U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

DOE ZERO ENERGY READY HOME™

U.S. DOE ZERO ENERGY READY HOME 2018 WINNER Housing Innovation Awards

High Performance Homes

Rose Acres
Westminster, MD

BUILDER PROFILE

High Performance Homes
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FEATURED HOME/DEVELOPMENT:

Project Data:

- Name: Rose Acres
- Location: Westminster, MD
- Layout: 6 bdrm, 3 bath, 1.5 fl + bsmt, 4,270 ft²
- Climate: IECC 4A, mixed-humid
- Completed: April 2017
- Category: custom for buyer

Modeled Performance Data:

- HERS Index: without PV 35; with PV 14
- Projected Annual Energy Costs: without PV $1,300; with PV $600
- Projected Annual Energy Cost Savings: (vs typical new homes) without PV $1,650, with PV $2,350
- Projected Annual Energy Savings: without PV 18,500 kWh; with PV 26,300 kWh
- Added Construction Cost: without PV $31,500, with PV $56,500
- Savings in the First 30 Years: $104,000

An empty-nester couple found everything they needed and more in this custom home built to the exacting standards of the U.S. Department of Energy's Zero Energy Ready Home program in Westminster, Maryland. The home provides 4,270 square feet of living space including two bedrooms plus his and her offices for the work-from-home couple; a great room, breakfast room, dining room, kitchen, and bathrooms on the main floor with full wheelchair accessibility; a second-story loft; a hot tub; a complete two-bedroom mother-in-law apartment in the daylight basement; and beautiful views of the surrounding countryside, all at energy bills of under $50 per month.

"After having outrageously high energy costs over the past several years, we now look forward to seeing how small our utility bills are each month," said the home owners. "We're truly enjoying the comfort of our DOE Zero Energy Ready home thanks to a geothermal heat pump and the R-value and air-tightness of SIPs construction, along with the insulated concrete foundation walls. The home effortlessly maintains even temperatures throughout, while delivering super clean air."

The home owners also sing the praises of their builder, Kiere DeGrandchamp, who launched High Performance Homes in Gettysburg, Pennsylvania, in 2014. DeGrandchamp builds five to ten custom or semi-custom homes a year, all of which are certified to the DOE Zero Energy Ready Home program. "The DOE ZERH program encapsulates everything we try to achieve – a quality built home that is livable, efficient, healthy, and environmentally friendly," said DeGrandchamp.

Every DOE Zero Energy Ready certified home is also labeled through the ENERGY STAR Certified Homes program and the U.S. Environmental Protection Agency's Indoor airPLUS program. To gain the DOE Zero Energy Ready Home label, homes must meet several mandatory criteria, including being insulated to meet or exceed levels specified in the 2012 International Energy Conservation Code, meeting the hot water distribution requirements of the EPA's WaterSense program, installing HVAC

ZERO ENERGY READY HOME
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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 3.0/3.1 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.

High Performance Homes built this 4,270-ft² custom home in Westminster, Maryland, to the high performance criteria of the U.S. Department of Energy Zero Energy Ready Home (ZERH) program. Even without the photovoltaic panels, the home achieves a very low HERS score of 35; with the 5.94 kW of PV roof shingles added, the home's HERS score is reduced to HERS 14.

What makes a home a DOE ZERO ENERGY READY HOME?

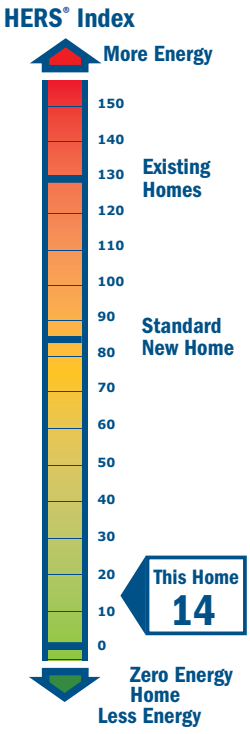
1 **BASELINE**
ENERGY STAR Certified Homes Version 3.0/3.1

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.

ducts (if any) within the conditioned space of the home, and installing solar electric panels or having the structural support, and the conduit and electrical panel space in place for future photovoltaic panel installation.

The 2018 award-winning home, dubbed Rose Acres by its owners, is a one-and-a-half story home with a walk-out basement. High Performance Homes constructed the below-grade walls of precast concrete panels with an integrated R-21 of rigid foam and integral metal-faced foam-insulated concrete studs. The panels were installed on site, then 2 inches of rigid extruded polystyrene (XPS) foam was laid down to provide an R-10 insulation layer under the entire poured concrete basement slab.

The above-grade walls were constructed of 6.5-inch R-23 structural insulated panels (SIPs), which provide an R-30 insulation value. The sturdy panels, which consist of two sheets of OSB sandwiching a layer of rigid expanded polystyrene foam, come to the site pre-cut for fast assembly with no construction waste. The solid panels block air flow and resist movement in high winds while the continuous layer of rigid foam stops heat transfer through the walls. Around the perimeter of the first-floor bands, a 4.5-inch-thick SIP wall was installed to eliminate any thermal bridging and provide an R-15 insulation value. The bands were sealed with 1 inch of closed-cell spray foam and further insulated with an R-19 batt between the floor joists. The entire assembly nets an R value close to R-30. Every crack and joint was sealed using low-expansion foam and caulk. The SIP panels were covered with house wrap plus tar paper behind the diamond lath on any areas to be clad with stone. The remainder of the house was clad with vinyl siding per manufacturer's instructions. At the wood-to-foundation transition, weep screed was installed to help ensure proper drainage.

The vented attic was insulated and air sealed along the entire ceiling deck with 1 inch of closed-cell spray foam then R-49 blown fiberglass for a total insulation value of about R-53. The attic has full ridge and soffit vents. The lifetime-warrantied roofing shingles were applied over 15# felt. The eaves, valleys, and gables all have ice-and-water shield that extends 12 inches past the interior plane of the walls. The builder used kick-out flashing and 5-inch sidewall flashing to help keep water out of the walls. All of the downspouts are connected to pipe to carry runoff 10 feet away from the foundation with pop-ups for overflow.

High Performance Homes installed ENERGY STAR-rated windows that are double pane with low-emissivity coatings and an argon fill with an insulation U-factor of 0.25 and a solar heat gain coefficient (SHGC) of 0.29.

ENERGY STAR appliances, LED lighting, and low-flow plumbing fixtures provide energy and water savings in the fully wheelchair-accessible kitchen and throughout the home. A ground-source heat pump heats the home and also provides most of the family's hot water.

The tight home was tested per DOE Zero Energy Ready Home requirements and showed air leakage of only 1.1 air changes per hour at 50 Pascals, which is more than twice as tight as is required by the 2015 International Energy Conservation Code.

To provide good ventilation for the home, DeGrandchamp installed a ventilation system that employs a fresh air intake, timered exhaust, and a controlled smart switch venting system that calculates the makeup air needed and opens the fresh air damper when needed to provide balanced fresh air.

The home is heated and cooled with an ultra-efficient ground-source heat pump. The closed-loop horizontal ground-source heat pump draws heat from the ground in the winter and sheds heat to the ground in the summer. The heat pump has a heating efficiency of 5.3 COP and a cooling efficiency of 24.4 EER or 27.4 SEER. All of the ducts are located within the conditioned space of the home.

The ground-source heat pump also helps to provide domestic hot water with a desuperheater that supplies hot water to a 55-gallon storage tank plus a .91 EF, 55-gallon electric water heater. A push-button-activated hot water recirculation pump and low-flow fixtures help to reduce hot water usage.

The highly efficient home achieves a Home Energy Rating System (HERS) score of 35, far below the 80 to 100 of typical code construction. With the addition of a 5.94-kW solar system, the HERS score drops to 14 and annual energy bills drop from an estimated $1,290 per year to $585 per year or $49 per month. To minimize the visual impact of the roof-mounted photovoltaic array, the builder selected PV shingles rather than panels. The shingles are similar in dimension to roofing shingles and actually take the place of some of the roof shingles for a profile that blends in.

One of the unique aspects of the project for DeGrandchamp was the design. The home owners, one of whom is a realtor, wanted the home to both look good and be very energy efficient. It also needed to be handicapped accessible as the husband is wheelchair bound. The home owners already owned the land and had already had plans drawn by an architect when they contacted DeGrandchamp. "Once we were contracted to build the home, we made engineering changes to accommodate the DOE Zero Energy Ready Home principles plus make the home accessible for the handicapped home owner," said DeGrandchamp. To facilitate the design process, DeGrandchamp set up three formal meetings with the home owners, in addition to many informal meetings. "To improve accessibility and to keep the home as energy efficient as possible, we wanted to make sure we were not missing out on any detail that could

HOME CERTIFICATIONS

- DOE Zero Energy Ready Home Program – 100% Commitment
- ENERGY STAR Certified Homes Version 3.1
- EPA Indoor airPlus
- DOE Zero Energy Ready Home Quality Management Guidelines
- National Green Building Standard

For DeGrandchamp "the biggest reward is always a happy home owner!"

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 house is wrapped in a blanket of thermal protection including an inch of spray foam plus R-49 of blown fiberglass above the ceiling, 6.5-in. SIP above-grade walls, foam-insulated precast-concrete below-grade walls, and a 2-inch-thick layer of XPS foam under the slab.

improve the home owner's ease and convenience when living and working in his home," said DeGrandchamp.

Among the changes DeGrandchamp made to improve accessibility were selecting and installing appliances that could be accessed from wheelchair height, designing the kitchen and master baths with roll-under sinks and counter tops, installing a wheelchair-friendly shower, adjusting the height of the electrical outlets and switches, relocating the electrical box from the basement to the main floor, and moving the solar inverters from the basement to the garage for accessibility. Other changes included designing zero-entry thresholds for the front door and garage entrance to the home and installing a wheelchair-accessible path to the basement entrance.

To improve energy efficiency, DeGrandchamp re-engineered the wall system to accommodate SIPs and other insulation improvements, moved a set of outside stairs that led to a room above the garage into conditioned space, and added insulation under the basement slab. He also adjusted the home's orientation on the site to maximize beneficial solar gain through the oversized south-facing windows. The eaves were extended to minimize overheating from high summer sun.

On all of his homes, to help ensure that the details specified in the plans get implemented during actual construction, DeGrandchamp holds individual meetings with all of the trade foremen as well as pre-construction meetings with teams that could include the excavator, framer, plumber, electrician, and HVAC geothermal contractor. "By the time the framer arrives, the team already knows where all of the utilities will be located, which reduces confusion and duplication of efforts," said DeGrandchamp. "We work with the same crews consistently. There is an expected level of expertise to be a part of one of our projects," said DeGrandchamp. "By working with the same teams over and over, we minimize the need to retrain or to explain our modifications from the typical building process."

"To qualify a home to this program, you have to be forward-thinking, creative, detailed, striving for improvement, and seeking repetitive predicted performance results. The DOE ZERH program is willing to educate builders to improve their techniques to reach such standards and the program also creates the opportunity for participants to learn from each other. The webinars, seminars, conferences, materials available online, and supportive DOE staff have created an environment of learning. We really like the fact that we can reach out to other builders in this program and discuss best practices or successes they have posted on their social media pages. We feel it is more of a community than a program," said DeGrandchamp.

Photos provided by High Performance Homes.

KEY FEATURES

- **DOE Zero Energy Ready Home Path:** Performance.
- **Walls:** 6.5″ R-23 SIPs; house wrap; stone and vinyl siding; 4.5″ SIPs; 1″ closed-cell spray foam + R-19 batt at rim joists. All joints caulked.
- **Roof:** Asphalt shingles, 15# felt; all eaves, gables, and valleys have ice-and-water shield; kick-out flashing; 5" sidewall flashing.
- **Attic:** Vented attic, 1″ closed-cell foam sprayed on ceiling deck + R-49 blown fiberglass = R-56 total.
- **Foundation:** Basement of R-21.3 insulated concrete panel walls; R-10 under slab.
- **Windows:** Double-pane, single-hung, low-e, argon-filled, U=0.24, SHGC=0.17.
- **Air Sealing:** 1.1 ACH 50.
- **Ventilation:** Controlled smart switch venting system that calculates makeup air; fresh air intake; timered exhaust.
- **HVAC:** Ground-source heat pump, 5.3 COP, 24.4 EER, 27.4 SEER; mastic-sealed ducts.
- **Hot Water:** 55-gallon desuperheater + 0.91 EF 55-gallon electric tank water heater. Push button recirculation pump.
- **Lighting:** 100% LED or CFL, all ENERGY STAR fixtures.
- **Appliances:** All ENERGY STAR.
- **Solar:** 5.94-kW PV system.
- **Water Conservation:** Low-flow fixtures; recirculation pump. Native landscaping.
- **Energy Management System:** Energy management system.
- **Other:** Low- or no-VOC products; motion-sensor garage exhaust fan; ADA accessible.

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