



Building America Comprehensive Energy Retrofit

Efficient Solutions for Existing Homes

Case Study: SMUD's Energy Efficient Remodel Demonstration Project

Sacramento, CA

SMUD worked with DOE's Building America program to cut energy use by more than 50% in this gut rehab of a 1950s tract home in Sacramento.

"The most important thing we took away from this project is that small changes can make a large impact on making homes more efficient."

Dennis Lanni, *Co-President,
Housing Group Fund*

A SMUD Deep Retrofit Exceeds 50% Energy Savings

In 2009 the Sacramento Municipal Utility District (SMUD) worked with the U.S. Department of Energy's Building America program to demonstrate how a simple package of off-the-shelf energy-efficiency measures could achieve dramatic energy savings in a whole-house energy retrofit. SMUD and DOE's National Renewable Energy Laboratory designed the energy-efficiency measures for a retrofit of an abandoned, foreclosed 1950's era home that achieved annual energy savings of over 50%.

"We wanted to test whether a simple package of energy-efficiency upgrades could achieve a 50% annual source energy savings in homes built before 1978 [compared to the pre-retrofit home]," said Mike Keesee, a project manager in SMUD's Energy Research and Development group.

SMUD found a test house through the Sacramento Housing and Redevelopment Agency's (SHRA's) Neighborhood Stabilization Program (NSP) and Vacant Property Program (VPP). Within these programs, builders and developers retrofit abandoned homes in low-income neighborhoods and sell these homes to low- and middle-income families. The home, on Mascot Avenue, in Sacramento, was acquired by the Housing Group Fund (HGF), a private real estate development company, in spring 2009. The 4-bedroom, 2-bath, 1,260-square-foot "neighborhood eyesore" had been vacant for over 2 years and needed extensive repair to interior walls, floors, ceilings, and roof, making it



BEFORE



AFTER

In addition to cosmetic changes, the builder replaced insulation, appliances, lighting, HVAC, and windows, and air sealed everywhere.

an excellent candidate for a gut rehab. SMUD partnered with HFG to fund the energy-efficient retrofit to the home (within SMUD's Energy Efficient Remodel Research and Development Program).

"SMUD used funds to pay us the difference between our standard practice and the higher [energy-efficient] standard," said Dennis Lanni, co-president of the Housing Group Fund. "When you are working with houses with such extensive damage, we learned that it is actually fairly easy to upgrade to a higher level of energy efficiency."

"We learned that when you are working with houses with such extensive damage, it is really easy to upgrade to a higher energy efficiency standard."

Dennis Lanni, Co-President,
Housing Group Fund

The SMUD/Building America Energy-Efficient Package

Through Building America, SMUD worked with NREL to develop the package of energy-efficiency features. NREL's computer-assisted energy modeling tool, BEopt, evaluates a broad range of energy-efficient measures to determine the least-cost measures to achieve the maximum amount of energy savings. NREL used BEopt to come up with a package of measures that cut annual electricity use by 4,852 kWh (47%) and annual gas use by 577 therms (59%), for an energy savings of 53% compared to a baseline estimate of the home's energy use.

Before the package was implemented, the Mascot house earned a California Home Energy Rating Score (HERS) of 241.3. For comparison, a home built to California's current energy code standard would achieve a 100. (Note, the national HERS rating is calculated differently.) After the retrofit, this home scored an 85.76 (a whopping 155 points better!)

For more about SMUD research,
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These are the measures that were implemented in the Mascot Avenue retrofit.

- **Air sealing the house.** All envelope penetrations and all accessible joints and seams were caulked or weather-stripped.
- **Replacing and increasing attic insulation** from rotting R-19 batts to R-44 blown-in cellulose.
- **Adding a radiant barrier.** In the hot Sacramento climate, the sun's rays heat the roof; as this heat radiates into the attic, it can raise attic temperatures to well over 100 degrees, increasing cooling loads in the living space below. A radiant barrier, installed between the attic rafters with an air gap on the underside of the roof sheathing and with foil facing the inside of the attic, reflects radiant heat back toward its source, reflecting as much as 97% of the sun's energy.
- **Replacing the existing rooftop-mounted heating and air conditioning system** with a new packaged electric air conditioner rated at SEER 16/EER 13 and an 80-AFUE gas furnace (the highest AFUE for such packaged systems). Because of the improved air and duct sealing, the original 3-ton air conditioner was more accurately sized to 2 tons.
- **Replacing ducts.** The original, uninsulated, leaky ducts were replaced with new ducts sealed and insulated to R-8 that tested for air leakage at 3.75% at 25 pascals.
- **Replacing the existing 50-gallon water heater** (0.52 energy factor) with a condensing, tankless gas water heater (0.98 energy factor). Tankless water heaters save energy and money by heating the water on demand and not heating a tank of water continuously. SMUD chose a condensing gas water heater that achieves energy factors as high as 0.98 by using conventional and condensing heat exchangers to capture heat from flue gases as well as latent heat generated when water vapor in these gases condenses into liquid.
- **Installing high-performance windows.** The original aluminum frame, single-pane, clear glass windows were replaced with ENERGY STAR, vinyl frame, dual-pane, low-e windows with U-values of 0.29 to 0.28 and solar heat gain coefficient values of 0.22 to 0.24.
- **Installing an ENERGY STAR programmable thermostat.**
- **Replacing all incandescent lighting fixtures with ENERGY STAR compact fluorescent lamp (CFL) fixtures.**
- **Replacing the dishwasher with an ENERGY STAR dishwasher.**
- **Upgrading the ventilation.** The pre-retrofit home had no mechanical ventilation so ENERGY STAR fans were installed in the bathrooms and kitchen.

Energy-Efficient Features

- **Air Sealing:**
Caulking, foaming, and weather stripping of all accessible cracks, joints, and seams. Test out at 1,121 cfm₅₀; 6.7 ACH₅₀.
- **Attic:**
R-44 blown-in cellulose insulation
- **Roof:**
Radiant barrier in attic
- **Walls:**
R-15 blown-in cellulose insulation
- **Air Conditioner:**
2-ton, SEER 16, EER 13 electric air conditioner
- **Furnace:**
80-AFUE gas furnace (roof-mounted and packaged with AC)
- **Ducts:**
R-8 insulated ducts tested to 3.75 @ 25 Pa
- **Water Heating:**
Condensing, tankless gas water heater (EF .98)
- **Windows:**
dual pane, U-0.29-0.28; SHGC 0.22-0.24
- **Programmable thermostat**
- **Lighting and Appliances:**
100% hardwired ENERGY STAR CFL lighting fixtures and ENERGY STAR dishwasher
- **Ventilation:**
ENERGY STAR low-sone bathroom fans with timers



BEFORE



AFTER

The poor condition of the home's walls, floors, and ceiling made it an ideal candidate for a gut rehab.

BUILDER PROFILE

Builder's Name:

Housing Group Fund

Contact:

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916-548-2524

Where: Sacramento, California

Founded: 2007

Employees:

6, not including subcontractors

Number of houses

retrofitted a year: 50

Average house price:

\$100,000

"There is no magic bullet," said Lanni. "All of the little things add up to a huge impact. We experienced some very low-investment, high-return measures for energy efficiency. [For example], we were redoing the roof, so it was really easy to add a radiant barrier," said Lanni. "The one that blew us away was air sealing. It is so simple, and it makes a huge difference."

Dollars and Sense

The Sacramento Housing & Redevelopment Agency (SHRA) used federal stimulus funds to pay \$86,050 for repairs to the originally foreclosed house, including mold removal, asbestos abatement, new kitchen and bath, and all-new flooring. SMUD estimates the cost of the energy upgrades at \$25,000 including the replacement of the roof. (The costs do not include utility incentives or federal tax credits.)

In December first-time homebuyers Ken and Diana Tate bought the home for \$117,000. Utility bill savings for the homeowners are estimated to be \$1,264, compared to what they would have paid for the home's utilities in its pre-retrofit state.

For More Information

www.buildingamerica.gov

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1-877-EERE-INFO (1-877-337-3463)
eere.energy.gov/informationcenter

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Bottom Line

"My message for the construction industry is that these new energy measures are the wave of the future and everyone should embrace them because this will become the new building standard in construction," said Lanni.