Building America Case Study

Evaluation of Residential Integrated Space/Water Heat Systems

Illinois and New York

PROJECT INFORMATION

Project Name: Evaluation of Residential Integrated Space/Water Heat System: Illinois and New York

Partners:

Partnership for Advanced Residential Retrofit (PARR), *gastechnology.org/PARR*

Nicor Gas, *nicorgas.aglr.com*

New York State Energy Research and Development Authority (NYSERDA), *nyserda.ny.gov*

Building Component: Space heating and domestic hot water

Application: Retrofit; residential

Year Tested: 2012–2014

Applicable Climate Zone(s): All

PERFORMANCE DATA

Cost of energy efficiency measure (total cost including labor): $5,750 on average

Projected energy savings: 130 therms per year on average (11.5% of DHW and space heating gas use) for cold climates

System efficiencies: From low eighties (80%) to low nineties (90%)

Combined space and water heating systems, referred to herein as *combis,* use a single heating device to provide domestic hot water (DHW) and space heating (SH) for a building. The combination of an air handling unit (AHU) and tankless water heater in pre-engineered or engineered applications can enhance the energy efficiency of meeting these heating needs in residential applications.

Although residential combi systems have been applied in buildings for two decades or more; their market share barely exceeds 2%. However, new housing construction practices and modern retrofit measures are leading to more thermally efficient building envelopes and the decline of average home SH loads, making combi systems more applicable. Moreover, manufacturers are beginning to market systems that can better meet these loads.

The U.S. Department of Energy's Partnership for Advanced Residential Retrofit (PARR) Building America team put commercialized combi units into the field through local contractors who were trained by manufacturers and PARR staff under the auspices of utility-implemented emerging technology programs. With support from PARR, the New York State Energy Research and Development Authority and other partners, the project documented system performance and installations in Illinois and New York.

Lessons Learned

- Combis sold as integrated water heater and AHU packages for this evaluation were not designed to maximize temperature drops across the hydronic coils while maintaining sufficient supply air flows and temperatures. Therefore, water temperatures returning from the AHUs to the water heaters were not low enough to induce condensing water heater operation and resulted in annual efficiencies in the eighties (80%).

Building America SM U.S. Department of Energy

Description

PARR upgraded this furnace and water heater with a combined tankless water heater and hydronic furnace.

The tankless water heater delivers DHW and hot water to a fan coil (hydronic furnace) for space heating.

With minor duct transitions, the hydronic furnace was a simple replacement for the existing furnace.

For more information, see the Building America report, *Evaluation of Technical and Utility Programmatic Challenges with Residential Forced-air Integrated Space/Water Heat Systems,* at: *buildingamerica.gov*

Image credit: All images were created by the PARR team.

- Some AHU manufacturers have focused on combi system performance. Their AHUs are designed with water-to-air heat exchangers that more effectively transfer heat from the hot water to the room air, thereby maximizing coil-temperature drops while maintaining comfortable supply air. Resulting efficiencies from those systems were in the low nineties (90%).
- To satisfy market demand for unlimited DHW, contractors may choose the highest capacity tankless water heater available. However, despite manufacturer-claimed turndowns of up to 10:1 (in terms of burner capacity), results from this evaluation indicate compromised performance when SH loads were low.
- There are often strong correlations between reduced AHU return water and increased efficiencies. More research is needed to better understand factors that affect condensing operation, such as heat exchanger and combustion design and control strategies.
- Field tests for these evaluations exposed installation deficiencies that were caused by contractor unfamiliarity with the products and the complexity of field engineering and system tweaking to achieve high efficiencies. Widespread contractor education must be a key component to market expansion of combi systems.
- Installed costs for combis need to decrease by about 15%–25% to make the utility total resource cost of combis marginally acceptable. Utilities use this methodology to weigh the benefits of an energy efficiency measure against the total cost to implement it.
- Utilities are looking for ways to improve the benefits of high-efficiency standalone water heating measures in their energy efficiency programs. Raising water heating and SH efficiencies with one energy efficiency measure could increase the benefits enough to outweigh the cost to implement a combi system measure.

Looking Ahead

Demonstration and pilot data are extremely valuable for providing as-installed performance data, user satisfaction, and installing-contractor behavior. However, the many host-site variables make direct system comparisons difficult. More research is needed to determine how well heating systems such as traditional furnace/water heater, combis, and heat pumps compare in similar as-installed scenarios under controlled conditions.

U.S. DEPARTMENT OF ENERGY
Energy Efficiency & Renewable Energy

For more information, visit:
buildingamerica.gov

The U.S. Department of Energy's Building America program is engineering the American home for energy performance, durability, quality, affordability, and comfort.

DOE/GO-102014-4475 • November 2014