



## BUILDING AMERICA TOP INNOVATIONS HALL OF FAME PROFILE

### INNOVATIONS CATEGORY:

1. Advanced Technologies and Practices
- 1.2 Energy Efficient Components

## Tankless Gas Water Heater Performance

Incorporating tankless water heaters was one of many energy-efficiency recommendations Building America's research team IBACOS had for San Antonio builder Imagine Homes.

Although tankless gas water heaters should save approximately 33% on hot water heating compared to a conventional storage water heater, actual energy savings vary significantly based on individual draw volume. Above 10 gallons per draw, the efficiency approaches the rated energy factor. The greatest savings occur at a daily use quantity of about 50 gallons.



### **BUILDING AMERICA TOP INNOVATIONS**

**Recognizing Top Innovations in Building Science** – The U.S. Department of Energy's Building America program was started in 1995 to provide research and development to the residential new construction and remodeling industry. As a national center for world-class research, Building America funds integrated research in market-ready technology solutions through collaborative partnerships between building and remodeling industry leaders, nationally recognized building scientists, and the national laboratories. Building America Top Innovation Awards recognize those projects that have had a profound or transforming impact on the new and retrofit housing industries on the road to high-performance homes.

*As improved thermal enclosures dramatically reduce heating and cooling loads, the water heating load continues to grow in importance. Building America research has provided critical insight regarding one of the most significant innovations available to address this load.*

Building America teams have worked with many builders to use tankless gas water heaters as a way to meet performance goals. The energy factor for a typical tankless water heater of 0.8 suggests a 33% reduction in gas use relative to a typical 0.6 energy factor (EF) storage water heater. Tankless water heaters can deliver large quantities of hot water under changing load conditions and at a relatively constant temperature, like storage water heaters, but without suffering the standby loss (tank heat loss) of the storage water heaters (NREL 2006).

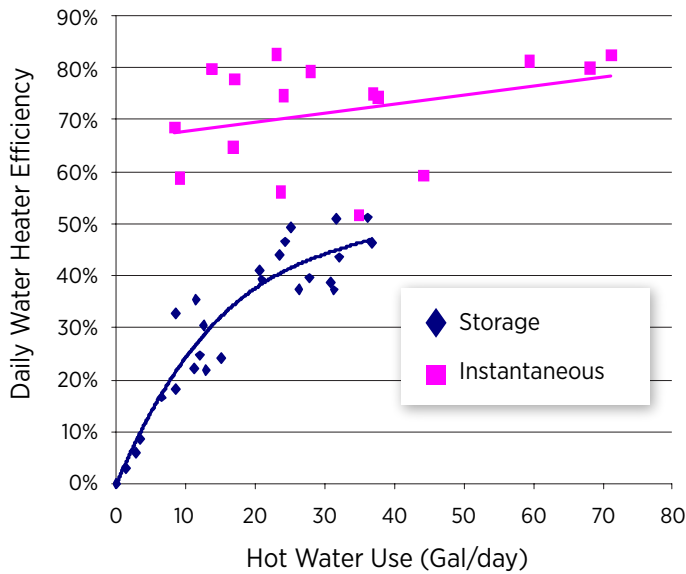
With data about standby loss understood, Building America researchers focused on a new research question: Does real-world water use impact the efficiency of the water heater? In other words, related to water use (not standby loss), is the tankless or tank water heater more efficient? And, at what daily use quantity is a tankless water heater most efficient?

Tests were completed by Davis Energy Group, a Building America research partner on the CARB team, to compare the real-use efficiency of a storage type gas water heater (0.60 EF) and a tankless water heater (0.82 EF). The test site was an existing home occupied by two people. The existing storage water heater was monitored for about two weeks to measure hot water supplied and gas consumed. The existing water heater was replaced by a tankless water heater and again monitored.

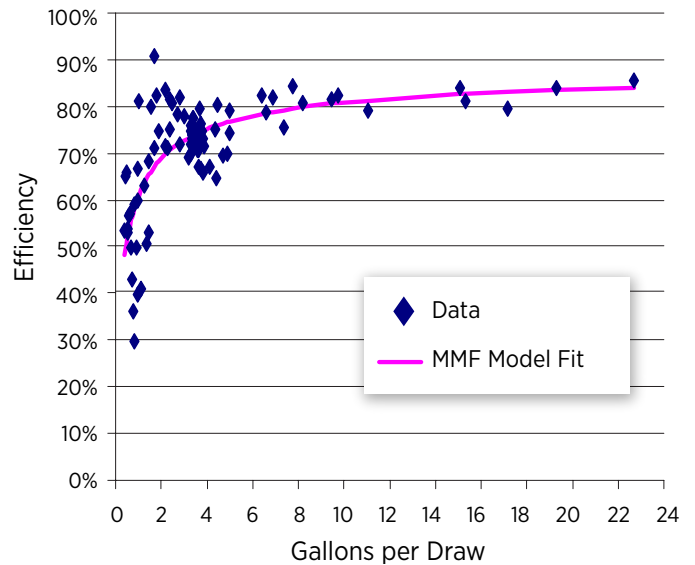
Results showed that tankless water heater efficiency correlates with daily usage (gallons per day), but correlates better with the individual draw volume (gallons per draw). The first chart below shows that tankless hot water use has a daily efficiency that is close to the 33% savings suggested by its 0.8 energy factor. However, as shown in the second chart, when efficiency is looked at based on individual draw volumes, the gas savings are less at lower draws and closer to the rated efficiency of 80% at draws of 10 gallons or more. This is because there is some heat loss at the heat exchanger after each draw when the heat exchanger cools down and the amount of energy lost will be the same after a large draw as after a small draw. As shown in the third chart, energy savings are not linear with hot water use. The greatest energy savings occur at a daily use quantity of about 50 gallons.

These results are useful for estimating energy savings resulting from replacement of storage type water heaters with tankless water heaters, and can provide a basis for the development of a separate federal test standard for tankless water heaters. Currently, the same standard covers both.

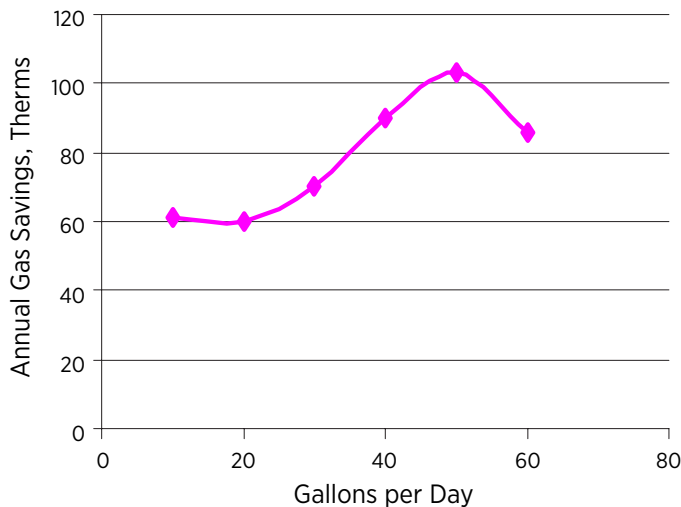
1. Measured Performance of Storage and Tankless Gas Water Heaters as a Function of Daily Hot Water Use (NREL 2006)



2. Performance of a Tankless Gas Water Heater as a Function of Draw Volume (NREL 2006)



3. Approximate Annual Energy Savings as a Function of Daily Hot Water Use (NREL 2006)



REFERENCES

**CARB.** 2009. *Tankless Water Heaters*, Prepared by Steven Winter Associates, Inc. for the U.S. Department of Energy Building America. [http://apps1.eere.energy.gov/buildings/publications/pdfs/building\\_america/tankless\\_water\\_heaters.pdf](http://apps1.eere.energy.gov/buildings/publications/pdfs/building_america/tankless_water_heaters.pdf)

**NREL.** 2006. *Building America System Research Results: Innovations for High performance Homes*, NREL/TP-550-39024, Prepared by the National Renewable Energy Laboratory for the U.S. Department of Energy Building America.