility programs do load shifting now and more likely with FERC changes in 2022. That doesn't mean that those thermostats are a significant part of any vendor's population of installations. Enrollment rates aren't necessarily that high for thermostats that already exist in the service territory, even if you get paid for load shifting.
- Again, not sure what that would do to the metric scores.



ENERGY STAR Connected Thermostats Stakeholder
Meeting
Line-Voltage Thermostat Data Analysis

Agenda

- Our Company & Product
- Line-Voltage Thermostat Data Analysis
- Investigation of Tau
- Conclusions / Recommendations



Located in Newfoundland, Canada



What we Do

We develop
IoT Technology
to **save energy**



Our Product Lineup:

Sold in Canada and the US



Electric Baseboard Heaters



Electric In-Floor Heating



Air Conditioners

ENERGY STAR Smart Thermostat Certification

Via system



This is an archived ticket

[Redacted] ⋮ Dec 14, 2018 04:50 am

Dear Mysa,

My energy company, PSE, provides \$75 dollar rebates for ENERGY STAR® certification thermostat models. It would be a great support for our budget if I plan to buy 7 Mysa Thermostats.

Does the Mysa Smart Thermostat has ENERGY STAR Certification? If not, do you plan to obtain one and make sure it qualifies the PSE rebate program (<https://www.pse.com/rebates/smart-thermostat>) in the near future?

Energy Star Certified

Via email

This is an archived ticket

[Redacted] ⋮ May 14, 2018 04:46 pm

To: Mysa Smart Thermostats <hello@getmysa.com> [Show more](#)

Hello,

Are your thermostats Energy Star Certified?

Regards,



Our customers are asking for ENERGY STAR certification!

Question about energy star

Via email



This is an archived ticket

[Redacted] ⋮ Jan 29, 2019 05:31 pm

To: Mysa Smart Thermostats <support@getmysa.com> [Show more](#)

Good afternoon,
My girlfriend and I have recently purchased a condo and it has electric baseboard heat and there is a program called Mass Save which will give us a rebate on smart thermostats but the thermostat has to be energy star certified, is the mysas thermostat Energy Star certified?

Thanks,



Sent from my iPhone

ENERGY STAR Thermostats

Via email



This is an archived ticket

Rating Good, I'm satisfied

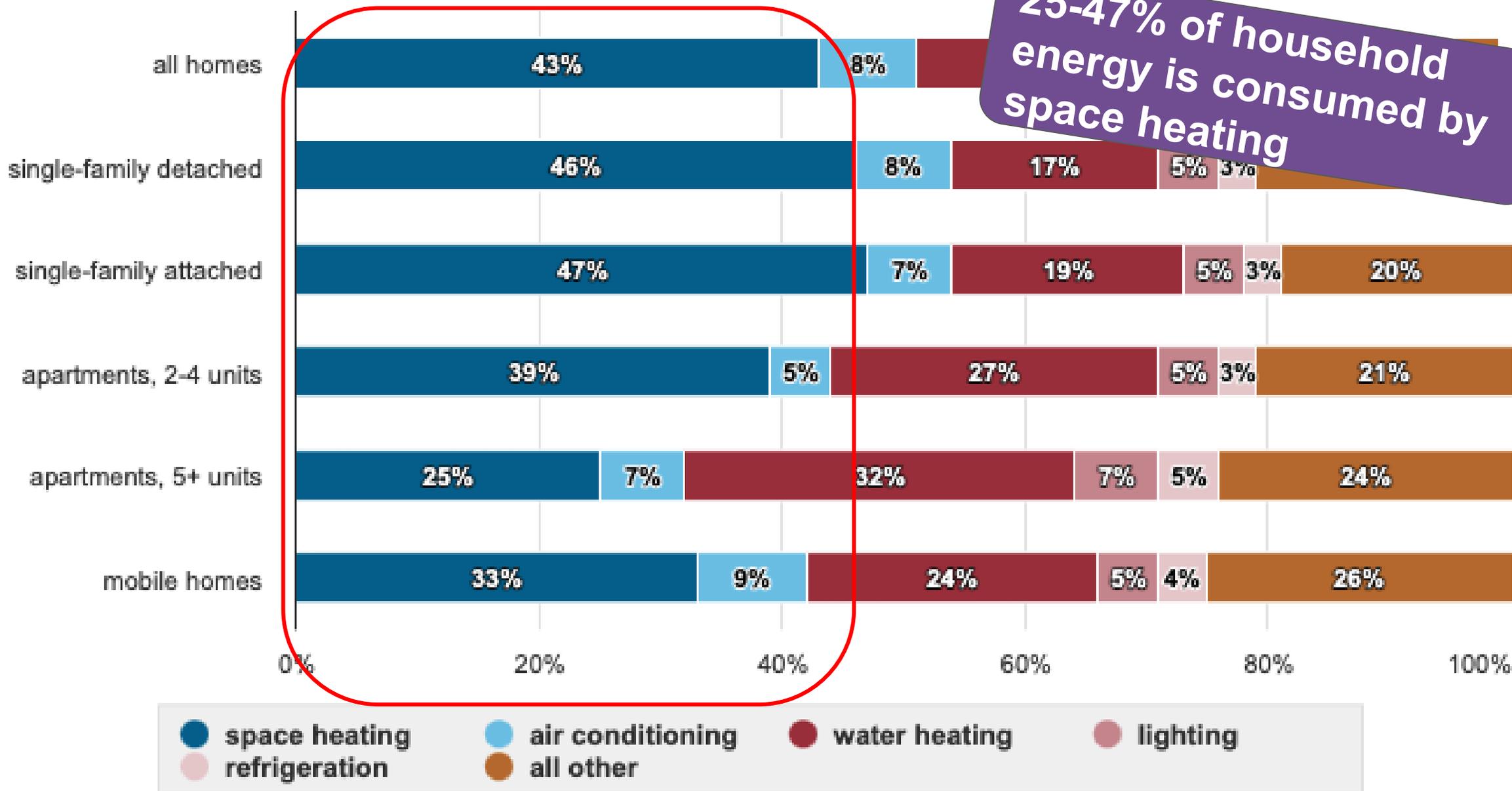
[Redacted] ⋮ Mar 09, 2018 12:14 pm

To: Mysa Smart Thermostats <hello@getmysa.com> [Show more](#)

I live in Chicago, and our local utility offers hefty rebates for "ENERGY STAR Smart Thermostats" (<https://www.comed.com/WaysToSave/ForYourHome/Pages/SmartThermostatRebates.aspx>). I don't see Mysa on the list. If it's not too hard for you to register Mysa as one of these Energy Star thermostats, it would be a nice bonus for some of your customers. I imagine other utilities have these programs too. I've already pre-ordered Mysa (and I'm excited about having them for next winter!), so this probably wouldn't come in time to help me, but it would be great for others.



End-use consumption shares by types of U.S. homes, 2015



ENERGY STAR Connected Thermostat Standard

- Does not currently include line-voltage heating
 - Thermostat that is powered by and/or switches > 30 Vac
- Mypsa Line Voltage heating that controls 120/240 Vac
 - Baseboard
 - Fan Forced
 - Radiant
 - Electric In-Floor



Analysis of 51 thermostat files

- Installed ES Field Saving Software
- Selected sample files:
 - Hot-Humid: 7
 - Marine: 14
 - Cold-Very Cold: 20
 - Hot-Dry/Mixed-Dry: 7
 - Mixed Humid: 3

Results

- Total Thermostats: 51
- Overall Compliant: 17 (33%)
- Compliant relaxing tau to -5: 21 (41%)
- Compliant ignoring tau, but not CV RMSE: 27 (53%)
- 100% of devices that passed the filters met the percentage savings requirement

data_range	n_days_insufficient_data	percent_savings_baseline	alpha	tau	mean_sq_err	root_mean_sq_err	cv_root_mean_sq_err	mean_abs_err	mean_abs_pct_err	total_core_heatin	daily_mean_core_heat	cc
365	13	33.07109125	8.34752474	-23.15719653	20905.01822	144.5856778	0.6778490566	104.5898821	0.4903400808	30502	213.3006993	
365	4	25.54976308	30.49723046	-0.8048674179	29506.81481	171.7754779	0.4147138834	126.4851765	0.3053704719	34793	414.202381	
365	20	18.17321422	4.743141156	-10.95782317	1748.552142	41.81569254	0.5242380333	32.41229913	0.4063488829	2712	79.76470588	
365	1	12.77210895	9.59808151	-16.03778426	12544.78995	112.0035265	0.362813421	90.07094231	0.2917671231	51863	308.7083333	
365	2	4.209676173	3.16984473	-57.64420784	17981.73987	134.0960099	0.7031395362	101.6082544	0.5327882679	34900	190.7103825	
365	4	2.792324932	11.92020934	-53.63081102	29450.11798	171.6103668	0.2472319826	131.3524863	0.1892341134	229756	694.1268882	
365	13	0.9170340776	0.9310155045	-328.2926169	49580.57427	222.6669582	0.7157678526	160.8032912	0.5169057295	31731	311.0882353	
365	11	12.79463247	3.941771044	0.0137982466	2517.255092	50.17225421	0.5019061663	39.00707522	0.3902135132	8197	99.96341463	
365	5	22.83930142	18.23605319	9.512223402	5329.620429	73.00424939	0.5027527874	53.45386771	0.3681166674	25702	145.2039035	
365	1	10.74363697	20.76025957	17.51874337	30496.48528	174.632429	0.6935974675	143.6668069	0.5706095598	36256	251.7777778	
365	1	18.57780664	14.54883014	14.54308975	15770.56865	125.5809247	0.6856429797	79.97333848	0.4366360434	27840	183.1578947	
365	18	12.00074192	20.87234443	1.290802731	19838.60643	140.849588	0.5201116411	109.4087334	0.4040108081	16790	270.8064516	
365	7	9.329056838	22.38917732	8.735319044	12877.13157	113.4774496	0.2232882708	89.22629507	0.1755695533	77248	508.2105263	
365	2	38.80113055	27.45707075	8.6249706	3245.495598	56.96925134	0.4075217203	46.84237107	0.3350804723	14958	139.7943925	
365	7	28.08181462	13.56926567	14.13325706	6565.374521	81.02699872	0.5842628896	58.92200718	0.4248700153	20525	138.6824324	
365	9	25.37353263	23.53810068	7.706491743	14006.68055	118.3498228	0.3531563858	94.2234011	0.2811630386	86461	335.120155	
365	2	12.57947861	10.9241365	12.69278359	3824.910527	61.84586104	0.5777987017	46.08059274	0.430510728	2890	107.037037	
365	7	21.08748461	20.33883396	10.46000697	35529.50271	188.4927126	0.9056212443	136.8602608	0.6575509362	13737	208.1363636	
365	9	17.63799004	14.69285081	10.3163864	2675.671655	51.72689489	0.2965796822	39.24884388	0.2250359251	33487	174.4114583	
365	7	7.677058699	1.957383779	-9.409627435	1429.925641	37.8143576	0.5890018953	28.78508515	0.4460769804	3291	64.52941176	
365	17	1.021839335	1.404171494	-293.4694673	73337.83047	270.8095834	0.6296952509	238.277851	0.5540514087	39996	430.0645161	
365	10	0.01436140688	0.01144963297	-30048.29036	67022.83147	258.8876812	0.7524574286	197.7016947	0.5746202683	55049	344.05625	
365	19	11.77610564	11.14582654	-25.94955304	51027.47779	225.8926245	0.8865113917	161.376184	0.4904391586	74364	329.0442478	
365	5	15.99807708	14.67307499	-26.32908289	92244.02556	303.7170156	0.7389458697	225.82262	0.5494281971	29593	411.0138889	
365	9	1.55E-05	8.4E-06	-36734077.63	77647.46093	278.6529399	0.8946914811	222.4480703	0.714230374	54504	311.4514286	
365	2	17.83564701	13.2331064	-26.71458861	46746.26655	216.2088494	0.5637803904	160.299843	0.4179935666	116200	383.4983496	
365	3	15.89926396	18.2605461	-22.11421865	59546.83233	244.0221964	0.5073966802	186.9149883	0.3886533517	137065	480.9298246	
365	23	34.73607837	7.327955401	-18.68005988	13347.55046	115.5315994	0.8516496615	88.38176392	0.6515126573	4341	135.65625	
365	4	16.79294098	7.66411945	-0.5714908905	14384.02642	119.933425	0.6523072245	98.8318395	0.5375375793	32911	183.8603352	
365	18	7.873036441	8.888614458	-39.573231	20795.9669	144.2080681	0.3058099138	110.1355249	0.2335551389	150428	471.5611285	
365	22	19.36300036	16.17714434	8.203747388	9978.29344	99.89140824	0.3901525845	79.63818203	0.3110481982	40453	256.0316456	
365	13	4.203097098	1.994593214	-24.83242957	14127.37879	118.8586505	0.8882531263	79.56094893	0.5945739863	20607	133.8116883	
365	6									0		
365	6	2.102223444	3.810701775	-85.28480453	51116.54578	226.0896853	0.527716459	168.7799066	0.3939495718	73690	428.4302326	
365	13	1.421651106	0.454565745	-261.412732	11795.78078	108.6083826	0.8028448765	83.08639653	0.614183603	27597	135.2794118	
365	2	23.81735946	3.140290198	-10.57436315	4308.701166	65.64069748	0.597214684	52.27795754	0.4756372966	17366	109.9113924	
365	13	4.203097946	1.994593634	-24.83241579	14127.37883	118.8586506	0.8882531274	79.56094872	0.5945739847	20607	133.8116883	
365	5	8.756035062	13.60797883	-2.168946815	6135.736941	78.33094498	0.2223042526	63.30917013	0.1796722579	86328	352.3591837	
365	9	17.32059724	13.91408887	0.3014552253	11285.83247	106.2347988	0.3521211935	73.8019283	0.2446206269	64262	301.6995305	
365	13	1.421651106	0.454565745	-261.412732	11795.78078	108.6083826	0.8028448765	83.08639653	0.614183603	27597	135.2794118	
365	8	22.21566545	17.78693846	8.744803789	14679.4564	121.1588065	0.3033353807	89.16753996	0.2232414653	94663	399.4219409	
365	9	19.32310918	28.51963447	10.54186624	64105.75577	253.1911447	0.5538160708	202.1372322	0.4421436137	112008	457.1755102	
365	15	9.120343173	6.32580801	1.303452676	9250.575306	96.17991114	0.5424257322	65.10263366	0.3671592468	34399	177.314433	
365	11	10.73573217	10.4845419	8.04040879	7991.200341	89.39351398	0.3717507064	71.06227204	0.2955186417	42803	240.4662921	
365	9	11.77194214	19.6161686	-1.961946732	59319.5529	243.556057	0.3842295865	182.3773915	0.2877152413	144525	633.8815789	
365	9	19.56012475	1.991560065	-32.15408853	2532.78626	50.32679829	0.4891767714	40.64438017	0.3950636111	13786	102.880697	
365	12	25.47633679	15.97240277	-13.70816355	34391.15418	185.4485216	0.4777526565	133.4745466	0.3438572528	71423	388.1684783	
365	21	11.51924643	9.64165155	3.007687661	5434.759215	73.72081941	0.3117483525	57.54208641	0.2433322198	43275	236.4754098	
365	6	13.75044201	4.85412119	2.130027387	1225.174501	35.00249279	0.2813928923	26.80398323	0.2154832346	22639	124.3901099	
365	7	6.756842131	4.587504966	-54.23687425	100542.5501	317.0844526	0.8684665248	248.5399089	0.6807290272	60608	365.1084337	
365	10	20.23046562	13.24463559	-1.906200867	10355.50381	101.7619959	0.4339352812	66.67474059	0.284315594	24389	234.5096154	

20/51 tau values are positive 39%

Positive Tau Climate Zone Distribution

- Hot-Humid: $0/7 = 0\%$
- Marine: $12/14 = 86\%$
- Cold-Very Cold: $8/20 = 40\%$
- Hot-Dry/Mixed-Dry: $0/7 = 0\%$
- Mixed Humid: $1/3 = 33\%$

Heat Source Climate Zone Distribution

Climate Zone	Primary Heating Source (Built-in electric units)
Total U.S.	7.8%
Hot-Humid	7.9%
Marine	14.9%
Cold-Very Cold	7.8%
Hot-Dry/Mixed-Dry	6.3%
Mixed Humid	6.9%

Source: <https://www.eia.gov/consumption/residential/data/2015/hc/php/hc6.6.php>

Investigation of Tau

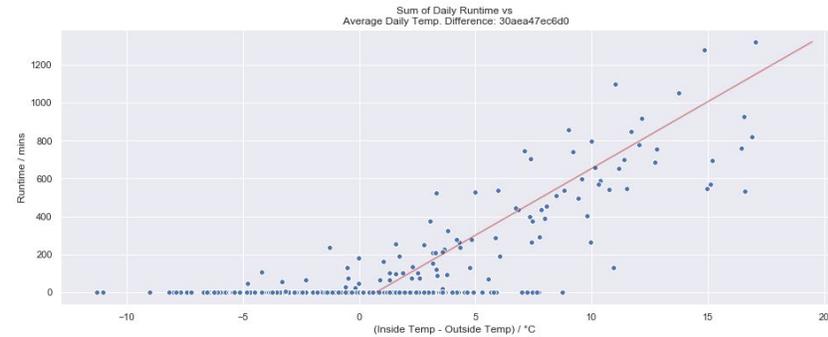
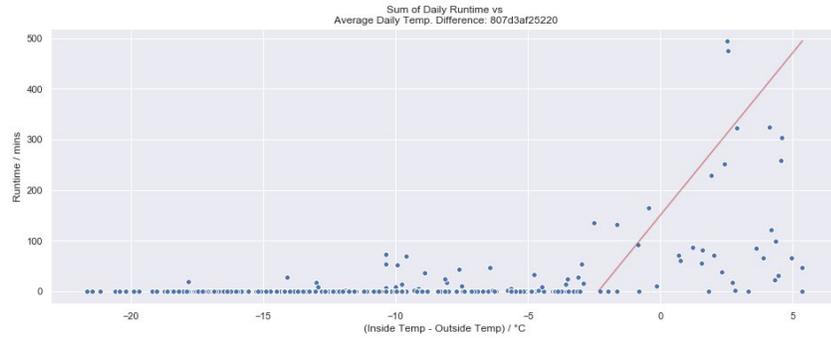
Calculate Tau Manually (Empirical Tau)

- Plot daily average runtime (y-axis) and internal - external temperature difference (x-axis) for each thermostat over a period of 1 year
- Disregarded days with runtime < 30 mins
- Draw a line of best fit
- Determine x-axis intersection

Runtime vs temp difference plots

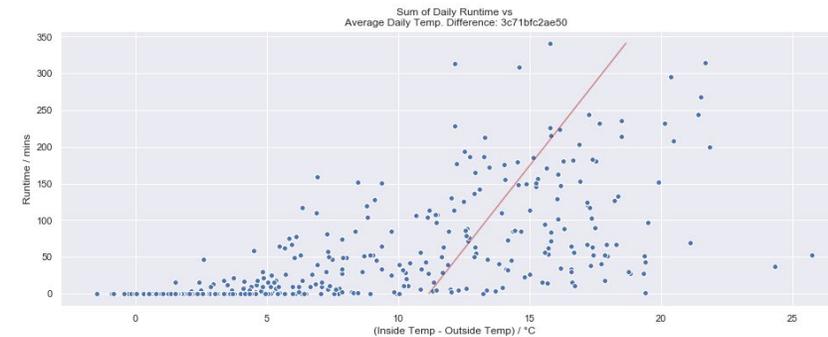
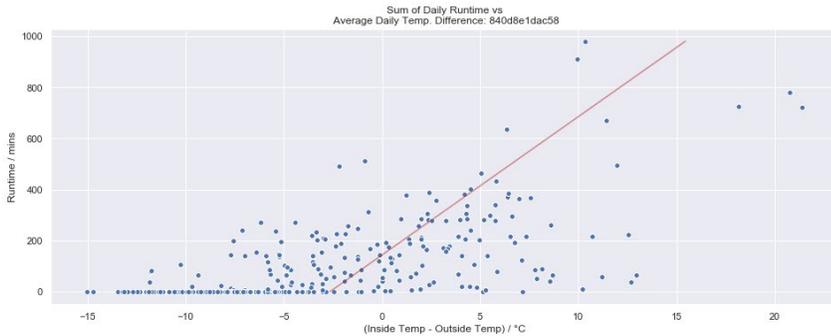
*Examples below had a negative tau generated from the CT field saving software

$R^2 = 0.14$



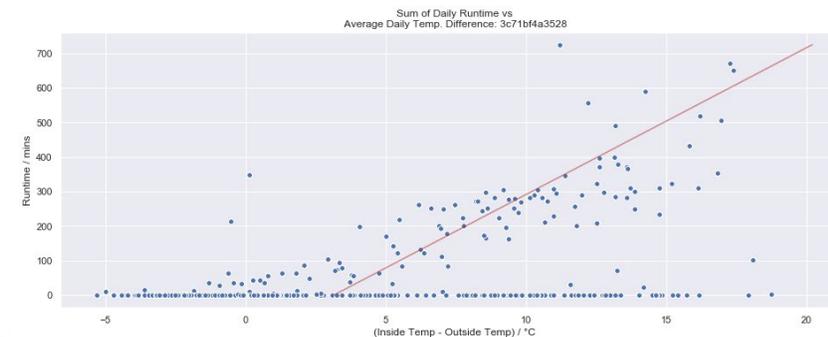
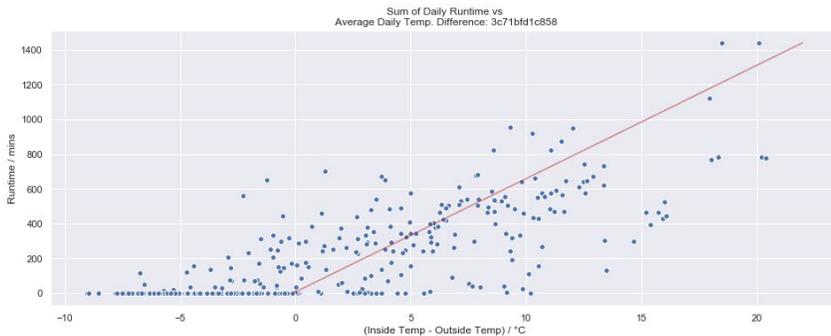
$R^2 = 0.68$

$R^2 = 0.27$



$R^2 = 0.12$

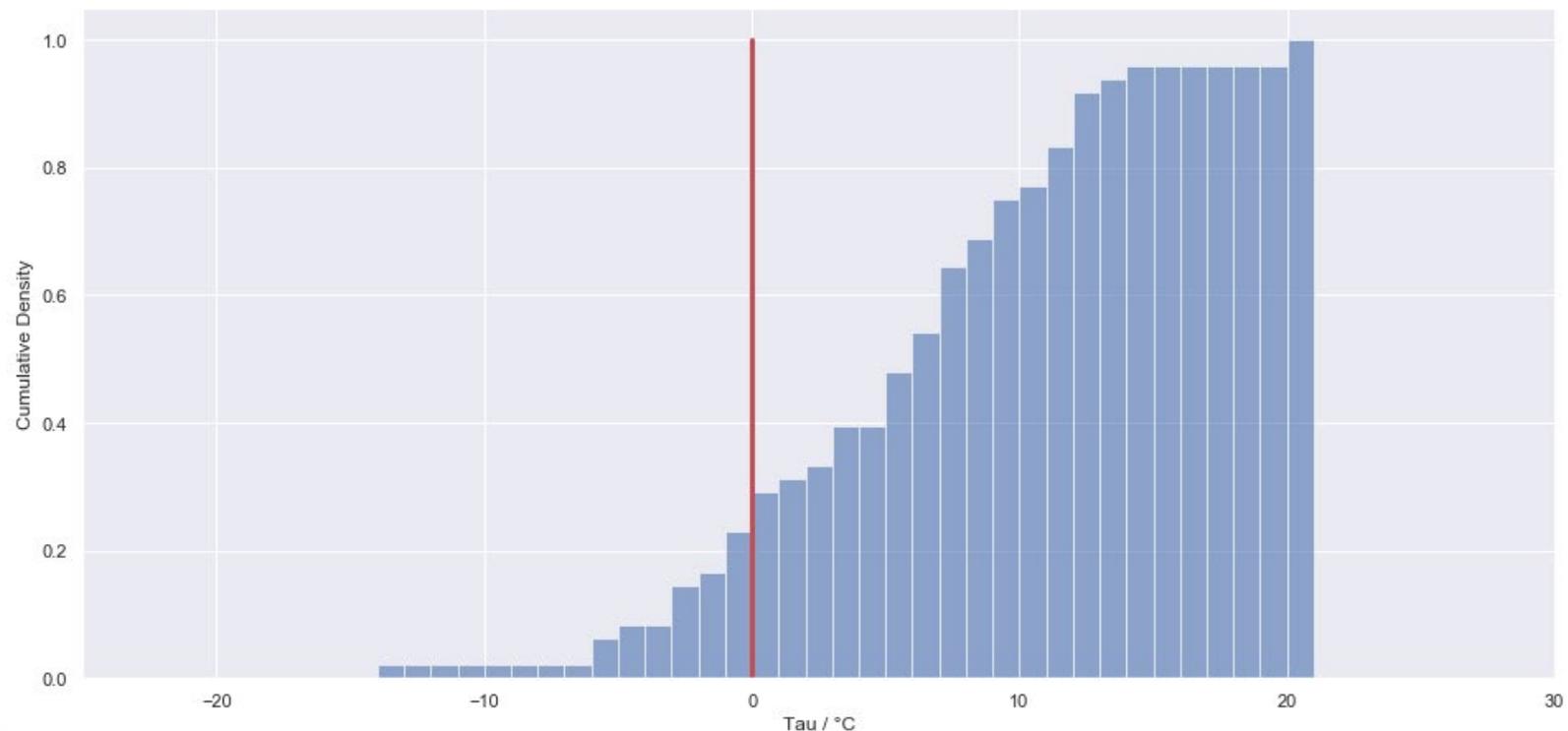
$R^2 = 0.45$



$R^2 = 0.51$

Distribution of Tau

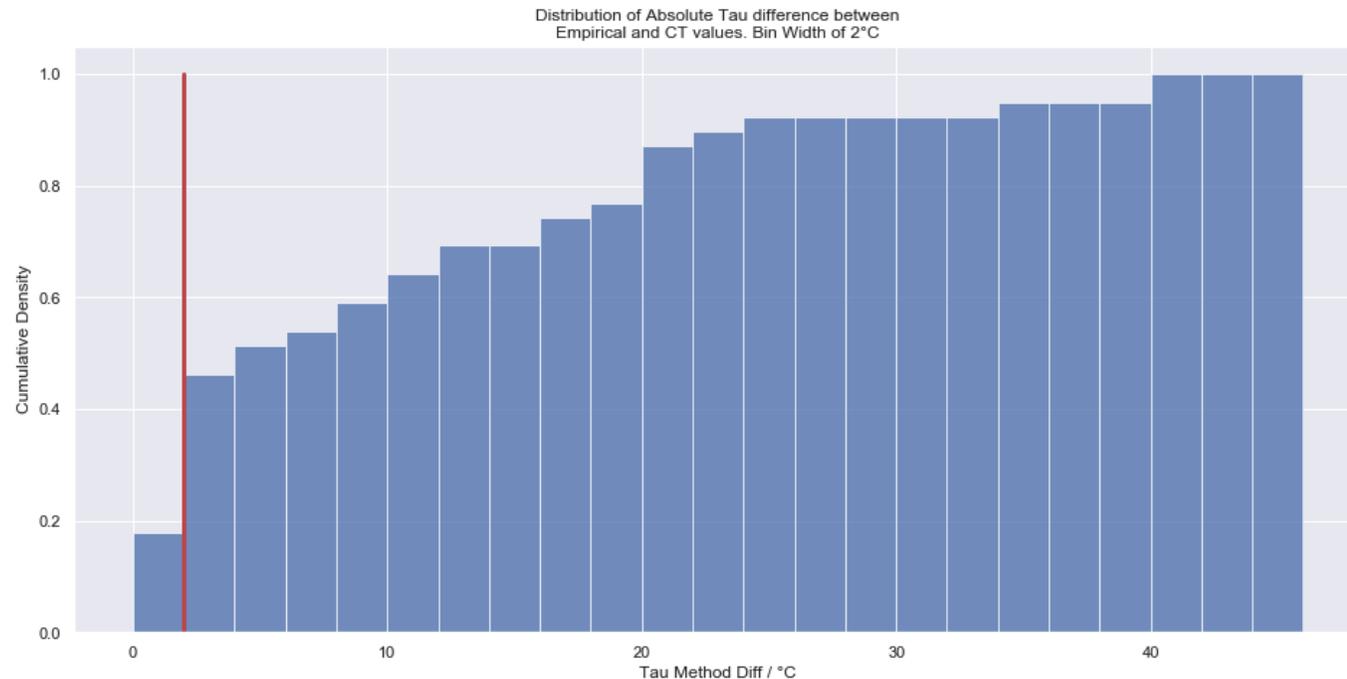
- All 51 thermostat files
- Used line of best fit & the X-axis intersection to determine tau.
- Roughly 22% of devices are < 0 tau
- Compared to CT Field savings software 61% of devices are < 0 tau



Distribution of Tau Method Comparison

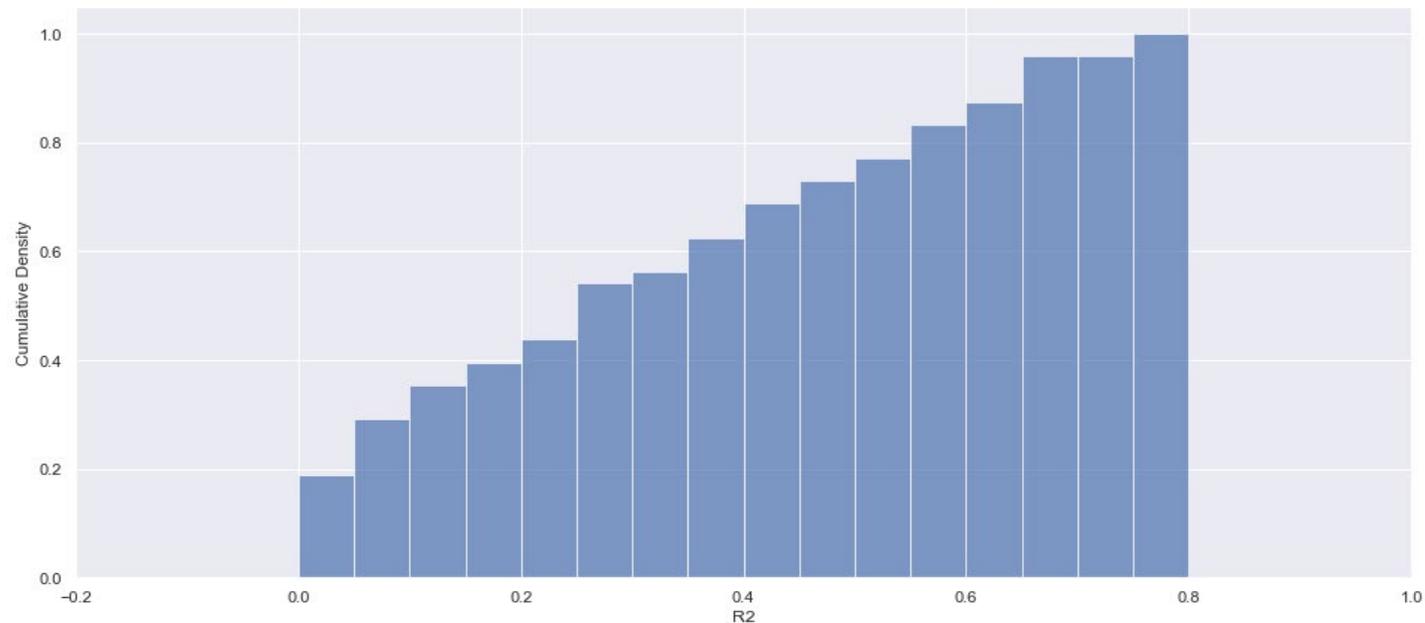
- Absolute Tau difference between Empirical and CT values
- Empirical Tau values were higher on average than the CT Field Savings Software Tau values

9 devices had a difference greater than 50°C (18.4% of observations)



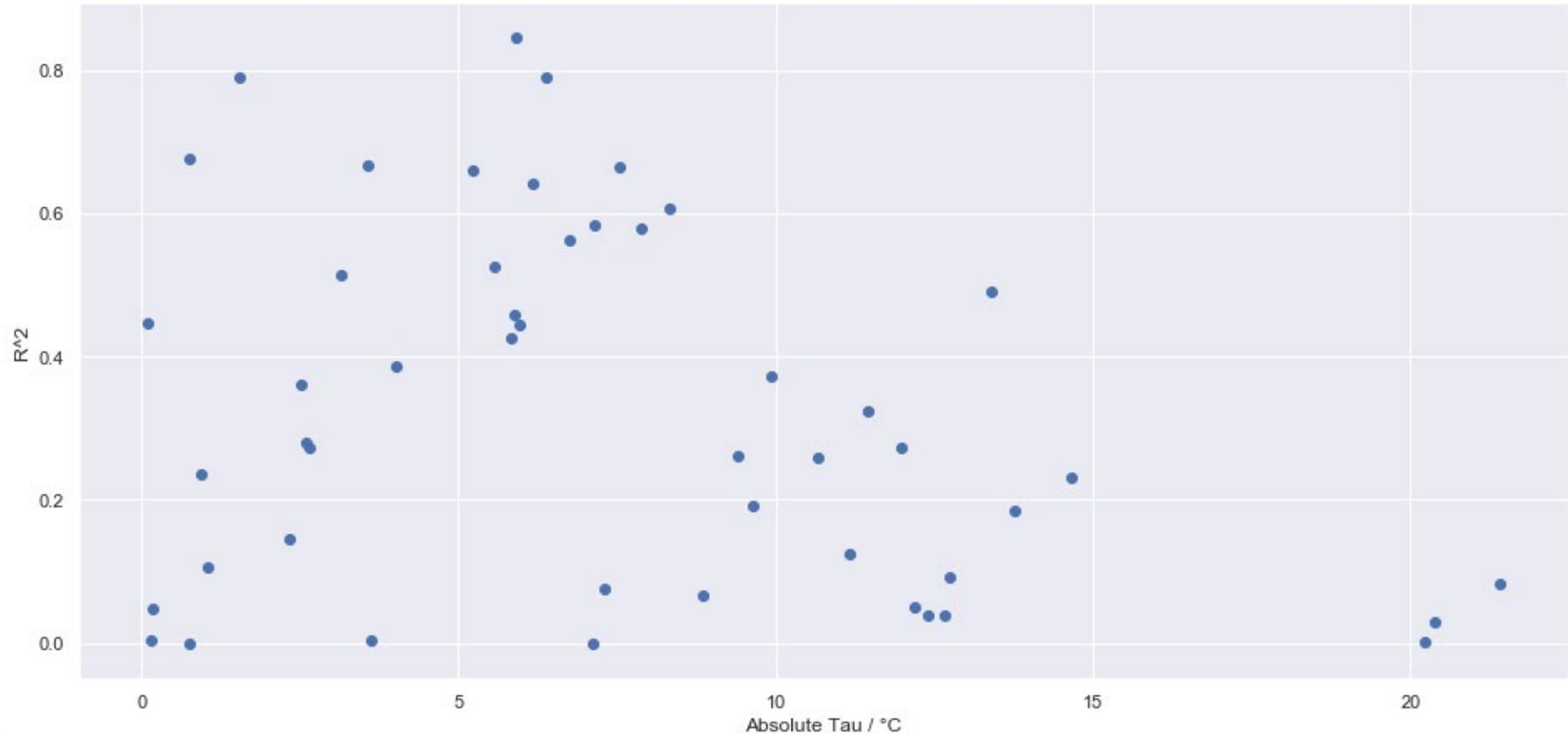
Distribution of R^2

- The sample predominantly had low R^2 values
 - Potentially due to the presence of other heating / cooling sources
- 60% of them $< .4$, and 80% $< .6$



R² and Tau

- 0.09 correlation
- The lower R² is the further Tau can stray in absolute value.



Observations / Recommendations

- There is a linear relationship between indoor/outdoor temp difference vs runtime.
- The sample had relatively low R^2 values, presumably due to the interference of other heating sources.
 - Overall, **three-quarters of U.S. homes use two or more energy sources.** (<https://www.eia.gov/energyexplained/use-of-energy/homes.php>)

Observations / Recommendations

- 100% of devices that passed the filters met the percentage savings requirement
- There is a significant deviation between the calculated empirical tau and the tau generated from EPA software optimization engine
 - Encouraging vendors to calculate empirical tau for a set of 20-50 thermostats and submit to EPA.





Discussion: Line Voltage Thermostats

- Analysis is on one thermostat vs. a whole home
- Choosing only thermostats that meet the model may bias the sample, in a different way than for other thermostats that have many installations fall out.
 - Counter-thought: the ones that fit best might be ones that carry most of the heating load. [Not everyone buys this argument.]
 - Note also that could aggregate all the Mysa-controlled baseboards, but there may well be other heating sources that are not Mysa-controlled.
- Potential change: keep tau values within a physically reasonable range when we calculate the fit. (Use a Bayesian penalty for fit results that go outside a physically meaningful tau.) Or substitute an average tau and re-fit model. Average tau per climate zone across all vendors?
- Slope has no effect on score – tau is what sets the savings, because it gives the % of the difference the 1F setback is. Savings proportional to reciprocal of $T_{in} - T_{out} - 1$.
- Are there any Python functions that do this kind of thing? Any Bayesian model with a prior on tau?



Discussion: Line Voltage Thermostats

- For Mysa: any additional information about these thermostats, e.g. whether there were multiple thermostats, whether it was multifamily, heating type? All baseboard, none in the sample share a home. Otherwise, no. Could look into it.
 - Average 2.5 Mysa tstats per home, can check whether there were additional thermostats
 - Are the ones that fit the model best the ones that have no additional Mysa in the home? Will check.
 - Do not have information about other, non-Mysa heat sources.
- Do you have any formal or informal ways of examining the data to guess whether there are additional heat sources? R^2 value is indicative.
 - Other reasons for poor R^2 – insolation, leaky envelope plus wind, etc.
 - Heating times anomalous for that home could indicate this.
 - Any such model could potentially be applied to other thermostats.