

Greenhill Contracting

Jewels Court Home
Gardiner, NY



BUILDER PROFILE

Greenhill Contracting, Esopus, NY
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FEATURED HOME/DEVELOPMENT:

Project Data:

- Name: Jewels Court Home
- Location: Gardiner, NY
- Layout: 3 bdrm, 3.5 bath, 3 fl + bsmt, 3,912 ft²
- Climate Zone: IECC 6A, cold
- Completion: May 2016
- Category: custom for buyer

Modeled Performance Data:

- HERS Index: without PV 29, with PV -11
- Projected Annual Energy Costs: without PV \$1,875, with PV -\$322
- Projected Annual Energy Cost Savings (vs home built to 2009 IECC): without PV \$3,200, with PV \$5,397
- Projected Annual Energy Savings: without PV 24,615 kWh, with PV 41,518 kWh
- Added Construction Cost: without PV \$45,000, with PV \$87,000

This custom home perched on a hillside overlooking the Hudson River Valley near Gardiner, New York, has terrific views outside and terrific news inside. The home was built by Anthony Aebi of Greenhill Contracting in Esopus, New York, to the exacting specifications of the U.S. Department of Energy (DOE) Zero Energy Ready Home (ZERH) program. With high-performance walls and HVAC inside, plus 13.4 kW of solar panels on the roof, the home owners should have zero energy bills. In fact they may get enough credit on their utility bills to power an electric car with the surplus.

The 3,912-ft² home achieved a Home Energy Rating System (HERS) score of -11. That is better than net zero (a home that produces as much power as it consumes in a year) and far better than a typical new home, which would score roughly 80 to 100. This equates to energy savings of \$5,400 a year compared to a home just built to local code, which in New York is equivalent to the 2009 International Energy Conservation Code (IECC).

Even without the PV added, the home would achieve a HERS 29, thanks to the highly efficient shell and high-performance features. Like all DOE Zero Energy Ready homes, this home met the requirements of ENERGY STAR Certified Homes Version 3.0 and the U.S. Environmental Protection Agency's Indoor airPLUS program, as well as the hot water distribution requirements of the EPA's WaterSense program and the insulation requirements of the 2012 IECC. Certified homes are also required to have a solar electric system installed or have the conduit and electrical panel space in place for it.

All of Aebi's homes are certified through the DOE Zero Energy Ready Home program. "I started building in 1995 but didn't 'really' start building until 2007 when I started building zero energy 'homes of the future,'" said Aebi. Aebi became a partner of the DOE program in 2007 and completed his first certified



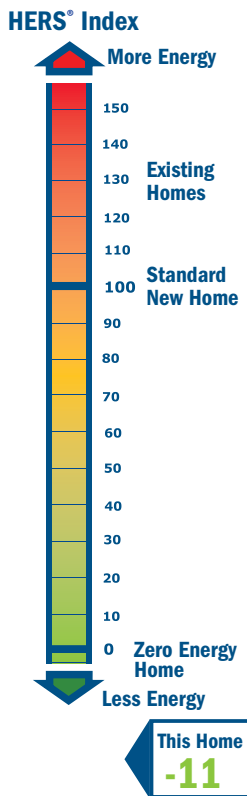
The U.S. Department of Energy invites home builders across the country to meet the extraordinary levels of excellence and quality specified in DOE's Zero Energy Ready Home program (formerly known as Challenge Home). Every DOE Zero Energy Ready Home starts with ENERGY STAR Certified Homes Version 3.0 for an energy-efficient home built on a solid foundation of building science research. Advanced technologies are designed in to give you superior construction, durability, and comfort; healthy indoor air; high-performance HVAC, lighting, and appliances; and solar-ready components for low or no utility bills in a quality home that will last for generations to come.

Greenhill Contracting built this 3,912-ft² house in Gardiner, New York, to the high performance criteria of the DOE Zero Energy Ready Home (ZERH) program. In addition to its efficient design, this home saves energy with ENERGY STAR-rated appliances and all LED lighting. Low-flow plumbing fixtures reduce water and water heating demand. Outside, drought-tolerant turf and native plants eliminate the need for landscape irrigation. The home meets EPA's Indoor airPLUS requirements; the use of zero-VOC paints, non-combustion HVAC, and redundant air filters should contribute to good indoor air quality.



What makes a home a DOE ZERO ENERGY READY HOME?

- 1 **BASELINE**
ENERGY STAR Certified Homes Version 3.0
- 2 **ENVELOPE**
meets or exceeds 2012 IECC levels
- 3 **DUCT SYSTEM**
located within the home's thermal boundary
- 4 **WATER EFFICIENCY**
meets or exceeds the EPA WaterSense Section 3.3 specs
- 5 **LIGHTING AND APPLIANCES**
ENERGY STAR qualified
- 6 **INDOOR AIR QUALITY**
meets or exceeds the EPA Indoor airPLUS Verification Checklist
- 7 **RENEWABLE READY**
meets EPA Renewable Energy-Ready Home.



DOE home in 2008; it was one of the first zero energy homes in the Northeast. He has since certified 30 custom and production homes. He earned three DOE Housing Innovation Awards in 2015 and one in 2014. In addition to this custom home, he was also recognized for a production home in 2016 that was one of five production homes certified at his Green Acres community in the Village of New Paltz, located in the Hudson River Valley 60 miles north of New York City. Aebi currently has 22 more single-family homes planned and just started construction on his first multi-family project—a low-rise, mixed-use zero-energy building he calls “ZERO Place” that will include 48 dwelling units plus 7 retail spaces.

The 2016 award-winning home’s style, which Aebi refers to as Hudson Valley Dutch Colonial, lends itself perfectly to a simple, compact rectangular form that provides optimal performance in this cold-climate location. Like all of Greenhill Contracting’s homes, the shell of this three-story-plus-daylight-basement home is constructed of insulated concrete forms (ICFs), from the footing to the roof line. ICFs are like large hollow bricks made of rigid foam with plastic spacers that stack to form walls. The hollow walls are filled with concrete and reinforced with steel rebar run vertically and horizontally to form a solid mold-, fire-, pest-, and storm-resistant wall with continuous rigid insulation on the inside and exterior for an R-22 insulation level. The foam sides also provide two continuous thermal layers with no thermal bridging for very low heat transfer through the walls.

Aebi starts the ICF walls below grade where they serve as the foundation stem walls, providing R-22 of slab-edge insulation for the basement floor slab. The slab is poured over 4.3 inches (R-27) of closed-cell spray foam, which is sprayed directly onto a gravel base. The ICF blocks serve as the basement and above-grade walls all the way up to the roof line of the three-story home.

The ICF blocks are sealed at the seams to provide a continuous air barrier. They also serve as the drainage plane so no house wrap is needed. An elastomeric waterproofing compound is applied with a caulk gun and putty knife to provide a seamless, jointless flashing layer around all of the doors and windows. Vinyl siding is used for the exterior cladding.

Aebi constructs a sealed, unvented attic that is insulated on the underside of the roof deck with two types of spray foam. He sprays 11 inches of open-cell spray foam (R-4.45/in.) followed by 2 inches of closed-cell spray foam insulation



The walls are made of insulated concrete forms. These ICF blocks have a center core of steel-reinforced concrete with rigid foam layers on both the inside and outside to form a very sturdy structure with a continuous thermal blanket, comprehensive draft protection, and a continuous wall water barrier. The ICF walls are resistant to mold, fire, pests, and high winds.

(R-7.4/in.) to completely fill the roof rafter cavities and encase the rafters, providing R-64 worth of insulation and creating a thermal break to keep heat from transferring to the outside. Above the roof deck, a self-adhered bitumen membrane is installed at the roof edges and valleys and the roof is covered with enhanced-performance shingles that have a 130-mph wind-speed rating.

High-performance triple-paned windows complete the thermal envelope of this snug, draft-free home. In fact the home is so airtight that a blower door test of whole-house air leakage showed the home had leakage of only 0.16 air changes per hour at 50 Pascals pressure difference. That level of airtightness (which is typical of Aebi's homes) is far below the 3 ACH 50 required by the 2015 International Energy Conservation Code and even well below the 0.60 ACH 50 required in the Passive House U.S. standard.

To provide fresh air for the homes, Aebi installed an energy recovery ventilator (ERV). The ERV runs 24/7 at low speed to exhaust air from the bathrooms, kitchen, laundry, and attic. The bathroom exhaust registers are also equipped with occupant-controlled boost settings and the kitchen range has a dedicated, occupant-controlled 100-cfm range hood fan. Fresh air is brought into the home from an air duct that brings the outside air through the ERV, which has a MERV 7 filter on it. The fresh air and exhaust air ducts pass through a heat exchanger which transfers heat and humidity from the warmer air to the cooler air, warming incoming air in the winter and cooling incoming air in the summer. The incoming fresh air is then ducted to the return side of the air handler, where it is again filtered via a set of electro-static and media air-filters rated at MERV 11 to help ensure clean air for the airtight home.

The home is heated and cooled with a highly efficient ground source heat pump rated to have a coefficient of performance (COP) of 5.7 and an energy efficiency ratio (EER) of 44. The air handler is located inside the home in a utility room and all of the sealed metal ducts are located within the conditioned space of the home. The heat pump draws heat from the ground using a closed-loop system installed in a 500-ft-deep standing well column that is filled with ground water, which increases efficiency by 15%.

Aebi installed a 13.4-kW solar electric system on the home, which helped the home achieve a Home Energy Rating System (HERS) score of -11 and cut annual utility costs from an expected \$1,875 without the PV to -\$322 per year with the PV system installed.

HOME CERTIFICATIONS

DOE Zero Energy Ready Home Program, 100% commitment

ENERGY STAR Certified Homes Version 3.1

EPA Indoor airPLUS

LEED for Homes, silver

Greenhill Contracting follows the DOE Zero Energy Ready Home Quality Management Guidelines. Pre-construction meetings were held with the project team (architect, builder staff, trade reps, HERS rater) and the team followed durability management work scopes. "We have been working consistently with the same crews and encouraging them to think outside the box. The construction team is continuously innovating and improving the design on each new home we build."

— Anthony Aebi, owner
Greenhill Contracting



Every DOE Zero Energy Ready Home combines a building science baseline specified by ENERGY STAR Certified Homes with advanced technologies and practices from DOE's Building America research program.



The central manifold and PEX tubing provide fast, efficient distribution of hot water from the ground source heat pump desuperheater and the air source heat pump water heater.

to freeze and interior temperatures can be maintained for days. Aebi tested this by monitoring indoor temperatures in one of his houses during a four-day period of severely cold winter weather when outdoor temperatures ranged from -8 to +16°F. Even though no heating systems were on in the house, the indoor temperature never dropped below 56°F.

Aebi also noted that team has worked tirelessly to reduce the construction costs associated with the high-performance homes, including developing continuous improvement strategies. Aebi is confident that he could incorporate the ICF and spray foam thermal and air-control strategies to achieve the DOE Zero Energy Ready without any significant costs over a code-built home. Adding the ground-source heat pump for space conditioning, the air-source heat pump for hot water, the triple-pane (rather than double-pane) windows, and the ERV increased the cost approximately \$45,000 over a code-built home. The PV system was an additional \$42,000 for a total of \$87,000 in costs above a code-built home. Incentives offset about \$33,000 of this added cost, according to Aebi.

Aebi appreciates the way the DOE Zero Energy Ready Home program brings builders together to educate the public about high-performance homes. He does his part by speaking at regional and local builders' conferences; publishing in construction journals; and opening his houses for educational tours by local builders, code officials, students, and home buyers. He promotes the DOE Zero Energy Ready certified homes through his website, weekly print advertising, and social media. He admits, though, that many of his home buyers are referred by current home owners of Greenhill Contracting certified homes.

“Convincing others that this kind of construction is easy and the right thing to do for us all” is a challenge admits Aebi but the challenge is offset by the rewards, including “home owners who are so happy with their homes.”

Photos courtesy of Greenhill Contracting

Aebi noted that the ICF house is not only energy-efficient; it's also disaster resistant. With the footing-to-roofline steel reinforcement, the ICF exterior walls are resistant to earthquakes, tornados, and hurricanes. Hurricane clips and closed-cell spray foam in the attic reduce the potential for roof uplift during high winds. The ICFs are fire-, moisture-, and bug-resistant. The home's highly insulated enclosure reduces the impacts of power outages. Pipes are less likely

KEY FEATURES

- **DOE Zero Energy Ready Home Path:** Performance.
- **Walls:** R-22 ICF, vinyl siding, liquid-applied door and window flashing.
- **Roof:** Asphalt shingles, peel-and-stick at edges and valleys.
- **Attic:** R-64 vaulted ceilings, insulated, unvented roof with 11" open-cell + 2" closed-cell spray foam.
- **Foundation:** ICF below-grade foundation walls for R-22 at slab edge, R-27 closed-cell spray foam under slab.
- **Windows:** Triple-pane, U=0.17, SHGC=0.23, argon-fill, vinyl-framed.
- **Air Sealing:** 0.16 ACH 50.
- **Ventilation:** ERV, MERV 7 and 11 filters, returns from bathrooms, kitchen, and laundry.
- **HVAC:** Ground-source heat pump, 5.7 COP, 19.5 EER, all ducts inside.
- **Hot Water:** Ground-source heat pump desuperheater and 50-gal. air-source heat pump tank water heater 3.1 EF.
- **Lighting:** 100% LED.
- **ENERGY STAR Appliances:** Refrigerator, clothes washer, dishwasher, heat pump clothes dryer.
- **Solar:** 13.4-kW PV.
- **Water Conservation:** Low-flow fixtures, drought-tolerant plants.
- **Energy Management System:** None.
- **Other:** No-VOC paint, 75% construction debris recycled, disaster-resistant ICF construction with spray foam and hurricane clips.