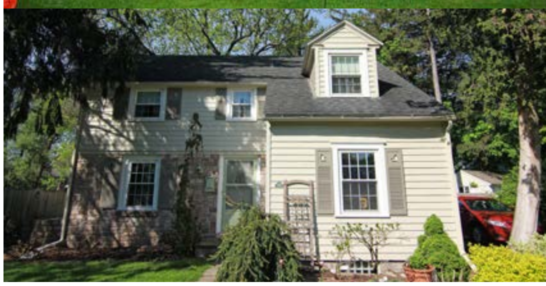

Building America Case Study

Exterior Insulation Pre- and Post-Retrofit

Syracuse, New York

PROJECT INFORMATION

IBACOS, *ibacos.com*

Construction: Deep energy retrofit

Type: Single-family

Partner:

GreenHomes America, Inc., *greenhomesamerica.com*

Size: 700–2,400 ft^2

Date Completed: 2013

Test House 1: Two-story, built in 1933

Test House 2: Ranch style, built in 1956

Test House 3: Two-story, built in 1963

Climate Zone: Cold

PERFORMANCE DATA

Total Heating and Cooling Peak Load Reduction

Test House 1:
- Pre-retrofit Btu/h: 114,989
- Post-retrofit Btu/h: 44,398

Test House 2:
- Pre-retrofit Btu/h: 80,572
- Post-retrofit Btu/h: 31,330

Test House 3:
- Pre-retrofit Btu/h: 139,744
- Post-retrofit Btu/h: 69,188

Building America U.S. Department of Energy

The U.S. Department of Energy Building America team, IBACOS, in collaboration with GreenHomes America, Inc. (GHA), contracted with the New York State Energy Research and Development Authority to research exterior wall insulation strategies that could be implemented as a part of overall deep energy retrofits (DERs) on nine homes in the Syracuse, New York, area. The three test houses in this project represent one of each type of enclosure strategy: rigid foam insulation, spray foam insulation, and a control house that follows Home Performance with ENERGY STAR® (HPwES) guidelines. This research investigated cost-effective DER solutions for improving the building shell exterior and achieving a cost-reduction goal—including reducing labor costs—to reach a 50/50 split between material and labor. The resulting market strategy is designed to integrate with other home improvement projects such as siding or window replacement, with energy and appraisal value attributes, to encourage market acceptance of DER solutions.

Post-Retrofit Information

Test House 1 (right), with the rigid foam DER, has an approximate center-of-wall R-value of R-28, including furring strips for siding. Test House 2 (upper left corner, top photo) with the spray foam DER, has an approximate center-of-wall R-value of R-30. Both homes received heating, ventilating, and air-conditioning upgrades as a part of the integrated DER solution. The control house, Test House 3, meets criteria from the HPwES program, including dense-pack walls and window upgrades.

IBACOS worked with GHA to retrofit three houses, including Test House 1 shown in this photo.

Project Cost and Projected Annual Utility Cost Savings*

Test House 1:
- Project cost: $18,702
- Projected annual utility cost savings: $82

Test House 2:
- Project cost: $14,719
- Projected annual utility cost savings: $447

Test House 3:
- Project cost: $36,646
- Projected annual utility cost savings: $338

*Project costs and projected utility cost savings are for *exterior wall retrofit measures only.* Modeled (BEopt Version 2.3.0.1) pre-retrofit to post-retrofit cost savings are included because insufficient pre-retrofit utility data were available for comparison.

Key Energy Efficiency Measures

PRE-RETROFIT HVAC
(Similar for all three houses)
- Heating type/efficiency: Gas, 80% annual fuel utilization efficiency (AFUE)
- Air conditioning type/efficiency: Single-stage, seasonal energy-efficiency ratio (SEER) 8, or none
- Water heater type/fuel: Gas standard

POST-RETROFIT HVAC
(Similar for all three houses)
- Heating type/efficiency: Gas, 95% AFUE
- Air conditioning type/efficiency: Single-stage, SEER 13
- Water heater type/fuel: Gas premium

For more information, see the Building America report *Exterior Insulation Implications for Heating and Cooling Systems in Cold Climates* at *buildingamerica.gov*.

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

(Left) Contractors are installing the 2×4 framing on the existing siding of Test House 2. (Above) The spray foam is being installed within the new framing.

To validate the performance of the three test houses, IBACOS first conducted short-term performance tests after each test house was upgraded. Then, IBACOS installed long-term monitoring systems to collect performance data on the test houses for 1 year (September 2013 through September 2014). The associated Building America report discusses the long-term monitoring results.

Lessons Learned

IBACOS learned key lessons that were common to all three strategies:

- To achieve a cost-effective retrofit, homeowners who are interested in DERs must already be interested in replacing the siding—and possibly the windows—on their homes.
- Ledger boards may need to be installed in some areas to allow for deflection between the top and bottom of the siding.
- A spray foam technique called *picture framing* is needed to reduce bowing between the 2×4 framing members. This involves spraying the perimeter of the framed section and then filling the rest with foam.
- Before the spray foam is applied, preparatory work, including protecting windows and exposed foundation from overspray, needs to be completed.
- The original design was to install the new windows after the new wall and framing were constructed and insulation applied. The team learned that it was more efficient to install the windows at the same time as the wall framing. This way, full sections of the home are completed simultaneously and disruptions inside the home are minimized.

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