Building America Comprehensive Energy Retrofit

Efficient Solutions for Existing Homes

Case Study: SMUD's 32nd Avenue Remodel

SMUD Energy-Efficient Remodel Demonstration Program
Sacramento, CA

This abandoned, derelict house in Sacramento was transformed into an attractive home that is 20% more energy-efficient than a new built-to-code home in California. The work, part of a research and development program of the Sacramento Municipal Utility District, included NREL, a DOE Building America research partner, and a local builder, the Housing Group Fund.

BUILDER PROFILE

Builder: Housing Group Fund
(916) 826-1681
www.housinggroupfund.com

Location: Sacramento, CA

Founded: 2001

Employees: 6

Number of retrofits per year: 40-60

Retrofit Turns Derelict House into High-Performing Home

A builder teamed with the Sacramento Municipal Utility District (SMUD) and the U.S. Department of Energy's Building America to turn an abandoned neighborhood eyesore into a home that performs better than a new built-to-code California home. The retrofitted home sold at a profit within a single month.

The slab-on-grade tract home on 32nd Avenue in a low-income area of Sacramento had been vacant for two years when Housing Group Fund, a local builder, purchased it in 2009 for $55,000. The four-bedroom, two-bath home required the extensive renovation typical of aging, abandoned homes—a new roof, new water heater, new kitchen and bathrooms, new carpets, and new windows and doors.

The architecture of the 1,340 ft² home presented additional challenges. The home was built in the 1950s with an open-beam ceiling after the fashion of Joseph Eichler, a developer who incorporated modern styling into tract homes. This aesthetically attractive ceiling had drawbacks—it had minimal insulation and provided no attic space for ductwork. Furthermore, the home's only heat was provided by a single gas furnace built into a living room wall, and the home had no wall insulation.

The builder worked with SMUD and the National Renewable Energy Laboratory (NREL), a Building America research partner, to transform the house into an attractive, energy-efficient home. Its California Home Energy Rating Score (HERS II) is now 80, 20% less than a new home built to current California code. The home's original HERS II score was 259, so the retrofit achieved a 69% improvement.

Building America U.S. Department of Energy

Workers place the first row of R-18 expanded polystyrene panels on a galvanized steel starting track. The foam panels insulate the home and give it a fresh new exterior.

Installing the Quad-Lock® R-ETRO System "was like stacking Legos®," said Dennis Lanni, co-president of the Housing Group Fund. The blue plastic clips hold the next course of foam panels and have a base plate that maintains a ¼-inch gap between the panels and the existing wall, providing a drainage space for moisture.

"Rightsizing the HVAC equipment gives you a tremendous bang for your buck."

DENNIS LANNI
Co-President
Housing Group Fund

The 32nd Avenue project is one of five "deep retrofits" performed through a SMUD research and development program, which aims to show the dramatic energy savings that can be achieved in existing homes. These five foreclosed and abandoned homes have been retrofitted to reduce their energy use by more than 50%.

The 32nd Avenue house "looks like a new production home, but it performs better," said SMUD project manager Mike Keesee.

To achieve that performance, NREL conducted a detailed energy analysis of the home, then used its BEopt software to determine the most cost-effective energy-efficient upgrades. SMUD provided design and technical assistance along with cash incentives for construction and marketing.

Energy Efficiency Measures

The team built a soffit in the hallway and installed a duct system for central heating and air conditioning.

"It turns out the house was laid out perfectly for doing this," said Keesee.

The crew converted an existing closet into a conditioned, air-tight space to house the new 0.95 AFUE gas furnace and SEER 14.5 electric air conditioner, which are controlled by an ENERGY STAR programmable thermostat. The ducts into each room are R-6 insulated and tightly sealed with just 3.75% leakage at 25 Pascals of pressure. Spot ventilation is provided by ENERGY STAR bathroom low-sone fans with timer controls and an ENERGY STAR range hood in the kitchen.

Installing the duct system in an Eichler-style house was "pretty tricky," said Dennis Lanni, co-president of Housing Group Fund, "but we enjoyed the challenge."

The team replaced old windows and appliances with energy-efficient components, which, as part of a major rehabilitation project, added only a small cost over the price of standard components. The new low-emissivity, vinyl-framed, dual-pane windows are ENERGY STAR rated, with values of U=0.29, SHGC=0.24. The gas water heater with a 40-gallon storage tank has an energy factor (EF) of 0.62, and the ENERGY STAR dishwasher has an EF of 0.69. The team installed 100% ENERGY-STAR-rated compact fluorescent light fixtures.

Innovations

The 32nd Avenue home still had two major energy issues. The ceiling had only minimal insulation and the walls had no insulation at all. The team took innovative approaches to both problems.

Exterior Roofing Insulation

The ceiling above the open beams consisted of a 1¾-inch tongue-and-groove cellulose panel to which the roof was directly attached. The team considered air-sealing the roof by adding foam polyurethane insulation to the underside of the ceiling. They rejected the idea for two reasons: it was costly and would hide the home's best aesthetic feature, the open beams.

Instead, they chose to put rigid insulation on top of the roof deck—an approach common in flat-roof commercial buildings but seldom used in residential construction. The team removed the composition roof, leaving the existing cellulose panel. Above that panel the team installed two layers of 3-inch rigid R-38 urethane foam panels, staggering their seams. New OSB sheathing and asphalt composition shingles completed the roof. Fascia and eave boards were raised to compensate for the roof's increased thickness.

Lanni said it was "an ongoing battle" to identify and seal leaks along the roof's edges and laps, but the team succeeded in creating an energy-efficient roof.

Exterior Wall Insulation

"Insulating the walls," Keesee said, "is the hardest thing to do in a retrofit. You have a choice of drill-and-fill or ripping off all the sheetrock." Since both methods are expensive and can give poor results, the team decided to try an innovative technology: rigid foam panels applied to the entire exterior of the home.

The existing exterior consisted of steel siding over a three-coat stucco finish. The steel siding had been nailed to 1x4" wood cleats drilled into the stucco. The team removed the steel siding and left the wood cleats for attaching the new siding.

The R-ETRO System, manufactured by Quad-Lock, includes a galvanized steel starting track, plastic clips, and R-18 expanded polystyrene panels. The panels are 48 inches wide, 12 inches high, and 4¼ inches thick.

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>
> **DENNIS LANNI**
> *Co-President*
> *Housing Group Fund*

The team attached the starting track to the bottom of each wall to hold the first row of foam panels. Screws secured the panels to the cleats on the existing walls. Each panel had a series of slots on top to receive plastic clips, which held the next course of foam panels. The clips also had a base

Energy-Efficient Upgrades

- **Roof insulation** – *Before:* 1¾-inch cellulose panel. *After:* 6" R-38 exterior rigid foam above cellulose panel.
- **Wall insulation** – *Before:* None. *After:* 4 inches of R-18 Quad-Lock® exterior rigid foam.
- **Air sealing** – *Before:* None. *After:* All accessible cracks, seams, and openings caulked, foamed, or weather-stripped.
- **Heating** – *Before:* Wall-mounted 0.58 AFUE gas furnace. *After:* Central 0.95 AFUE gas furnace.
- **Air conditioning** – *Before:* None. *After:* Central electric, SEER 14.5, EER 12.
- **Ducts** – *Before:* None. *After:* R-6 insulated, located in conditioned space.
- **Thermostat** – *Before:* None. *After:* ENERGY STAR, programmable.
- **Ventilation** – *Before:* None. *After:* ENERGY STAR bathroom low-sone exhaust fans with timer controls, and range hood exhaust fan.
- **Water heating** – *Before:* 50-gallon gas storage tank, 0.52 EF. *After:* 40-gallon gas storage tank, 0.62 EF.
- **Windows** – *Before:* Aluminum-framed, single-pane, est. U=1.07, SHGC=0.70. *After:* ENERGY STAR, low-e, vinyl-framed, dual-pane, U=0.29/SHGC=0.24.
- **Lighting** – *Before:* Incandescent. *After:* 100% ENERGY STAR CFLs.
- **Dishwasher** – *Before:* Unrated. *After:* ENERGY STAR Tier 2, EF=0.69.
- **Calif. HERS II rating** – *Before:* 259. *After:* 80, a 69% improvement.
- **Air leakage** – *Before:* unknown. *After:* Blower door – 1,100 cfm, 6.3 ACH at 50 Pa; duct blaster – 3.75% leakage @ 25 Pa.

To add insulation while preserving the home's open-beam ceiling, workers place 6 inches of rigid R-38 urethane foam panels on top of the roof deck. SMUD's Mike Keesee said it was an unusual yet successful approach to insulating a residential building.

plate to maintain a ¼-inch gap between the foam panels and the existing wall, providing a drainage space for moisture. Workers applied a new layer of stucco over the foam panels.

The Quad-Lock R-ETRO System insulated the walls, gave the house a fresh, even exterior, and was installed easily and quickly.

"It was amazing," Lanni said. "The concept is pretty simple, like stacking Legos®. And it added some nice features to the house. You go inside, and it feels good—tight and very comfortable."

"The Quad-Lock system is the way to go whenever possible," Keesee agreed.

A certified California HERS II rater inspected and tested the energy features of the home, conducting blower door and duct leakage tests and verifying the attic insulation, HVAC, and water heater ratings.

Dollars and Cents

The 32nd Avenue project was the Housing Group Fund's second research and development retrofit performed with SMUD and NREL. Housing Group Fund has been in business for 10 years and retrofits 40 to 60 homes each year in low-income neighborhoods.

Housing Group Fund bought the 32nd Avenue house for $55,000 in August 2009. The entire remodel cost $77,000; $26,769 of that was for energy efficiency. Housing Group Fund sold the house to a first-time homebuyer for $132,500 in May 2010, one month after putting it on the market.

"There's lots of opportunity in distressed houses," Lanni said, "and energy efficiency doesn't take a whole lot of money. It's knowing what to do the right way, like caulking gaps and putting in gaskets. Rightsizing the HVAC equipment gives you a tremendous bang for your buck.

"The extra effort pays off in quicker sales," Lanni added. "It's always easier to sell houses with energy upgrades. And people who've bought our houses tell their friends about them."

The Bottom Line

SMUD's aim is to replicate the demonstration projects' success on a large scale.

"There are huge opportunities in the foreclosure market," Keesee said. "You can achieve dramatic energy savings without too much of a cost. We took an eyesore in the neighborhood and made it into a really attractive, energy-efficient home."

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PNNL-SA-78347 March 2011