Researchers find that some 'green' hot water systems fail to deliver on promises

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Two researchers affiliated with the Virginia Tech College of Engineering have published a paper which reports that hot water recirculating systems touted as "green," actually use both more energy and water than their standard counterparts.

Marc Edwards, the Charles P. Lunsford Professor of Civil and Environmental Engineering in the Virginia Tech College of Engineering, originated the efficiency study of the systems as part of an undergraduate design class six years ago. After a thorough analysis, the class concluded the claims as false, and that it "was thermodynamically impossible for these systems to save energy as claimed," said Edwards.

The topic was selected as part of a dissertation by Randi Brazeau during her doctorate in Virginia Tech's Charles E. Via Jr. Department of Civil and Environmental Engineering. The results are presented in a paper published in the most recent issue of *Journal of Green Building*.

Brazeau, now an assistant professor of environmental science at Metropolitan State University of Denver, examined the energy and water savings of continuous hot water recirculating systems in a comparative, direct test versus traditional hot water systems in which consumers often wait for the cold water to flush down the drain before the water warms to a comfortable temperature for showering.

She found that the recirculation systems used 20 percent more energy even in the best possible scenario in which the water pump was only on

for a few seconds before use, and in scenarios where the pump was always on, the recirculation systems could require more than double the energy to operate. The consumer pays for this extra energy in higher electric and fuel bills.

"Randi demonstrated that when all energy costs are accounted for, including that necessary to run the pump, the hot water recirculating systems always used much more energy than the conventional systems," said Edwards.

A previous U.S. Department of Energy report and certain manufacturers claimed the recirculation devices would not only eliminate wait times, but also would save both water and energy. It also was assumed that because consumers did not need to wait for water to warm, the hot water recirculation systems would at minimum save water from being wasted. But that claim did not consider that it takes water to make energy, said Edwards.

The research found that the "so-called green" hot water recirculation systems used more net water than the conventional systems after accounting for water needed to produce the extra energy. "These are really consumer comfort and convenience devices, a luxury really, masquerading as 'green' or environmentally conscious devices," Edwards said.

Other findings: On-demand electric systems operate with nearly 100 percent energy efficiency, but cannot be used in many circumstances dependent on scaling and incoming water temperature, and may require expensive upgrades to home electrical systems and use of low or ultra-low flow showerheads.

In many cases, hot water recirculating systems touted as "green" are not just a consumer choice, but required in some new homes and businesses

in the United States, said Brazeau. But their energy savings, and therefore lessened environmental impact claimed by manufacturers "do not hold water," she added.

Brazeau and Edwards calculated that a typical consumer with an electric water heater would pay as much as $158 more annually compared to systems without recirculation. More research, though, is necessary to better inform policy and decision-making by regulators, public health officials, manufacturers, and consumers, Edwards and Brazeau said.

Provided by Virginia Tech