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

DOE ZERO ENERGY READY HOME™

U.S. DOE ZERO ENERGY READY HOME 2016 WINNER Housing Innovation Awards

Charis Homes

ICF Home
Richfield, OH

BUILDER PROFILE

Charis Homes, North Canton, OH
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Rater: Residential Energy Services
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FEATURED HOME/DEVELOPMENT:

Project Data:

- Name: ICF Home
- Location: Richfield, OH
- Layout: 4 bdrm, 4 bath, 2 fl + bsmt, 5,505 ft²
- Climate Zone: IECC 5A, cold
- Completion: January 2015
- Category: custom for buyer

Modeled Performance Data:

- HERS Index: without PV 31
- Projected Annual Energy Costs: without PV $2,322
- Projected Annual Energy Cost Savings (vs home built to 2009 IECC): without PV $4,144
- Projected Annual Energy Savings: without PV 27,741 kWh
- Added Construction Cost: without PV $22,000

Charis Homes built the first U.S. Department of Energy Zero Energy Ready certified home in the state of Ohio. The high-performance home, completed in 2015 in Richfield, Ohio, also earned Charis Homes its first Housing Innovation Award from DOE.

Charis Homes' founders Glenna Wilson and Todd Scott are also celebrating the fact that this home has earned their lowest HERS score to date, achieving a HERS 31 with no solar photovoltaic system included. A HERS (or Home Energy Rating System) score is an indicator of a home's energy performance. Typical new homes would score 80 to 100; a net zero home (one that produces all the power it uses in a year) would score a HERS 0. Wilson, who cofounded Charis Homes in 2003, said "We joined ENERGY STAR in 2004 and our first HERS score was 66. Our average HERS score is 40. With the DOE Zero Energy Ready Home we have achieved a HERS score of 31, our lowest ever. We're very happy about that."

The home owners are happy about it too. "Our old house was remodeled to be as energy efficient as possible. Our new home, which is built to the U.S. DOE standards, offers much more consistent indoor temperatures. It significantly reduces exterior noises and it offers us lower utility bills."

Every home built to the DOE Zero Energy Ready Homes criteria must be certified to ENERGY STAR Certified Homes Version 3.0 and the U.S. Environmental Protection Agency's Indoor airPLUS program. Each home must meet 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 solar electric panels installed or have the conduit and electrical panel space in place for future installation of solar panels.

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.

Charis Homes built this 5,505-ft² home in Richfield, Ohio, to the performance criteria of the DOE Zero Energy Ready Home (ZERH) program. The rear of the home takes advantage of a sloping lot for a conditioned daylight basement that permits more living space on a smaller footprint.

What makes a home a DOE ZERO ENERGY READY HOME?

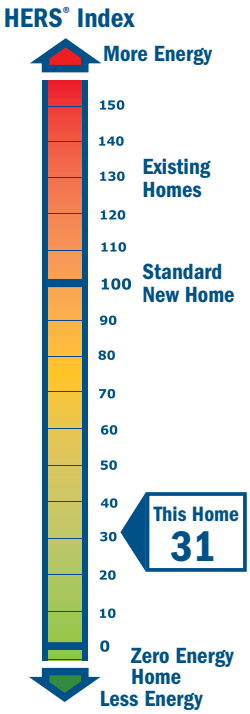
1 **BASELINE**
ENERGY STAR Certified Homes Version 3.0

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.

Charis Homes pre-wired the two-story-plus-basement home for future installation of solar panels and a battery storage system and engineered the garage roof to support the panels, which the home owner hopes to install in 2017.

Insulated concrete forms (ICFs) were used to construct the high-performance shell of the home. ICFs are like hollow blocks made of rigid foam. The blocks are stacked like bricks, reinforced with rebar, and filled with concrete, which hardens in place to form a very sturdy storm-resistant, moisture-resistant, fire-resistant, and bug-resistant structure that is also highly insulated and air sealed because of the continuous layers of insulation and concrete. The steel rebar runs both vertically and horizontally to provide walls that are rated to withstand winds up to 150 miles per hour.

The 11-inch-thick, R-22 ICFs were used to form the walls of the full basement, all the first-floor walls, and most of the second-floor walls of the 5,505-ft² home. The remaining second-floor walls consisted of 2x4 studs staggered to align with the front or the back of 2x6 top and bottom plates. This allowed the builder to weave R-23 of mineral wool around the studs to stop thermal bridging between the interior and exterior wall sheathing. The walls were sheathed with a sheathing product consisting of ½-inch rigid foam board adhered to OSB that was coated with a weather-resistant coating. The walls were covered with house wrap that was taped at the seams to provide a weather-resistant barrier. Tape flashing helps protect doors and windows from water intrusion. The below-grade surface of the exterior walls was covered with a dimpled plastic polyethylene membrane that relieves hydrostatic pressure against the wall by providing a pathway for liquid water to flow down to the footing drains.

The second-floor ceiling drywall forms the air barrier in the vented attic. To prevent air leakage, all drywall-to-top plate seams and joints were sealed with expandable spray foam. Crews carefully sealed around wiring, lighting fixtures, and bath exhaust fan ducts, etc., before installing R-50 of blown cellulose.

The ICF basement walls provide protection for the sides of the basement slab. Nailing strips in the ICF walls allowed the walls to be drywalled without the need for additional framing. Before pouring the slab, Charis Homes laid a pad of 8 inches of gravel and topped this with 2 inches of rigid foam board and a 6-mil vapor barrier. Radiant floor tubing was installed over this then the 4-inch concrete slab was poured over the tubing. For the first and second floors, radiant

The walls and foundation of this home are constructed using insulated concrete forms. The ICFs provide a mold-resistant, pest-resistant, storm-resistant and highly insulating shell for the basement, first-floor, and second-floor walls. A water-resistant barrier of dimpled plastic protects the below-grade surface of the basement walls.

floor tubing was attached to the underside of the subfloor then covered with foil-faced radiant insulation.

A ground-source heat pump supplies hot water for the radiant floor heating and provides most of the domestic hot water. A tankless gas water heater serves as a backup source for the domestic hot water and for floor heating. The heat pump also provides cooling.

The ICF construction and careful air sealing produced a draft-free home that was blower door tested for air tightness and showed an air leakage rate of only 1.65 air changes per hour at 50 Pascals. This is well below the 3 ACH 50 required by code for the cold climate zone. To bring fresh air into the home, an energy recovery ventilator (ERV) was installed. The ERV cycles on for 20 minutes each hour on low speed, drawing fresh, filtered air into the home while exhausting stale air from the home. A heat exchanger transfers warmth from the warmer duct to the cooler duct to heat incoming air in the winter and cool incoming air in the summer. The ERV utilizes a bathroom kit that increases exhaust air flow from bathroom areas when the light is switched on.

For added energy savings in the home, all of the light fixtures have ultra-efficient LED light sources. All of the ceiling fans, laundry, and kitchen appliances are ENERGY STAR rated. For added protection, a whole-house surge suppressor was installed.

The home was situated on the lot so that the garage roof would have adequate south-facing space for the future addition of 10 kW of PV panels. The home was pre-wired for solar panels and a battery storage system.

Storm water runoff is managed on site with downspouts and underground piping and proper grading and swales that direct surface water to a storm water drainage easement located on the sloped property.

Wilson estimated the project cost is about 3% more than an ENERGY STAR home or 6% more than a standard code home but incentives will offset some of the costs, including utility rebates and a 30% federal tax credit to the home owner for the ground source heat pump. The home owner could recoup that 3% difference in about three years. Without the PV, Wilson calculated that the home owner's annual energy bills will be about $2,300 but their annual savings compared to a code-built home will be over $4,100.

HOME CERTIFICATIONS

DOE Zero Energy Ready Home Program

ENERGY STAR Certified Homes Version 3.0

EPA Indoor airPLUS

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.

Fiber cement and stone siding add to the durability of the ICF home while low-emissivity coatings on the double-pane windows contribute to energy savings.

With a little extra marketing effort, there has been some immediate return on investment for Charis Homes. Charis Homes promoted its first certified DOE Zero Energy Ready Home on its website, Facebook, and Twitter. Charis Homes also sent out press releases, which resulted in the home owner of the DOE Zero Ready Home being interviewed by the local newspaper.

"Leading up to our first certification, we began promoting our partnership with the DOE by having brochures printed and available in our model home. We also began educating our client list by sending emails and posting on social media. And we added an informational page on our website," said Wilson. "The extra cost to build has been offset by the free media coverage we have received. Those articles have resulted in meetings with several potential new clients."

Reaching this level of efficiency was a team effort for Charis. "We collaborated with our ENERGY rater, George Trappe at Residential Energy Services, our HVAC company, and Performance Systems, a facilitator who implements training between the building industry and utility companies. We met many times before the project began to ensure all the correct processes, procedures, and products were used in the home," said Wilson.

For Wilson and Scott, though, the best part is running into their home owners in the neighborhood and hearing how pleased they are with their new homes.

Photos courtesy of Charis Homes

KEY FEATURES

- **DOE Zero Energy Ready Home Path:** Performance.
- **Walls:** Mostly 11-inch-thick, R-22 ICFs, some 2x6 walls with ½" foam board exterior, house wrap.
- **Roof:** Self-adhered 50 mil. membrane in valleys, synthetic felt, 30-year architectural shingles.
- **Attic:** R-50 blown cellulose.
- **Foundation:** 11-inch-thick, R-22 ICFs with dimpled-plastic water barrier over below-grade surfaces.
- **Windows:** Double-pane, low-e, argon-filled, U=0.34, SHGC=0.29.
- **Air Sealing:** 1.65 ACH 50.
- **Ventilation:** ERV, bath exhaust fans.
- **HVAC:** Geothermal heat pump with back-up tankless water heater for heating, hot water, and air conditioning.
- **Hot Water:** Geothermal heat pump desuperheater with back-up tankless water heater.
- **Lighting:** 90% LED, 10% CFL.
- **Appliances:** ENERGY STAR kitchen and laundry appliances, ceiling fans.
- **Solar:** Pre-wired for solar PV, expect to install in 2017.
- **Water Conservation:** Low-flow toilets.
- **Energy Management System:** Programmable thermostat for each floor.
- **Other:** Active radon system with variable speed fan.

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