



## Building America Case Study Efficient Solutions for New and Existing Homes

# Simple Retrofit High-Efficiency Natural Gas Water Heater Field Test

Minneapolis, MN

### PROJECT INFORMATION

**Project Name:** Simple Retrofit  
High-Efficiency Natural Gas Water  
Heater Field Test

**Location:** Minneapolis, MN

**Research Team:** NorthernSTAR

**Partners:** None

**Building Component:** Water heating

**Application:** Single-family, retrofit

**Year Tested:** 2015

**Applicable Climate Zone(s):** All

### PERFORMANCE DATA

Cost of Energy-Efficiency Measure  
(including labor): \$1,800–\$2,200

Projected Energy Savings: 20%–40%  
water-heating savings

Projected Energy Cost Savings:  
\$50–\$70/year.

Water heating is the second-largest end use of natural gas in homes in the United States, accounting for 24% of residential use. Water heating is also typically one of the least-efficient end uses—the federal minimum efficiency, or energy factor, is 0.615 for a typical 40-gallon water heater. Higher-efficiency water heaters have the potential to provide large natural gas savings.

High-performance water heaters are typically more time-consuming and costly to install in retrofit applications, making them difficult to justify economically. However, recent advancements in high-performance water heaters have targeted the retrofit market, leading to simplified installations and reduced costs.

The U.S. Department of Energy’s Building America NorthernSTAR team worked with manufacturers on past projects and conducted field tests on their newest hybrid equipment. Residential retrofit hybrid water heaters combine several valuable features, including a high-input and energy-efficiency gas burner, some hot-water storage capacity, and compatibility with an existing ½-inch gas line.

The water heaters tested for this project were designed to improve the cost-effectiveness and increase market penetration of high-efficiency water heaters in the residential retrofit market. As highlighted in the following table and figure, the four water heater units successfully reduced costs while maintaining savings potential and installed efficiency compared to other high-efficiency water heaters; they also met the necessary capacity to improve cost-effectiveness. By eliminating the need for upgrading gas lines and meters and reducing the venting clearance requirements and installation difficulties, these water heaters minimized the installation costs for high-efficiency water heaters.

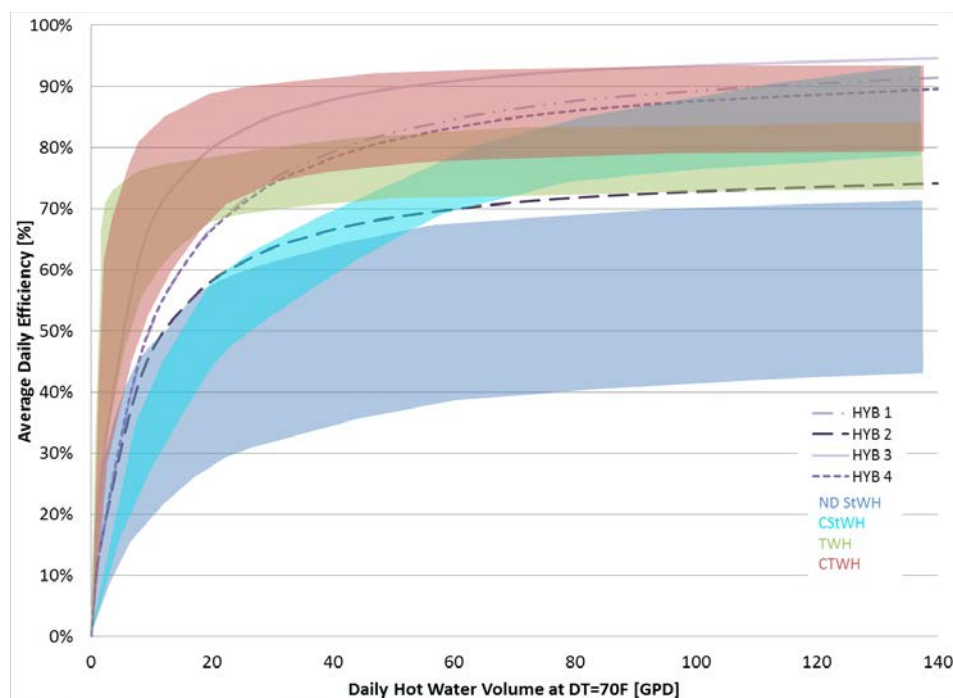
**Table 1. Hot Water Energy Consumption Reduction for Four Retrofit Water Heaters Compared to Minimum Efficiency Storage Water Heaters**

| Usage      | Hot Water Use (gpd) | Annual Natural Gas Savings (%) |      |      |      |
|------------|---------------------|--------------------------------|------|------|------|
|            |                     | WH 1                           | WH 2 | WH 3 | WH 4 |
| Very Small | 10                  | 48%                            | 42%  | 60%  | 50%  |
| Low Usage  | 38                  | 38%                            | 27%  | 45%  | 37%  |
| Medium     | 55                  | 35%                            | 24%  | 41%  | 34%  |
| High Usage | 84                  | 33%                            | 21%  | 38%  | 31%  |

## Description

Residential retrofit hybrid water heaters combine the following:

- A high-input and energy-efficiency gas burner
- Some hot-water storage capacity
- Compatibility with an existing ½-inch gas line.



Installed efficiency of retrofit high-efficiency water heaters compared to the installed efficiency of baseline (natural draft storage) water heaters and other high-efficiency water heaters.

## Lessons Learned

- **Results:** Retrofit water heaters can significantly reduce the cost of high-efficiency water heater installation while maintaining the energy savings and capacity of other high-efficiency systems.
- **Benefits:** They have reduced installed costs, improved occupancy acceptance, and increased water-heating energy savings of 20%–40%.
- **Costs:** They have reduced installed costs compared to other high-efficiency water-heating options. However, incremental costs compared to the baseline were still too great to achieve 6-year paybacks. Incremental costs of less than \$400 would yield paybacks of 6 years. Annual energy savings in the range of \$200 would also reduce paybacks to less than 6 years.

## Looking Ahead

Cost-effective energy savings would require either higher fuel costs (greater than \$1.50 per therm) or very high usage (around 120 gpd). For current fuel and incremental equipment costs, an increase in water heater efficiency to that of a heat pump water heater would also deliver 6-year paybacks.

For more information, see the Building America report, *Simple Retrofit High Efficiency Natural Gas Water Heater Field Test*, at [https://www1.eere.energy.gov/buildings/publications/pdfs/building\\_america/65444.pdf](https://www1.eere.energy.gov/buildings/publications/pdfs/building_america/65444.pdf).

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