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Lavatory Faucets: CA IOUs Response to CEC's Request for Information on Consumer Satisfaction and the Impacts of Hot Water Delivery Time on Savings

Summary: The CEC has cited the possibility that consumers may be dissatisfied with longer wait time for hot water to arrive at the faucet and "waiting a long time to get hot water delivered may actually cause water waste that would negate the savings" as the primary reasons for proposing the higher flow rate of 1.5 gpm at 60 psi. The CA IOUs acknowledge that there is some additional waiting time for hot water due to the ½ gallon per minute difference between 1.5 gpm and 1.0 gpm faucets, however, 1) there are studies that support consumer satisfaction with 1.0 gpm faucets and 2) any additional wait times will not definitively negate all the water savings. Even when assuming no water is saved during hot water draws, there will still be estimated savings from higher efficiency fixtures of 7.5 billion gallons from cold water savings (see Table 1 for a few scenarios).

1 Consumer Satisfaction

Consumers are satisfied with the performance of 1.0 gpm low-flow faucets. The WaterSense (2007) specification indicated that even "these [1.0 gpm] products have shown a high level of satisfaction," and also cites survey results from the Seattle Public Utilities regarding a pilot program that distributed free aerators in which only 2 percent of participants were dissatisfied with the 1.0 gpm aerators. Moreover, two residential indoor water conservation studies conducted by Aquacraft (2000, 2004) surveyed consumer satisfaction among participating single family households in three study areas using the following flow rates: 1.0 gpm and 1.5 gpm aerators in 37 households in Seattle, WA (2000), and 1.0 gpm (lavatory) and 1.5 gpm (kitchen) aerators in 26 households in Tampa Bay, FL (2004). Survey findings reveal that participants were satisfied overall with the low-flow faucet aerators that were installed as part of each study, averaging at least 4 out of 5 on level of satisfaction (5 being most satisfied). The level of satisfaction among participants increased between the studies, from 22 percent "liking the new aerators more than their old faucet fixtures" in 2000, to 40 percent in 2003, and to 60 percent in 2004. This suggests that the performance of low-flow faucet aerators has increased over time, leading to the assumption that technological innovation and/or behavioral shifts have influenced consumer perception of the performance of low-flow faucets and aerators. While the 2000 study does indicate some issues with longer wait times for hot water, this is not a universal issue, and no such issues were reported in the 2004 study.

2 Impacts of Hot Water Delivery Time on Savings

Regarding wait times resulting in wasted water, there is evidence to suggest longer wait times does not negate all water savings. First, not all water used in lavatory faucets is hot water. Between 30% (WaterSense 2007) and 50% (EBMUD 2003) of faucet water use is estimated to be cold water. These values do not distinguish between lavatory and kitchen faucets, but the estimates are used in the absence of additional information for lavatory faucets in isolation. Even when using the highest estimates for hot water use, the 1.0 gpm standard would result in an additional 4.2 billion gallons of water saved annually from cold water alone— more water used annually by the City of Beverly Hills (Census 2012; Mercury News 2014).

To further address the concern about potential wasted water, there are two considerations that suggest most consumers will realize a net water savings with 1.0 gpm fixtures. The first consideration is that only one-quarter of respondents reported waiting for hot water to arrive in order to perform typical tasks such as hand and face washing and brushing teeth (Hoeschele and Weitzel 2012). It is unclear that these results speak to the speed at which the consumers receive hot water, or whether waiting for hot water is a choice the consumers are making. Even if it is the former, given the variety of building conditions of the respondents and the variables determining hot water draw discussed below, it is unclear that the contribution of faucet flow to the wait times and that replacing their existing faucets with 1.0 gpm faucets rather than 1.5 gpm would result in additional claims regarding longer waiting times.

The second consideration is that in the scenarios where consumers choose to wait for hot water for their tasks, there are a number of variables that determine the time it takes for hot water to reach residential lavatory faucets (CEC 2005, Wilson 2009, Hoeschele & Weitzel 2012).[1] In terms of comparing specific flow rates of 1.5 gpm and 1.0 gpm, the half-gallon per minute difference will result in a longer wait time; however a third less water is flowing per minute. As Klein (2005) describes, flow rates of 1.0 gpm may result in water waste of ten gallons per day (if the wait time is one minute for each of 10 faucet draw events over a period of a day). Incidentally, assuming the same building conditions, 2.0 gpm faucets will roughly waste the same amount of cold water if the average wait time is 30 seconds (at 10 faucet draw events).

There will be temperature losses in the pipes due to the inverse relationship between flow rate and temperature drop. As flow rate decreases temperature drop increases. A 2005 Public Interest Energy Research (PIER) Program study evaluated how flow rates impact temperature drop. Researchers measured temperature drop when 135°F water moves through 100 feet of pipe. They concluded that reducing flow rate from 2.0 gpm to 1.0 gpm can increase temperature losses by 0.5 - 3.4°F. The magnitude of the temperature loss depends on the factors cited above (see footnote), and the amount of additional wasted water from the installation of a 1.0 gpm depends significantly on consumer preferences and behavior. In some cases with a 1.0 gpm faucet, consumers may compensate for the temperature losses by adding slightly less cold water at the tap. In some cases, consumers may desire to wait for the water to meet their desired

[1] E.g., design of the hot water distribution system, which includes the distance between the water heater and tap (i.e. pipe length), pipe size (e.g., ½ inch, ¾ inch, 1 inch), the flow rate of the faucet (e.g., 2.0 gallons per minute (gpm), 1.5 gpm, 1.0 gpm, 0.5 gpm), type of water heater (e.g., storage, tankless), inlet and outlet water temperatures, ambient air temperature and climate, type of piping material (e.g., copper, PEX), how much time has passed between hot water draws, and whether the pipes and/or water heater are insulated

temperature, in which case water may not be saved when compared to the faster flow rate of 1.5 gpm.

Uncertainty exists on the exact percentage of consumers that will experience the extreme impacts on wasted water and energy associated with the building's hot water distribution system. The CA IOUs developed four scenarios to help quantify the implications, shown in Table 1 below. The conclusion is that even if in the lowest savings scenario where the highest hot water use is assumed (70% of all draws use hot water), and there is no water savings associated with any hot water draw events at 1.0 gpm, the savings from cold water is still significant and justify a standard at this level. For the lowest savings scenario the resulting savings per faucet would be approximately 200 gallons per year, resulting in over $15 savings over the life of the product. Given the incremental cost for 1.0 gpm aerators of $0.50, the measure is still cost-effective.

Table 1: Scenarios for Water Savings from Lavatory Faucets

	Assumption	Additional Savings from 1.0 GPM vs. 1.5 GPM (Million Gallons Per Year)
Scenario A – High Estimated		
% Cold Water Draws	50%	6,874
% Hot Water Draws	50%	
% all scenarios where more water is wasted from waiting for hot water, negating savings	0%	6,874
	Total	**13,748**
Scenario B – Medium-High Estimate		
% Cold Water Draws	50%	6,874
% Hot Water Draws	50%	
% all scenarios where more water is wasted from waiting for hot water, negating savings	25%	5,155
	Total	**12,029**
Scenario C – Medium-Low Estimate		
% Cold Water Draws	30%	4,124
% Hot Water Draws	70%	
% all scenarios where more water is wasted from waiting for hot water, negating savings	50%	4,812
	Total	**8,936**
Scenario D – Low Estimate		
% Cold Water Draws	30%	4,124
% Hot Water Draws	70%	
% all scenarios where more water is wasted from waiting for hot water, negating savings	100%	-
	Total	**4,124**