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Richard,

In spite of the fact that I don't represent the Oregon Department of Energy any more, I'm submitting comments on the Energy Star water heater criteria as the person most responsible there, and most knowledgeable there over the years about water heating technologies and incentive programs for same.

I'm glad to see that Energy Star will finally tackle this important area of residential energy consumption, and that a nice cross-section of technologies is being considered. So I won't quibble about intent. And while I don't think it's appropriate to be fuel-neutral in this area, I understand USDOE's position in this circumstance, and I won't quibble about that, either. Besides, given the fairly grim future for natural gas over the next several years, I think consumers will fairly quickly get the picture and program managers won't have to work very hard to move people away from that thermodynamic folly.

So, to the comments.

1. **Your analysis could use some updating when it comes to average household energy and water use.** While I guess I understand your inclination to fall back on the water heater test procedure as methodology, I'm afraid it really doesn't represent reality any more. While the average inlet water temperature of 58°F may be reasonable, the assumed setpoint on the tank is not, nor is the assumption of more than 60 gallons of daily hot water use. As you know, water heaters are shipped, by law, with a setpoint of 120°F. We know that many of these get set up somewhat (and are virtually never set lower), but 135°F is unrealistically high. As an average, I tended to use 125°F in my analyses, even though our data (somewhat dated now) showed the number was probably between 127 and 129°F. I ended up conservative in many analyses, which was okay with me. When combined with your daily water use of more than 64 gallons,

your savings estimates, in both energy and dollars, are significantly too high, across the board.

Average daily household hot water use in Oregon, a few years ago when I was running the numbers, stood at about 51 gallons – significantly less than your 64.3 gallons. The average electric water heater energy use, which then was about 3,680 kWh, bore out the hot water use numbers. This seemed quite logical to us, as most showerheads in Oregon (more than 80%) had been retrofitted to 2.5 gpm models or better, we had significant market penetration of horizontal axis clothes washers (more than 40% at the time) and of efficient dishwashers (more than 65% met tax credit criteria at the time).

At the same time, as I point out for specific cases below, the installed cost estimates for many (but not all) of the advanced technologies are woefully low. I suspect, too, that your estimates of future natural gas and electricity prices, if you take real price escalation into account at all, will be woefully optimistic. Combined with optimistic savings estimates, you end up painting an unfortunately distorted picture of the relative merits of the technologies.

My conclusion here is that you very much need to tune up your analysis to account for what has happened with regard to the end uses for hot water across the country, in large measure due to the success of other Energy Star products, and to the new federal standards for these products, including showerheads, and what has happened to system installed costs, and what is *going* to happen to energy prices. While it might be too much to expect that the test procedure for water heaters can be brought up to date in any meaningful time frame, I think Energy Star, to the best of its ability, should represent reality in the marketplace. To do otherwise will be embarrassing to the program, even in the short term.

2. **The analysis also occasionally suffers from some misconceptions or omissions with regard to individual higher efficiency technologies.**

a. In the case of tankless gas-fired water heaters, under *Issues/Concerns* on page 4, the report states that, “Increased water consumption is attributed to the time it takes for the heat exchanger to become hot since consumers will typically run their faucets until hot water is delivered at the tap.” While the behavior is always true when the consumer is trying to get hot water, the tiny amount of lower temperature water that can be attributed to the extremely short time delay in the on-demand water heating function is but a small fraction of the cold water in the line between the remote tap and the water heater. The solution for this isn’t a storage water heater – it’s an on-demand *circulator* system (such as those made by ACT under the Metlund or Taco brand names) and better designed plumbing systems. This issue, as related to on-demand water heaters, is a non-issue, and shouldn’t even be mentioned. My many conversations

with owners of on-demand water heaters (Oregon has issued hundreds of tax credits for these by now) confirm this.

b, Your description of heat pump water heaters doesn't apply to the add-on type, which to my knowledge, is the only type available at the moment, the WatterSaver having left the market for now. In the add-on models, water is pumped from the bottom of the storage tank through the refrigerant-to-water heat exchanger within the heat pump unit and back to the tank inlet. This section also suffers from a lack of discussion of where the energy for heating the water comes from – the room the unit is in, which also tends to get dehumidified, which is often a good thing. In your very limited market analysis comments, you forget to note that add-on heat pump units have a substantial market potential just due to the fact that they can be added to a significant number of existing electric tank-type water heaters.

Your minimum first-hour rating for heat pump technologies is fundamentally flawed, in part because it's based on the USDOE test procedure, the specifications for which are flawed (as described in number 1 above). Much of the benefit of heat pump water heating is found in the significant reduction in electric system diversified demand. In basic terms, this is accomplished by slowing down the rate at which electricity is used to heat water. The first hour rating in such system isn't provided by the heat pump – it's provided by the storage tank volume. If you wish to limit the Energy Star rating to units of a certain capacity, you should use the same metrics as applied to all heat pumps – Btu/hour – and you should specify a minimum and a maximum. I would recommend 6,000 Btu/hour as a minimum and 15,000 Btu/hour as a maximum. Actual first hour performance will depend most on the storage tank volume, and after that, on the inlet water temperature and the hot water setpoint temperature.

c. While I understand the policy inclinations that lead you to want to include solar thermal water heating technologies in the program, your analysis paints an overly rosy picture of these systems. Based on more than 25 years worth of data in the Oregon Department of Energy tax credit program for these systems, your installed cost estimates are woefully low. A typical system today costs $4,500 or more, installed, and provides, in the *best* cases, when properly sized, about a 45% savings here in Oregon. It long ago became clear to me that the best way to do solar water heating was to spend that money on an incremental kW of solar photovoltaic capacity and run a heat pump water heater with it. Given the installed cost of solar thermal systems, at the moment and into the foreseeable future, they are a uniformly bad investment compared to the alternatives. A more realistic analysis would show this.

d. Your discussion of gas condensing water heaters also contains omissions and misconceptions. There are a number of these products available to and installed in the residential market. Again, many tax credits have been issued for them in Oregon since 1998, and the list of products available, under the Polaris, Rheem, and Voyager brand names, is shown on the ODOE web site at

http://www.oregon.gov/ENERGY/CONS/RES/tax/appheat.shtml .

You also fail to note that a number of these products are installed as part of combined space and water heating systems, which highlights the fact that you don't address the possibility, as Oregon does, that such products might be tested under the ANSI/ASHRAE 124-1991 test procedure for combined space and water heating systems, which yields a C_{EF} rating rather than an EF rating. Oregon accepts these ratings as equivalent and so will award tax credits on that basis.

The costs listed for these products are also woefully understated. Polaris models now cost more than $1,800, just for the tank, and the Rheem/Voyager models tend to cost $2,500 or more. This wasn't the case some 4 or 5 years ago, but times have changed. ODOE has system installed cost data for these products if you care to pursue it. It's likely that installed costs for these water heaters will exceed $2,500 in the best cases. To the extent that they are part of a combined space and water heating system, you'll have to decide how much of this cost should be allocated to the domestic water heating function (in the ANSI/ASHRAE test method, the water heating efficiency is given one-quarter of the weight in computing the combined annual efficiency rating, or C_{AE}.

3. **The inclusion of "advanced non-condensing gas storage water heaters" isn't warranted.**

The savings from this technology are not particularly noteworthy. And if North American natural gas production declines at the rate expected, and prices increase at the rate expected, very few households would invest $1,100 in a non-condensing storage water heater when for a few hundred dollars more, they could double their savings with an on-demand model or a heat pump water heater. In fact, given the high level of development of on-demand technology, the time for non-condensing storage models has come and gone. In less than 10 years time, it will be difficult to convince anyone to use natural gas for heating domestic water supplies, much less successfully pedal a product this inefficient.

4. **I concur with the Department's inclination not to use storage capacity-based EF levels in the program.**

The arguments here are well made.

5. I anticipate that you will have a serious debate about the widely varying warranty period requirements for the various technologies included in the program.

While I concur that minimum warranty requirements can help transition new technologies into the marketplace by lowering consumer risk, there is little to no discussion in the proposal document about how the differing required warranty periods were chosen, and there is no justification that I can see for making them so different from one to the next. While it's true that the systems have differing lifetimes, there is no reason in particular to correlate this with warranty periods. Why should a heat pump water heater have a shorter required warranty period (6 years) than an on-demand gas-fired unit (10 years)? They cost about the same to replace or repair, and are probably subject to similar potential for component failures.

I suggest you make an effort to reduce some of the warranty period disparity, perhaps by compromising them toward some middle ground.

Thanks for the opportunity to comment. Hope the program does well. We surely need the technologies and the savings.

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