



Building America Case Study

Singer Village: A Cold Climate Zero Energy Ready Home

Derby, Connecticut

PROJECT INFORMATION

Project Name: Singer Village Home

Location: Derby, CT

Partners:

Brookside Development, LLC.
brooksidedevelopment.com

Consortium for Advanced Residential Buildings, carb-swa.com

Size: 4,456 ft² including basement

Year Completed: 2014

Climate Zone: Cold

PERFORMANCE DATA

Source energy savings: 29.6%

HERS index: 45

Projected annual utility costs: \$2,443

Incremental cost of energy efficiency measures: 5.5% increase in builder cost over minimum code-compliant specifications.

Potential return on investment: Builder estimates an 8.2% increase in home price.

After progressively incorporating ENERGY STAR® for Homes into its standard practices over several years, Brookside Development was seeking to build an even more sustainable product and to address indoor air quality, water conservation, renewable energy readiness, and resiliency. These objectives align with the framework of the U.S. Department of Energy (DOE) Zero Energy Ready Home program, which builds upon the comprehensive building science requirements of ENERGY STAR for Homes Version 3 and proven Building America innovations and best practices. To meet this goal, DOE's Building America team, Consortium for Advanced Residential Buildings, partnered with Brookside Development to design and construct the first Zero Energy Ready Home in a development of seven new homes on the old Singer Estate in Derby, Connecticut.

The key features of any viable solution package are a building envelope with continuous thermal, air, and moisture barriers and a simplified heating, ventilating, and air-conditioning (HVAC) system designed to provide comfort as efficiently as possible. The basic cold climate package for these Singer Village Homes consists of:

(1) flash-and-batt cavity insulation with exterior rigid insulation; (2) critical air sealing of penetrations, the ceiling plane, and rim/band joist area; (3) properly designed HVAC with efficient heating equipment; and (4) field performance testing and HVAC commissioning to ensure each home performs as designed.

"We're promoting the energy efficiency of green because that puts green in your pocket."

– Mark Nuzzolo,
Brookside Development LLC
(Source: The New York Times 2010)

The end result was a DOE Zero Energy Ready Home that achieved a HERS Index of 45 and that subsequently won a 2014 Housing Innovation Award in the production builder category. The home also won a 2013 Connecticut Zero Energy Challenge Award in the affordable home category, because it had the lowest dollar per square foot construction cost (for the structure from the foundation up) of the 11 applicants. See: youtube.com/watch?v=3yS6XuRxtaM.

Key Energy-Efficiency Measures

HVAC AND WATER HEATING

- Natural gas condensing, two-stage furnace, 96% AFUE
- Dual-fuel heat pump, SEER 14/8.0 heating seasonal performance factor
- Natural gas, condensing tankless water heater, 0.94 energy factor
- ENERGY STAR-certified exhaust fans with built-in continuous and delay off controls were installed in all bathrooms and the garage. Configured to meet ASHRAE 62.2-2010 minimum ventilation requirement via low-speed continuous operation of two exhaust fans (first- and second-floor bathrooms).

ENVELOPE

- R-18 2-in. closed-cell spray foam (ccSPF) and 2-in. compressed fiberglass batt, 2×4, 16-in. o.c., oriented strand board, R-6.5 polyisocyanurate for above-grade walls
- Half wall, R-9.8 polyisocyanurate below-grade walls; ccSPF insulation in rim/band joist areas
- Vented attic with R-60 blown cellulose, spot-applied spray foam to provide critical air seal of ceiling plane
- Dual-pane, low-e windows with vinyl frame (U-0.28/SHGC-0.27)
- Tightly sealed house, ACH50 = 2.0.

LIGHTING, APPLIANCES, MISCELLANEOUS

- 100% compact fluorescent lighting/LED
- ENERGY STAR appliances

For more information, please see the Building America report, *Taking the Challenge at Singer Village—A Cold Climate Zero Energy Ready Home*, at: buildingamerica.gov.

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

| | Zero Energy Ready Home | 2009 Code Home | 2003 Code Home | Existing Home |
|--------------------------------------------------------|------------------------|----------------|----------------|----------------|
| Purchase Price | \$474,900 | \$439,000 | \$379,000 | \$329,000 |
| Down Payment (20%) | \$94,980 | \$87,800 | \$75,800 | \$65,800 |
| Loan Amount | \$379,920 | \$351,200 | \$303,200 | \$263,200 |
| Length of Mortgage (years) | 30 | 30 | 30 | 30 |
| Yearly Mortgage Interest Rate | 4.5% | 4.5% | 4.5% | 4.5% |
| Mortgage (per month) | \$1,925 | \$1,779 | \$1,536 | \$1,334 |
| Insurance (per month) | \$100 | \$100 | \$100 | \$100 |
| Property Tax (per month) | \$580 | \$580 | \$550 | \$525 |
| Est. 1st Year Maintenance/Replacement Cost (per month) | \$10 | \$50 | \$206 | \$365 |
| Heating (per month) | \$48 | \$99 | \$199 | \$257 |
| Water Heating (per month) | \$10 | \$27 | \$29 | \$32 |
| Cooling (per month) | \$5 | \$8 | \$20 | \$40 |
| Lighting, Appliances, and Miscellaneous (per month) | \$109 | \$115 | \$115 | \$115 |
| Utility Service Charge (per month) | \$32 | \$32 | \$32 | \$32 |
| Est. Tax Benefit (per month, based on 25% bracket) | (\$511) | (\$472) | (\$408) | (\$354) |
| Estimated Total Monthly Cost | \$2,308 | \$2,318 | \$2,379 | \$2,446 |

Cost comparison of Brookside Development's Zero Energy Ready Home versus similar lower performance homes.

The annual cost of homeownership (mortgage, utilities, insurance, property taxes, maintenance, and tax deductions) was estimated to be lower by \$130–\$1,657 for this home versus similar market alternatives (2009 International Energy Conservation Code [IECC]-compliant homes, 2003 IECC-compliant homes, and typical mid-1990s homes). From a holistic global perspective, the environmental benefit of this high performance home over 30 years is estimated to be equivalent to planting 1,641 trees, eliminating 502,531 miles driven by an average passenger car, or taking 38 passenger cars off the road for 1 year.

Lessons Learned

- Complying with the water efficiency requirement of the DOE Zero Energy Ready Home can be difficult without incorporating an on-demand recirculation pump or revising floor plans to have all water areas centrally located to minimize the length of the hot water distribution system. In addition, when using a tankless water heater, the lag time of the heat exchanger achieving full temperature will make the water efficiency requirement more challenging to meet without a recirculation pump.
- Air sealing the transitions between the foundation and the above-grade walls and from the above-grade walls to the roof/ceiling was critical to the success of constructing a tight and resilient building envelope.