11/20/2009

Ms. Chang,

The following comments on the Energy Star Program Requirements for Programmable Thermostats - Tier 1, Draft 1 Version 2.0 are offered on behalf of the Ingersoll Rand, residential Solutions [formerly known as Trane Residential Systems]. --- Some overall comments are perhaps appropriate to encourage a rethinking of the overall approach to the Energy Star program for setback thermostats, followed by line by line comments.

Overall Comments

Since the thermostats are not significant energy consumers in themselves, they merit a somewhat different perspective than other Energy Star products.

When setback thermostats properly programmed **and used**, they will lead to significant energy conservation. EPA should be encouraging the use of programmable setback thermostats on the widest possible range of installed systems. There are roughly 100 million residential thermostats in the US, and several million commercial ones. Most of these thermostats control simple heat/cool systems which are replaced at a rate of less than 10%/year. A reasonable specification can lead to a moderately-priced thermostat which stands a good chance of being a market success and conserving energy on a goodly percentage of those millions of installations.

The stated intent "to target leadership models with the capability of controlling the latest and most efficient multi-stage HVAC equipment" will cause the thermostat program to forego the vast majority of the energy savings potential. The installed base of some 85 million residential central air conditioners and 100 million furnaces is predominantly single-stage. Multi-stage installations represent a modest percentage of current sales and a miniscule percentage of the installed base. If the thermostat carries the complexity and cost needed to support multi-stage systems, communications and HAN interface, the market penetration, and consequent conservation attainment, will be severely limited.

Trane endorses the concept of a phased approach to application of new tiers. Three modifications of EPA's planned implementation of the phased approach are recommended. First, keep Tier 1 relatively simple so that the benefit of a more user-friendly PT can be captured by the mass market to have the maximum benefit. Second, target Tier 1 to the mass market of the installed base of single-stage systems to capture the maximum potential energy savings. Third, retain Tier 1 when Tier 2 is introduced, with Tier 2 incorporating more features (e.g., duplex communication). If the two tiers are specified and designed carefully, they should be able to be retained in perpetuity.

Line-by-Line Comments

	Partner Commitments
Line	**Comment**
11-13	(1) The issue is not the "most energy savings", but delivery of some measurable reduction in energy consumption, with the percent reduction to be defined. (2)

	Communication is perhaps premature and is not a true energy saving feature, per se. (3) Ease of use is perhaps the determinant as to whether the potential savings will be realized. (4) "Reduced toxic substances" is relevant and un-measurable. Furthermore, it is not clear that this worthy goal is a consumer demand.
16	If Tier 1 were to "fully realize the energy-saving potential", there would never be a justification for a higher tier, other than trying to limit the energy Star designation to some arbitrary percentage of the market [such as 25% or 35%].
17-18	The "near future" mention suggests that the Tier 1 standard will not be sufficient to earn the Energy Star designation long enough to warrant development of products to meet the standard. Furthermore this is inconsistent with the longevity of a set of standards implied in S.1462.
19	To the degree that the metrics in question facilitate quantitative estimates or measures of the realizable reductions in energy consumption, this is a worthy goal.
27-158	These programmatic requirements have not been reviewed in depth.
	Eligibility Criteria
182-188	It's a small point, but low voltage thermostats also "the control line-voltage load … indirectly".
203	The HAN would seem to be intended to affect communication within "a single dwelling unit" as contrasted to a "single local area". The latter could be anything from a metropolitan area to a portion of a single room.
206-223	It is not clear which of these functions are intended to be provided by the PT and which are to be provided by other hardware.
224-231	It is assumed that these notes will be deleted from the final version of the eligibility criteria. Comments on these notes are limited accordingly.
235-236	For the intended meaning, the wording should be: " … to the premises from the outside air or ground (in the heating mode) or from the premises to the outside air or ground (in the cooling mode)." Note that this does not encompass the possibility of a water interface such as a pond, lake, or other source of water that can be used as a heat exchange medium.
240	"… the furnace is used below the thermal balance point and …". The "thermal balance point" is the temperature at which the heat pump's heating capacity just matched the thermal load of the heated space.
245-246	This is: "The setting to which the HVAC system is to control the temperature of the conditioned space." Units of measure are irrelevant in the definition as is the mention of a time interval.
245-264	Once set point has been defined as a temperature setting, it is not necessary to keep saying "setpoint temperature" over and over. It fact, it is redundant
248-250	"Comfort Setpoint: The temperature setting during the 'comfort time'." The comfort time is defined next. There is no need to do it twice.
255-	"Energy-Saving Setpoint: The setpoint for energy-saving periods (usually

256	specified for both heating and cooling seasons).”
255-264	The word “temperature” can be deleted here in 10 places.
266	“…off in an hour.”
266-269	If you are going to cite the NEMA standard 9whichis a good measure) you should use their definitions of cycle rate and duty cycle --- The word “standard” should be dropped at the end of line 269 which currently reads “standard … standard.[1]”.
271	These are “Recovery Protocols”, “Recovery Algorithms”, “Recovery Schemes” or something equivalent, not “Recover Systems”.
273-274	“… changes setpoint from the set-back or set-up setpoint to the comfort setpoint at the programmed time.
276-286	The word “temperature” can be deleted as it is redundant.
278-279	End the last sentence at the end of line 278: The goal is energy conservation. The draft, as it presently stands, in intended to facilitate multistage heating and cooling. HVAC systems are single stage.
283	This requirement will violate the minimum 8hrs setback time due to the need to start the equipment several hours early to minimize the use of auxiliary heat.
300-309	The stated intent “to target leadership models with the capability of controlling the latest and most efficient multi-stage HVAC equipment” will cause the thermostat to miss the vast majority of the energy savings potential. The installed base of some 85 million residential central air conditioners and 100 million furnaces is predominantly single-stage. Multi-stage installations represent a modest percentage of current sales and a miniscule percentage of the installed base. If the product carries the complexity and cost needed to support multi-stage systems, communications and HAN interface, the market penetration, and consequent conservation attainment will be severely limited.
309	What communications protocols are required? Many utilities have their own, proprietary communications networks. How are the devices going to be matched to the specific utility communications network providing the demand response or time-of-use rate information?
316	Driven by CA Title 24, 5-2 and 5-1-1 PTs have been in the market in order to offer a low cost solution. If 7 day programmability is required, why have 5-2 or 5-1-1 PTs? Just offer easy programming of the 7 day versions
313-320	As a default, the 5/2 schedule is reasonable, provided that the user can adjust the schedule to accommodate his lifestyle. --- The wording appears to imply, on the one hand, that the scheduling is “user selectable”. But lines 319-320 then say that the day and sleep periods *must* be at least 8 hours in duration. --- The user needs to be able to set the start and end times for each mode and the associated setpoints. One should not assume that the premises under PT control are unoccupied during the day. About 1/3 of the US population is either under 18 or over 64. These people do not typically live in a home that is unoccupied for 8+ hours per day during the week. --- --- Various occupations have schedules quite different than anticipated here: e.g., nurses, fire-fighters, police and others who do shift work.

317	A thermostat with a good user interface would not require separate, pre-programmed schedules. Almost everyone needs to adjust the programmed period times and temperatures so even multiple pre-programmed schedules will not ensure that the default settings will be used. Intuitive, easy to use designs are the key. Let the market decide what is acceptable.
323	The majority of systems sold each year (70%) are conventional single stage systems, and the percentage is significantly higher in the installed base.. Requiring the use of a premium dual fuel multi-stage PCT on a conventional single stage system will minimize the use of certified thermostats.
328	Why is a *module* specified? Isn't the goal upgradeability – not how it is achieved?
328	PCTs are a part of a utility's demand response and/or time-of-use rate system. The stats must be paired with and controlled by the utility's systems in order for them to achieve their goals. Why burden all Energy Star stats with this feature?
333-338	All five of these "minimum characteristics" are qualitative and subjective. These are at best goals, and not specifications. Effective *specific*ations need to be specific.
343	Communicating with energy management systems is a worthy goal, in general, but it overlooks two very important points. First, the PT is, itself an effective energy management system even with no communication. Second, in its eagerness to get the new PT specification in place, EPA is overlooking the fact that the utility energy management systems with which it is desired that it interface are still in the embryonic stage for the most part.

The complexity that EPA is calling for as a minimum will significantly detract from the "enhanced usability" sought. |
346-349	Trane endorses the concept of a phased approach to application of new tiers. Three modifications of EPA's planned implementation of the phased approach are recommended. First, keep Tier 1 relatively simple so that the benefit of a more user-friendly PT can be captured by the mass market to have the maximum benefit. Second, target Tier 1 to the mass market of the installed base of single-stage systems to capture the maximum potential energy savings. Third, retain Tier 1 when Tier 2 is introduced, with Tier 2 incorporating more features (e.g., duplex communication). If the two tiers are specified and designed carefully, they should be able to be retained in perpetuity.
359	The wording here leads to confusion since the night and (unoccupied) day modes should require no manual intervention. Rather than calling this an "energy saving mode", it might be better to call it an "Away" mode as you do in line 362. --- This should probably be a "toggle" with push-on/push-off with a visual indication when it is in the "away" mode.
366-367	"Away" is probably as good as any other.
368-369	This might be a bit confusing. Setpoint increase and setpoint decrease need two separate buttons.

This does not indicate how the user makes permanent changes to set the setpoints desired for each schedule period. |
| 373 | The use of Hold was one of the reasons stated for discontinuing the Energy Star certification of thermostats. Why would you want to have two options to override |

	the programmed settings?
373-377	A distinction needs to be made here on whether the user is overriding a comfort mode or a conservation mode. --- The comfort mode override is already specified in the "Away" button function of line 362. – The function under discussion here should be temporary override of a switch from a comfort mode to a conservation mode (or return of the system to a comfort mode a from conservation mode). In that case, the override should probably have a time-out on the order of 2-4 hours. --- Thus, the possible overrides are: • "<u>Away</u>" which puts the system in a conservation mode and holds it there until the next scheduled mode change to comfort mode. • "<u>Vacation</u>" [or "<u>Away -- Hold</u>"] which puts the system in a conservation mode and holds it there until manually reset to scheduled operation. • "<u>Comfort</u>" which puts the system in the comfort mode and holds it there for 2-4 hours [period pre-programmed or settable within this range]. At the end of this period, the system reverts to the scheduled mode.
379-385	EPA should define the functional requirement, not the design details of implementation.
387-388	This is an example of doing it right.
385	Let the market define acceptable font size
391	Delete all after "… memory". The rest is redundant.
393	This adds cost and contributes nothing to saving energy.
396-399	This wording has the potential to be read as minimum resolution $\geq 1^o$F, for example. The intended meaning is most likely that the minimum resolution $\leq 1^o$F. With this wording, a resolution of 0.5^oF would be acceptable, but a resolution of 1.25^oF would not. --- 1^oF is the finest resolution found on thermostats, and quite frequently the resolution is 5^oF on mechanical thermostats. Electronic thermostats tend to use 1^oF or 1^oC increments for set points and temperature display [but are not necessarily that precise]. A total temperature swing of 2^oF [i.e., +/- 1^oF] should be acceptable. Paradoxically perhaps, a total temperature swing 2^oC [i.e., +/- 1^oC] should also be acceptable.
401-408	See comments on the specific specification in the following lines. Note, however, that the lead requirement does not in any way "ensure maximum efficiency" as indicated in line 401.
409-410	The NEMA test is not performed in a room. It is performed in a test chamber with a volume of approximately 56 cu.ft. Refer to the NEMA standard figure 7-1.
415-418	The outdoor sensor would be of little use for conventional, single-stage heat/cool systems. --- Don't require this except for dual fuel systems.
420-423	Requiring a universal thermostat will raise the cost unreasonably and assure that the PT is not used for the overwhelming majority of single-stage heat/cool systems, thus defeating the objective of the Energy Star program to facilitate energy conservation.
420	Or have control algorithms that minimize the use of auxiliary heat when recovering from set back temperatures.
425-426	A conventional single-stage heat/cool system is not set up to adjust the latent/sensible split on a running basis. Evaporator modulation over a fairly wide range (typical of ECM --- not found on most systems) is required for effective humidity control. Further, effecting humidity control could result in increased temperature swing in the conditioned space. --- --- It might be reasonable to

	control a humidifier if additional cost and additional connection wires were accepted. --- Either suitable means for humidifier control should be defined or this requirement should be deleted.
428-431	A thermostat is essentially operational 100% of the time. The only major change in power consumption is likely to be associated with the display **if** the display is deactivated unless it is being used by the occupant [e.g., activates within "Z" seconds when any control button is depressed, and stays activated for 5 minutes after the last button activation]. Many users will probably want the display active at all times. This might be limited to being active in the comfort mode and when a "read" button is pushed. --- Note that this requires a "read" button for use when all the occupant wants to do is check the temperature. That will be an inconvenience, especially when in the comfort mode. Power requirements for thermostats will depend on the function set. The PCT may require up to 10 watts. A PCT with duplex communication does not have a "standby" mode for the communication receiver. The receiver must be active at all times.
440-441	These tables do not indicate the intended limits on setpoints for heating and cooling. A typical conventional thermostat may be able to be set from $50^{o}F$ to $90^{o}F$ in both heating and cooling with some restriction on the dead band between the maximum heating temperature and the minimum cooling temperature. The only time stipulation was the 8hr figure given on line 315 which was indicated to be too long for some users.
442-450	Upgradeability to a PTC requires that the hardware and software requirements for communication be known at the time of design of the PT, that there be a single, universal communication protocol, and that the power supply accommodate the needs of the features that can be added. The emerging disciplines [e.g., Smart Grid] have not matured to that stage yet, nor been universally adopted by the utilities.
450	Having a field-upgradable stat is not consistent with having the lowest costs. If the stat is to be communicating, it will be part of a HAN or utility demand response/time-of-use system. In the absence of a national standard, utilities are creating their own proprietary networks with their own, unique communications standards. Given this, it is not likely that stats would be upgraded in the field, but rather installed as part of a utility program. Likewise for a HAN, the network provider would know the needed communications protocol and select a stat that meets the needs of the system.
451	What is the standard for this communication protocol? Does it have to be a module or could it be a dedicated model that meets this requirement? If there is such a thing as a standardized protocol at this time then the appropriate descriptive documentation should be cited. It should be noted that to be effective and to be widely adopted any protocol will have to be an open protocol.
454-456	If data is to be logged it is necessary to provide a complete description of the data to be logged, the frequency of sampling, the data format, and the interrogation protocol. Without such a description, it is not clear that there is any benefit to data logging.

	It should be noted that well-designed and user-friendly PT is, in fact, an energy management system.
464-465	It is questionable whether universal models will be cost effective or whether models for heat pumps will be different than those for heat/cool systems [for example]. Requiring universal documentation is reasonable. Requiring universality in PT or PCT models is not.
463-475	Installer/servicer documentation requirements should be different from those for users and should be specified separately.
482-486	The cited Table 5-1 of DC3-2008 clearly envisions up to about 25 wires for a complex thermostat, and that is without communication provisions. This makes the ""no-new-wires" specification appear to be quite unrealistic, at least for some retrofit applications. An absolute minimum of 5 wires should be permitted.
488-492	The battery requirements have little to do with "Ease of Installation Requirements" which is the topic of this section.
491	Would consumers feel that 18 months is efficient and long lasting battery life?
494-499	Communication of the EPA intent for Tier 2 is important, but it is not a proper part of this specification.
506-508	The tests specified here are not sufficient to verify that a PT meets the functional requirements specified in this Eligibility Criteria document. For example, there is no testing of the schedule protocols setting ability, etc.
512	The verification requirements cited here (for ventilating fans) deal with verification **program** features, not with the specific tests required. As noted immediately above further elaboration is needed on the functional testing to be performed.
520-534	Tier 1 should not come into effect until 9 months after the final requirements document is published. This is the minimum lead time required to permit manufacturers to "tweak" designs to satisfy the full requirements. Tier 2 should not come into effect till three years later unless, as is suggested, EPA appreciates the wisdom of keeping a minimum function PT at Tier 1 for the vast majority of HVAC systems in the installed base, and have Tier 2 in parallel for the "Super Star" products. It would be a mistake to initiate a new Energy Star PT program that only stayed in place for some 18 months.
530	The proposed Tier 1 Specifications should be delayed until the Tier 2 specification is finalized due to the short time frame and limited number of controls that would meet the Tier 1 specifications.
536	A form of grandfathering should be implemented to preserve the new Tier 1 Energy Star PT program in parallel with the future Tier 2 Super Star PCT program, as discussed in the preceding comments.
549-554	Unless some new control concepts emerge which warrant a revision to the Eligibility Criteria, EPA should concentrate on increasing the market penetration of the PT and PCT developed to satisfy Version 2.0.

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