Assessment of a Hybrid Retrofit Gas Water Heater

According to 2009 data from the U.S. Department of Energy’s (DOE’s) Energy Information Administration, residential water heaters consumed 1.8 quadrillion Btu annually—less than 18% of the total energy consumed in residential buildings. DOE’s Building Technologies Office estimates that the April 2015 adoption of higher minimum residential water heater efficiency standards will save approximately 3.3 quads of energy—equal to approximately $63 billion in energy costs—from 2015–2044. The new standard is also expected to avoid approximately 172.5 million metric tons of carbon dioxide emissions, which is equivalent to the annual greenhouse gas emissions from approximately 33.8 million automobiles.

Efficient gas water-heating options include condensing storage units and tankless units. The market share of tankless units is rising rapidly in new construction; however, tankless retrofits are often hindered by significant costs. These include upsizing gas lines (from the typical ½-in. line that is common to storage water heaters), exchanging the standard Category I/B vent to PVC or stainless vent pipe, and adding electrical service. DOE’s 2014 Research & Development Roadmap for Emerging Water Heating Technologies identifies the inability to retrofit affordable, efficient water heaters as a key barrier in the marketplace, and it emphasizes that many water heaters are replaced in emergency situations when delays represent a significant inconvenience for the household.

In this project, the DOE Building America Alliance for Residential Building Innovation (ARBI) team completed a modeling evaluation of a hybrid water heater that combines a reduced-capacity tankless unit with a smaller storage tank and is compatible with the commonly available ½-in. gas lines and standard B vents in most homes. This product could meet a significant market need by providing a higher efficiency gas water heater for retrofit applications without incurring significant installation costs.
Lessons Learned

The performance assessment yielded the following observations:

• The hybrid water heater evaluated in this project is likely best suited for warmer climates and smaller homes in which peak hot water loads would be lower and the impact of reduced standby losses is more significant.

• Water heater performance under low loads is becoming increasingly important as residential hot water loads continue to drop due to lower fixture flow rates, more efficient appliances, energy input from solar or drain reheat systems, and lower loss distribution systems. Reducing water heater storage volume is important to minimizing standby losses and maximizing efficiency in low-load applications.

Looking Ahead

In recent years, the water-heating industry has started to develop a range of new efficient gas and electric product offerings. The greatest market success has been in the area of electric heat pump water heaters. The gas water-heating market is more challenging because gas prices are generally low and efficiency gains relative to standard product offerings are smaller. These factors require lower incremental first costs to deliver cost-effective solutions to the market-place. Utility incentives could play a significant role in developing a viable market for higher performance retrofit gas water heaters.