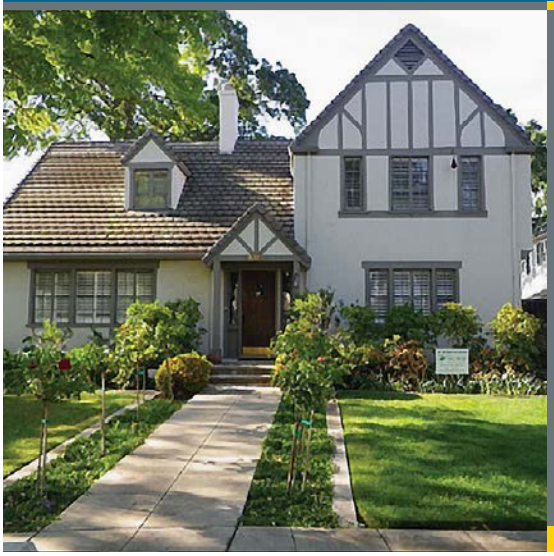


Building America Case Study

Performance of a Hot-Dry Climate Whole-House Retrofit

Stockton, California

PROJECT INFORMATION

Construction: Whole-house retrofit

Type: Single-family, affordable

Partners:

Builder: Green Home Solutions, *greenbygrupe.com*

Alliance for Residential Building Innovation, *http://arbi.davisenergy.com*

Size: 2,152 ft^2

Date completed: 2011

Climate Zone(s): Hot-Dry

PERFORMANCE DATA

HERS Index: Pre-retrofit rating = 314; post-retrofit rating = 156

Projected annual energy cost savings: $837

Incremental cost of energy efficiency measures: $23,756

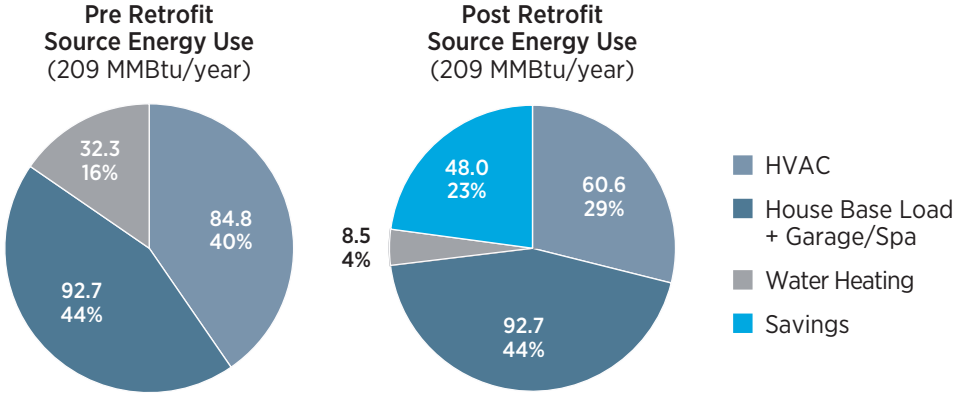
Incremental annual mortgage: $944 (at 4.5%)

Annual cash flow: –$107

Billing data: one year pre-retrofit, one year post-retrofit

Completing successful whole-house retrofits requires balancing a range of factors that maximize the cost-effective energy savings within the customer's budget, comfort, and aesthetic concerns. In this retrofit of a 1939 vintage Tudor-style home in Stockton, California, the homeowner and contractor (Green Home Solutions) worked together to implement an effective whole-house retrofit under the Large Scale Retrofit Program, Stockton Energy Challenge. This community-based program advances energy efficiency retrofits through consumer outreach and education, identification of market efficiencies, and promotion of home energy upgrades in the marketplace.

In this project, the U.S. Department of Energy Building America team Alliance for Residential Building Innovation (ARBI) monitored and documented the performance and cost effectiveness of the retrofit, which demonstrated a 28% reduction in site energy use (23% reduction in source energy use). Thorough documentation of these types of projects will help to inform the home energy retrofit industry's understanding of whole-house retrofit impacts in various climates and applications.



These charts show pre- and post-retrofit site energy use.

Building America SM U.S. Department of Energy

Key Energy Efficiency Measures

HVAC

- SEER 16 AC (12 EER) and 95% AFUE two-speed furnace replaced SEER 8/64% AFUE existing system; UV coil disinfection system
- Well-sealed R-8 flex ducts in vented attic and crawlspace replaced R-2.1 ducts, where possible. Many ducts were inaccessible.
- Additional bath fan added.

ENVELOPE

- R-49 blown ceiling insulation in vented attic (R-11 pre-retrofit)
- R-19 under floor insulation (no insulation pre-retrofit)
- Double-pane, low-e, vinyl windows; U = 0.30, SHGC = 0.30 (single-pane pre-retrofit)
- Reduced infiltration from 21.2 ACH50 (pre-retrofit) to 8.2.

LIGHTING, APPLIANCES, AND WATER HEATING

- 100% CFLs
- 0.96 Energy Factor condensing gas tankless water heater with demand recirculation system

For more information, please see the Building America report, *Performance of a Hot-Dry Climate Whole-House Retrofit,* at: *buildingamerica.gov*

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

The ARBI team relied on diagnostics and monitoring to document the impact of performance improvements, as well as to commission some of the advanced energy efficiency measures installed in the home.

The key retrofits for the house, completed in September 2011, included:

- New HVAC system with a 16 SEER/12 EER cooling system and 95% AFUE furnace
- Envelope sealing (ACH50 reduced by 60%) and duct sealing
- Floor and ceiling insulation
- High performance windows
- New condensing gas tankless water heater.

Lessons Learned

Whole-house energy retrofits provide an opportunity to go beyond simple measure upgrades to address potential energy savings. Although a systems approach provides more opportunities for savings, it also creates more complexity. Key lessons learned include:

- In many whole-house retrofits, site issues complicate the installation and add to overall costs. In this project, asbestos removal and duct access for remediation hampered implementation efforts and impacted savings.
- Actual energy savings were lower than predicted because of difficulties in modeling uninsulated exterior and transitional walls. The tankless water heater provided significant gas savings, but high retrofit costs and low natural gas prices will result in a long payback for the homeowner.
- The homeowner desired an upgrade from the existing single-pane glazed windows. Accounting for nearly one third of the retrofit cost, windows have long paybacks in mild climates. This is an example of balancing homeowner wishes versus cost-effective measures.

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