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

DOE ZERO ENERGY READY HOME™

U.S. DOE ZERO ENERGY READY HOME 2015 WINNER Housing Innovation Awards

High Performance Homes

Chamberlain Court #75
Gettysburg, PA

BUILDER PROFILE

High Performance Homes, Gettysburg, PA
Kiere DeGrandchamp
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Rater: Building Performance Solutions, LLC
John Hensley, johnh@bpsconsultant.com

FEATURED HOME/DEVELOPMENT:

Project Data:

- Name: Chamberlain Court #75
- Location: Gettysburg, PA
- Layout: 4 bedrooms, 4.5 baths, 2 floors, finished basement
- Conditioned Space: 6,869 ft²
- Climate Zone: IECC 5A, cold
- Completion: February 2015
- Category: Production

Modeled Performance Data:

- HERS Index: without PV 37, with PV 23
- Projected Annual Utility Costs: without PV $3,050, with PV $1,956
- Projected Annual Energy Cost Savings (compared to a home built to the 2009 IECC): without PV $2,801, with PV $3,895
- Builder's Added Cost Over 2009 IECC: without PV $30,000, with PV $55,000
- Annual Energy Savings: without PV 26,676 kWh, with PV 37,095 kWh

When Kiere DeGrandchamp founded High Performance Homes in 2013, he considered several different home labeling programs but the one he chose was the U.S. Department of Energy's Zero Energy Ready Home program.

"I just want the perfect house," said DeGrandchamp. "After doing research on other programs, this is the top as far as I'm concerned. It's the way we want to build. DOE offers the credentials and a good name to back it up. Every home I build will be DOE Zero Energy Ready labeled."

The production builder expects to build about 10 to 20 homes annually in Pennsylvania and Maryland and is currently building at a development of 450 homes called the Links at Gettysburg, Pennsylvania, where he has completed four homes and plans to build 300 more. The 2015 DOE Housing Innovation Award winning home is DeGrandchamp's first home to be completed at the Links and is the first home High Performance Homes has certified to the DOE Zero Energy Ready Home program.

The DOE Zero Energy Ready Home program requires homes to meet all of 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.

For DeGrandchamp, an important aspect of high-performance home construction is the whole-house approach—getting all the pieces and parts to work together. "You can take all the components and put them in a home and if you do it wrong, you can mess it up. That's why I think the third-party verification DOE requires is so important," said DeGrandcamp.

ZERO ENERGY READY HOME U.S. DEPARTMENT OF ENERGY

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.

High Performance Homes built this 6,869-ft² two-story home with daylight basement at the Links in Gettysburg, Pennsylvania. The production home was built to the U.S. Department of Energy's Zero Energy Ready Home program and will have energy bills of less than $2,000 per year despite its large size and cold climate location.

What makes a home a DOE ZERO ENERGY READY HOME?

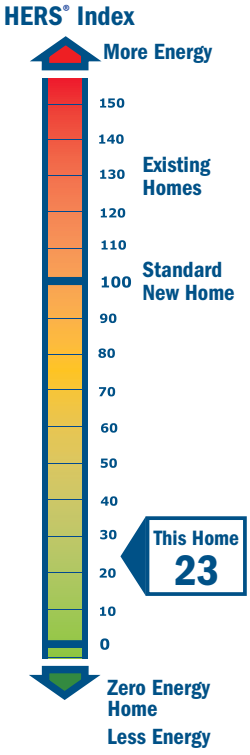
1 **BASELINE**
ENERGY STAR Certified Homes Version 3.0

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.

Home owners are now seeking out DeGrandchamp for this whole-house energy-efficiency approach. DeGrandchamp tells of a person in Colorado who read about a speech DeGrandchamp gave to the 18th Annual Congressional Renewable Energy and Energy Efficiency EXPO. He called DeGrandchamp ready to buy a lot that day. "He told me 'I've been looking for years for a builder who could put it all together," said DeGrandchamp.

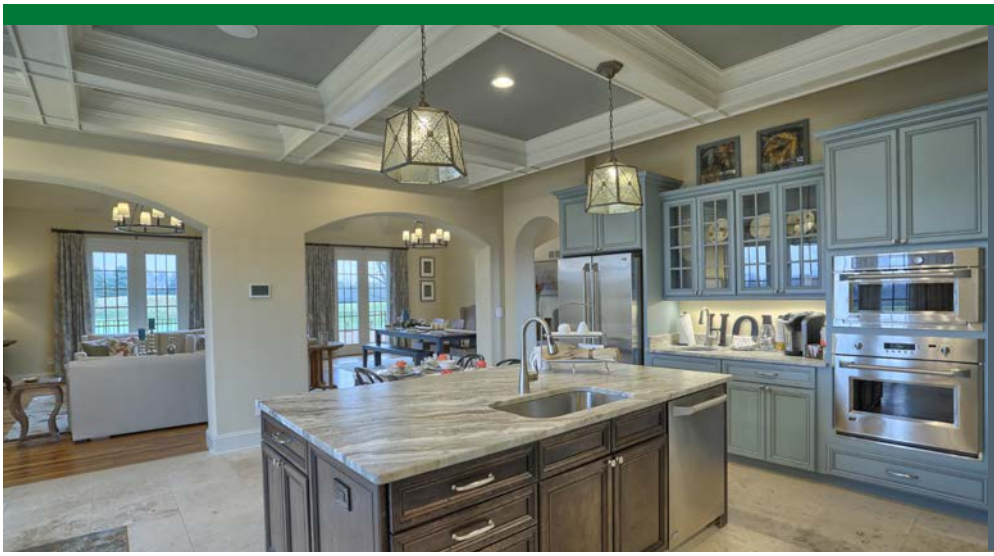
By putting it all together, DeGrandchamp has achieved significant levels of efficiency. "I exceeded the 2015 IECC (International Energy Conservation Code) by 16% on this house. One house at the Links was 23% better than the 2015 IECC," said DeGrandchamp. The award-winning home achieved a Home Energy Rating System score of 37 without a solar electric system, or HERS 23 when 6.26 kW of solar photovoltaic tiles were added to the roof. For comparison, a typical home built to the 2006 IECC would score a HERS 100.

DeGrandchamp's whole-house approach starts with an insulated basement. The poured concrete foundation walls are waterproofed with a spray-on coating. Under the slab, the builder installed 2 inches (R-10) of rigid XPS foam over a 4-inch-thick bed of crushed rock and a 6-mil vapor barrier, which also extended over the footer. The builder installed interior and exterior perimeter footing drains that go to daylight 10 feet out from the house. The gutters are oversized and all of the downspouts go 10 feet out to pop-up water diffusers.

The home is designed with a daylight basement. The lower-level daylight side walls consist of thick R-47 structural insulated panels (SIPs) (composed of two half-inch OSB layers sandwiching a 9.5-inch-thick layer of rigid foam) while the below-grade walls are insulated with .5-inch rigid foam that separates the concrete from the 2x4 stud walls, which are filled with R-15 batts. Some sections of the basement are unfinished; these are insulated on the inside with R-15 or R-19 fiberglass batt insulation.

The home's two stories of above-grade walls consist of 7-inch-thick R-24 SIPs. The rim joist areas are also constructed of R-24 SIPs. The SIPs are covered with house wrap. Weep screed is installed where applicable. The home is clad with stone and brick veneer.

Because the roof's complex design did not lend itself to SIP construction, regular roof trusses were used. The attic was air sealed and insulated along the underside of the roof deck with R-49 closed-cell spray foam. Knee walls were air sealed and insulated with rigid air sealing materials and spray foam. The



ENERGY STAR appliances, low-flow plumbing fixtures, and LED lighting add to water and energy savings, while the continuous thermal blanket protection provided by SIPs wall construction reduces heating and cooling bills in the expansive interiors.

sealed conditioned attic was tested for airtightness with a blower door, infrared camera, and visual inspection. The roofing is architectural shingles except where solar photovoltaic shingles were installed. This product consists of flexible photovoltaic tiles that are similar in dimensions to asphalt shingles and install in line with the shingles for a very low profile.

The home's windows are ENERGY STAR-certified, double-pane windows with wood and metal frames, an argon-gas fill between the panes to slow heat loss, and invisible low-emissivity coatings to limit heat gain. The windows have an insulating factor of U-0.26 and a solar heat gain coefficient (SHGC) of 0.28.

DeGrandchamp employed extensive air sealing throughout the home and achieved an airtightness of 1.15 air changes per hour at 50 Pascals (ACH 50).

The builder installed an energy recovery ventilator (ERV) to provide balanced whole-house mechanical ventilation. The system brings in fresh makeup air, which is circulated by the heating system's central air handler. Unlike an HRV, an ERV can transfer some moisture as well as heat to help remove moisture when humidity levels are high. The air is brought in through a HEPA filter. DeGrandchamp also installed an air cleaning system on the central air handler that removes 99.7% of contaminants via a MERV 14 filter and an ultraviolet (UV) cleaner.

The home's heating and cooling system consists of a ground source heat pump with two air handling units, both installed within the conditioned space of the home. The first air handler was installed in the mechanical room the conditioned basement. The second unit was installed upstairs. Notes DeGrandchamp, "I think I could have gotten away with one (indoor air handler). We built this home in the winter. The heat was set at 63, or 58 when we weren't in working in the house, and the upstairs unit never kicked on but the indoor temperature stayed in the low 60s." Most of the duct work is hard metal with a few feet of flex ducting for branch ducts. Duct leakage to unconditioned space was less than 10 cfm 25 and there was 0% leakage to the outside.

The outside part of the ground source heat pump consisted of a closed-loop well with a 700-foot vertical borehole. "I love geothermal," said DeGrandchamp. "It's using the ambient temperature of the ground, which stays around 55 degrees so I only need to move around 15 degrees to be comfortable at any time of the year. You can't get a more perfect system. It doesn't fail." The ground source heat pump has a heating efficiency of 4.4 COP.

HOME CERTIFICATIONS

DOE Zero Energy Ready Home Program, 100% commitment

ENERGY STAR Certified Homes Version 3.0

EPA Indoor airPLUS

National Green Building Standards, gold level

ENERGY STAR

Building America U.S. Department of Energy

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 home is equipped with a ground source heat pump for ultra-efficient heating and cooling. An ERV provides fresh air to the draft-free home.

A desuperheater attached to the ground source heat pump preheats domestic hot water in a 50-gallon tank then transfers it to a separate 50-gallon electric tank water heater. DeGrandchamp has installed circuit transducers on all of the appliances to see how much electricity they are using and said that the water heater is barely using any energy because of the preheating by the desuperheater.

The home is equipped with an energy management system that helps the home owner track energy usage and solar production. The builder installed 6.26 kW worth of solar shingles on the roof of the home. DeGrandchamp calculated that the solar shingles would add about $1,000 a year to the $2,800 in energy savings the home owner will already enjoy compared to a home built to the 2009 International Energy Conservation Code. The builder has committed to working with the solar shingle manufacturer to install the solar shingle product on all 300 homes at the Links.

The home meets all of the criteria of the EPA's Indoor airPLUS program, including low- or no-VOC carpets, paints, finishes, and glues. The home also meets the National Association of Home Builders (NAHB) National Green Building Standards, gold level.

Because this was the first DOE Zero Energy Ready home at the Links, DeGrandchamp provided extensive training to all of his subcontractors and employees. "The building envelope of this home is so important; every step needed to be completed and checked thoroughly before moving on to the next. We had pre-construction meetings with trades and post-installation checks to fix any problems."

For DeGrandchamp, the effort is worth it for the homeowner in terms of energy and maintenance savings. The effort is worthwhile for DeGrandchamp personally as well. "Every day I go to work, I know I'm affecting the world. I honestly think it's my responsibility to build a better house. This is the wave of the future, why not build to it now?"

Photos courtesy of High Performance Homes

KEY FEATURES

- **DOE Zero Energy Ready Home Path:** Performance.
- **Walls:** SIPs (R-24); house wrap.
- **Roof:** Asphalt shingles.
- **Attic:** Unvented; spray foam on underside of roof deck (R-49).
- **Foundation:** Basement walls insulated (R-15 and R-19); rigid XPS foam under floor (R-10).
- **Windows:** Double-pane; low-e; U=0.26; SHGC=0.28.
- **Air Sealing:** 1.15 ACH 50.
- **Ventilation:** ERV connected to central air handler; HEPA filters; MERV 14.
- **HVAC:** Ground source heat pump; COP 4.4.
- **Hot Water:** Desuperheater.
- **Lighting:** 90% LED; 10% CFL.
- **Appliances:** ENERGY STAR-rated refrigerator, dishwasher, and ceiling fans.
- **Solar:** 6.26-kW PV.
- **Water Conservation:** Low-flow fixtures; push-button timer and occupancy sensor controlled recirculation pumps; drought-tolerant plants; rain sensing irrigation.
- **Other:** Value engineered to reduce waste; low-VOC.

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