



Greenhill Contracting Inc.

Hickory Ridge
Gardiner, NY



BUILDER PROFILE

Greenhill Contracting Inc., Esopus, NY
www.zeronetnow.com
Anthony Aebi
845-594-5076
greenhillcontracting@yahoo.com
Rater: Integral Building & Design, Inc.
Pasquale Strocchia
pasquale@integralbuilding.com

FEATURED HOME/DEVELOPMENT:

Project Data:

- Name: Hickory Ridge
- Location: Gardiner, NY
- Layout: 4 bdrm, 3.5 bath, 3 fl, 3,912 ft²
- Climate Zone: IECC 6A, cold
- Completion: May 2017
- Category: custom spec

Modeled Performance Data:

- HERS Index: without PV 33, with PV 2
- Projected Annual Energy Costs: without PV \$2,300, with PV \$400
- Projected Annual Energy Cost Savings (vs typical new homes): without PV \$3,500, with PV \$5,500
- Projected Annual Energy Savings: without PV 23,500 kWh, with PV 36,400 kWh
- Added Construction Cost: without PV \$30,000 with PV \$80,000

Nearly 10 years ago, home owners of one of the first zero energy homes in the country, built in the Green Acres community in New Paltz, New York, posed the question, “Why isn’t every home built this way?”

While many are still pondering that question, builder Anthony Aebi of Greenhill Contracting in Esopus, New York, is doing his part to make sure more homes are built that way.

Aebi built his first zero energy home by accident in 2007, when his search for a better building material led to insulated concrete forms. When an energy rater tested the home’s performance, he told Aebi he had just built the first zero-energy home in the Northeastern United States. Aebi soon signed on with the U.S. Department of Energy’s Zero Energy Ready Home program and committed to building all of his homes to DOE’s criteria. Now 10 years later, Aebi has certified 25 homes through the DOE Zero Energy Ready Home program (and nine homes through its predecessor, the DOE Builders Challenge). Aebi routinely achieves Home Energy Rating System (HERS) scores of under 10 with photovoltaics, or under 40 when the renewable energy is not counted in the scoring. (Most typical new homes built to code would score about 80 to 100.)

Aebi won a 2017 Housing Innovation Award for a 3,912-ft² home he built on an empty lot in an existing development in Gardiner, New York, that scored a HERS 33 without PV, or HERS 2 when PV is included. Home owners can expect to save nearly \$5,500 per year in energy costs compared to a similar sized home built to the state’s energy code.

Aebi is more than willing to share the secrets of his success with others in the home building community. He has spoken at state and regional conferences, including the regional ACI (now Home Performance Coalition) conference, the



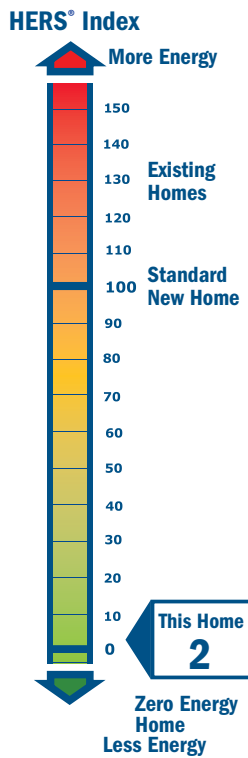
The U.S. Department of Energy invites home builders across the country to meet the extraordinary levels of excellence and quality specified in DOE’s Zero Energy Ready Home program. Every DOE Zero Energy Ready Home starts with ENERGY STAR Certified Homes Version 3.0 for an energy-efficient home built 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. A highly efficient air-source heat pump heats and cools the home's interior, while the roof-mounted photovoltaic system offsets electricity usage to cut energy bills to nearly zero. Many months the home owners see a credit on their utility bill.



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.



New York State Green Building Conference, and the Energy and Environmental Building Alliance (EEBA) conference. He's also met with representatives of the New York State Energy Research and Development Authority (NYSERDA) and provided instruction to builders through their sponsorship. More than 10 articles by or about Aebi have appeared in trade publications. Greenhill hosted a series of Open House events and several zero energy educational tours in 2017 for building professionals, code officials, students, and home buyers. For the past several years Aebi has provided tours for students from the engineering department of nearby West Point Military Academy. Aebi is currently working with West Point students who are preparing to participate in the DOE's Race to Zero Student Design Competition.

Aebi has also added articles and videos to his website to help home buyers understand what goes into a zero energy home. He's also increased his presence on social media like Facebook and Twitter. Greenhill Contracting also worked with a real estate agent to put together information packets for prospective buyers that includes brochures (from DOE Zero Energy Ready Home and EPA's Indoor airPLUS), testimonials, case studies, and a cost-benefits calculator. Greenhill has provided training in their energy efficiency features for sales agents who actively promote their homes through online databases, realtor open houses, and outdoor signage.

Aebi recognizes the value of home owners as spokesmen for their energy-efficient construction. "Many of our new home owners were referred by current home owners of Greenhill zero energy homes," said Aebi. To educate home owners and keep them informed, Greenhill provides each home owner with an individualized home owners' manual providing details on the features of their home and the company now offers annual spring and fall service checks to ensure systems are operating properly and filtration features are well maintained.

All of Aebi's homes are certified to the U.S. Department of Energy (DOE) Zero Energy Ready Home (ZERH) program. This program requires that homes meet the requirements of ENERGY STAR Certified Homes Version 3.0 and the U.S. Environmental Protection Agency's Indoor airPLUS, as well as the hot water distribution requirements of the EPA's WaterSense program and the insulation requirements of the 2012 International Energy Conservation Code. In addition, homes are required to have a solar electric system installed or have the conduit and electrical panel space in place for it.



Like a Styrofoam cooler, Greenhill Contracting's homes are wrapped in foam insulation, with 4.3 inches of closed-cell spray foam under the slab, 11.25-inch-thick R-22 ICF block walls, and 11 inches of open-cell spray foam plus 2 inches of closed-cell spray foam covering the underside of the roof deck and roof rafters to provide an R-64 insulated attic.

All of Greenhill's homes are constructed with insulated concrete forms (ICFs), which not only provide energy-efficiency advantages, but are also rated to withstand hurricane-force winds and earthquakes.

The homes start with the super-insulating properties of ICFs, which are hollow foam blocks that stack like Legos to form a hollow wall that is reinforced with steel rebar then filled with concrete. The concrete hardens and the foam sides remain in place to form a solid wall with continuous rigid insulation on the inside and exterior. 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 clean gravel base. The ICF blocks also serve as the basement and above-grade walls extending all the way up to the roof line of the two-story homes.

The ICF blocks are sealed at the seams to provide a continuous air barrier. They also serve as the drainage plane on the exterior side of the walls so no house wrap is needed. To protect the framing where windows or doors will be installed, an elastomeric waterproofing compound is applied with a caulk gun and putty knife to provide a seamless, jointless flashing layer around the openings. 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 against the roof decking (R-4.45/in) then covers this with 2 inches of closed-cell spray foam insulation (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 and a lifetime warranty.

High-performance triple-paned windows complete the thermal envelope of this snug, draft-free home.

The remarkably airtight home showed blower door whole-house air leakage results of only 0.12 air changes per hour at 50 Pascals pressure difference. That level of air tightness (which is typical of Aebi's homes) is far below the 3 ACH50 required by the 2012 International Energy Conservation Code and even well below the 0.60

HOME CERTIFICATIONS

DOE Zero Energy Ready Home Program, 100% Commitment

DOE Zero Energy Ready Home Quality Management Guidelines

ENERGY STAR Certified Homes Version 3.1

EPA Indoor airPLUS

Leed for Homes, silver



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.



A thick waterproofing paste is applied around window and door openings to provide a seamless layer of protection against rain intrusion. With the seams sealed, the ICFs provide a water-resistant barrier so no house wrap is needed.

duct, which pulls stale air out of the house. Both ducts pass through a heat exchanger which transfers heat and humidity from the warmer air to the cooler air, thus “recovering” warmth to heat up incoming air in the winter and cool 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 13 to help ensure clean air for the air-tight home.

The home is heated and cooled with a highly efficient air source heat pump rated to have a coefficient of performance (COP) of 3.62 and an energy efficiency ratio (EER) of 12. The air handler is located in the conditioned basement and all of the sealed metal ducts are located within the conditioned space of the home. The heat pump has a modulating condenser and variable-speed ECM blower.

Hot water is provided by an air-source heat pump water heater with a 50-gallon tank and an energy factor of 3.4.

Additional energy savings come from 100% LED lighting and ENERGY STAR rated appliances. Low-flow plumbing fixtures reduce water and water heating demand. Drought-tolerant turf and native plants were planted to eliminate the need for landscape irrigation systems.

Aebi noted that the ICF house is not only an energy-efficient house; it’s also a disaster-resistant house. 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 to freeze and interior temperatures can be maintained for days.

After 34 homes, the custom and production builder is beginning to make zero energy ready home construction look easy. In fact for Aebi the most challenging part isn’t technical difficulties with the construction. It’s “convincing everyone that building high-performance homes is easy and the right thing to do for us all.”

Photos courtesy of Greenhill Contracting

ACH 50 required in the Passive House Institute US (PHIUS) 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 13 filter on it. The ERV also contains an exhaust

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 membrane 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=0.20, SHGC=0.23, argon-fill, vinyl-framed.
- **Air Sealing:** 0.12 ACH 50.
- **Ventilation:** ERV continuous 20 cfm in baths and 43 cfm in kitchen with boost speeds and timers; MERV 13 and electrostatic filters.
- **HVAC:** Air-source heat pump, 3.62 COP, 12.0 EER, all ducts inside.
- **Hot Water:** Air-source heat pump water heater, 50-gal., 3.4 EF.
- **Lighting:** 100% LED.
- **ENERGY STAR Appliances:** Refrigerator, clothes washer, dishwasher, heat pump clothes dryer.
- **Solar:** 10.26-kW PV.
- **Water Conservation:** Low-flow fixtures; drought-tolerant plants.
- **Energy Management System:** None.
- **Other:** Disaster-resistant ICF construction with spray foamed roof and hurricane clips; triple-pane windows; maintains indoor temperature thru multi-day power outages. No-VOC paints; 75% of construction debris recycled.