

Evolutionary Home Builders

The Adaptation Home Geneva, IL



BUILDER PROFILE

Evolutionary Home Builders, Geneva, IL
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FEATURED HOME/DEVELOPMENT:

Project Data:

- Name: The Adaptation Home
- Location: River Forest, IL
- Layout: 5 bedrooms, 5 baths, 2 floors, full basement
- Conditioned Space: 4,798 ft²
- Climate Zone: IECC 5A, cold
- Completion: June 2014
- Category: Custom

Modeled Performance Data:

- HERS Index: without PV 30
- Projected Annual Utility Costs: without PV \$1,010
- Projected Annual Energy Cost Savings (compared to a home built to the 2012 IECC): without PV \$717
- Builder's Added Cost Over 2012 IECC: without PV \$4,300
- Annual Energy Savings: without PV 7,018 kWh

Evolutionary Home Builders in Geneva, Illinois, west of Chicago, is building 6 or 7 new homes a year, all to the high performance criteria of the U.S. Department of Energy's Zero Energy Ready Home program. The builder, Brandon Weiss, had two winning homes in the DOE 2013 Housing Innovation Awards.

This year's winning home, a 5-bedroom, 4,798-ft² two-story plus basement in River Forest, Illinois, will be 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 solar electric panels installed or have the conduit and electrical panel space in place for it.

The home will also be certified to the National Association of Home Builders Nation Green Building Standard emerald level. It would likely meet the Passive House U.S. criteria said Weiss although the home buyer has not requested it.

The home is located on a tight city lot. Weiss designed the house to be square in shape for efficiency and to get the back yard to the size the home owners wanted. The house was pushed to the north setback as far as possible to maximize southern exposure. There are many large deciduous trees on the east and west boundary of the lot, which help with summer shading. Drought-tolerant native plants and grasses were used to achieve water efficiency and eliminate the need for irrigation. The home owners wanted the home to have a craftsman feel with some Tudor influences. The home's large front porch allows for shading within this architectural style. Weiss kept the south side simple in shape so he could maximize solar heat gain in the winter. The simple shape also allows the builder



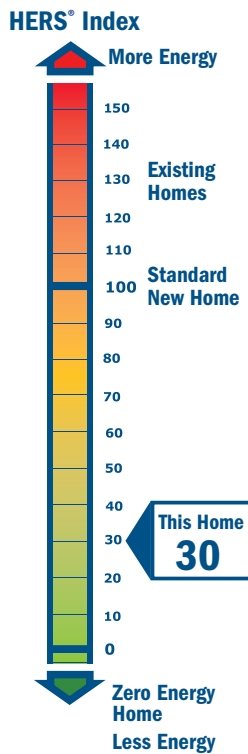
The U.S. Department of Energy invites home builders across the country to meet the extraordinary levels of excellence and quality specified in DOE's Zero Energy Ready Home program (formerly known as Challenge Home). Every DOE Zero Energy Ready Home starts with ENERGY STAR Certified Homes Version 3.0 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 details are part of every aspect of this two-story home built by Evolutionary Home Builders in River Forest, Illinois, to the criteria of the U.S. Department of Energy's Zero Energy Ready Home program. Highly efficient heat pumps provide heating and cooling while an energy recovery ventilator and highly selective choices on indoor finishes, paints, and glues help to ensure healthier indoor air.



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.



to use continual load paths and tie downs in key places to help with disaster resistance and durability. Weiss elected to use fewer windows on the project, but to make those windows larger for natural daylighting and a sense of connection to the outdoors.

The home's construction starts with a concrete foundation, poured over two layers of 2-inch XPS rigid foam. Weiss also installed two layers of XPS 2-inch foam on the outside of the wall and 2 inches on the inside of the wall. This provided a total insulation value of R-30 on the foundation walls. The 2 inches of XPS at the slab perimeter provide a thermal break between the slab and the foundation wall. The foundation was waterproofed with a liquid-applied waterproofing membrane with 15 feet of head pressure resistance.

The home was stick built using advanced framing techniques including two-stud corners, right sized headers, 2x8 24 inch on-center studs, open-web floor trusses, and attic trusses. The wall cavities were filled with fiberglass blown-in batts (BIBs). The exterior was sheathed with CDX plywood that was then coated with a liquid-applied weather-resistant barrier, after the joints and seams were treated with the seam sealer. This provided a continuous air barrier and a backup water barrier. Weiss then used two layers of 2-inch reclaimed polyiso exterior continuous insulation that came from a commercial roof tear-off within 300 miles of the project site. He covered the polyiso with house wrap to serve as the primary weather-resistant barrier. He then installed a 3/4-inch ventilated rain screen with corrugated vented plastic strips at the top and bottom of the wall plus 1x3 furring strips. The house was clad with an engineered wood siding product that has a 30-year warranty on the finish. The house walls were framed, air sealed, insulated, and wrapped with house wrap before the attached garage and porches were framed to keep a consistent air and thermal barrier between these elements and the building shell for the conditioned building.

The roof has prefab trusses that were dropped into place with a crane and sheathed with 3/4-inch CDX plywood. Weiss used ice-and-water shield 6 feet up from the gutter eaves, 18 inches in from the rakes, and 18 inches up any roof-to-wall connections. He installed a double layer with an 18-inch lap in all the valleys. All of the hips and ridges (except where it was cut for ridge vents) were also coated with ice-and-water shield. All edges of the roof received edge metal flashing (at both rakes and eaves). All penetrations were sealed with a joint and seam sealer and then flashed with ice-and-water shield. Weiss used a synthetic underlayment



The home is equipped with 100% LED lighting, ENERGY STAR appliances, and EPA WaterSense rated plumbing fixtures for energy and water savings. A heat pump water heater (COP 2.4) is centrally located in the basement mechanical room and has a recirculation pump to speed hot water to faucets through insulated pipes. The heat pump water heater's cool exhaust air is ducted up behind the refrigerator to improve the refrigerator's cooling efficiency.

in the field of the roof. Architecturally raised asphalt 50-year shingles were used as finish roofing.

Numerous extra air sealing details were incorporated into the attic. After the trusses were installed, the builder attached half-inch sanded CDX plywood under the trusses. This integrated with a strip of plywood they had installed at the top of the top plates (and glued down using joint and seam sealer) prior to landing the trusses. This connection was sealed to the top plates with a continuous bead of sealant, then sealed on the outside with sealant and spray foam over the top. All of the seams on the inside were sealed with a high-performance air sealing tape. Penetrations through this plywood layer were minimized by installing a dropped drywall ceiling 11 inches below the plywood so mechanicals could be run between the plywood and the drywall. The only penetrations were conduit for future solar, conduit for attic lighting (required by code), a radon vent pipe, and one plumbing stack vent. Those penetrations were sealed with seam sealant, followed by EPDM gaskets, which were then taped with air sealing tape to the plywood. Then Weiss' crews sealed again from inside the attic with the sealant. Weiss installed baffles at all the eaves and used open-cell spray foam to seal them in place and to keep insulation from falling into the eaves. His crews then blew R-100 of fiberglass insulation onto the floor of the vented attic.

Weiss selected windows that were Passive House-compliant, UPVC-framed, triple-glazed, and argon-gas filled with a U-factor of 0.08 and a solar heat gain coefficient (SHGC) of 0.5. The exterior doors had an R-8 insulation value.

All of the air sealing details helped Weiss achieve a very airtight home that measured 0.33 air changes per hour at 50 Pascals for whole house air leakage.

Quality control is key to achieving the high levels of performance required to meet DOE's Zero Energy Ready Home criteria. Weiss held kickoff meetings with all trades prior to starting. All of the trades had worked on Weiss' previous Passive House project and he stressed the importance of improving air leakage in this house. Weiss has been using the same subcontractors for several years so they are trained in the techniques he requires.

The company has its own blower door so it can test after air sealing to find any missed holes. Weiss brought the rater in before insulation to do blower door testing. He also used theatrical smoke and thermal imaging to help find small leaks. The rater tested again during his insulation inspection and used thermal

HOME CERTIFICATIONS

DOE Zero Energy Ready Home Program, 100% commitment

ENERGY STAR Certified Homes Version 3.0

EPA Indoor airPLUS

National Green Building Standards: emerald level

Passive House Institute U.S. +



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 liquid-applied weather-resistant barrier plus 4 inches of rigid foam exterior insulation help provide a superior building envelope.

To provide fresh air to the home, an energy recovery ventilator was installed that supplies fresh air to the bedrooms and living areas through separate ducts while exhausting air out of the kitchen, baths, and laundry, with booster switches. The ERV model installed is one of the most efficient at heat recovery on the market and is set to operate around the clock year round, at a cost of about \$30/year to operate.

Two air-to-air heat pumps provide efficient heating and cooling with a cooling efficiency of SEER 14.1, a heating efficiency of HSPF 9.6, a coefficient of performance (COP) of 2.7, and an EER of 9.3. The units are concealed in the ceilings of closets on the first and second floors and ducts are run through the dropped ceilings to each of the rooms.

Solar panels were not installed on the home but conduit and electrical panel space were roughed in. Weiss calculated that a 5- or 6-kW photovoltaic system would get the home to net zero.

Weiss is active in the U.S. Green Building Council of Illinois and the local Passive House Alliance of Chicago and worked with both organizations to start a Green Built Home Tour in 2013. He noted that the tour is getting increasing attention with 500 people participating last year.

Weiss thinks interest in high-performance homes is growing and feels that the DOE program is helping increase that awareness. “I definitely like what DOE’s doing,” said Weiss, who said he will continue with the program to work on improving his company’s homes. “Always trying to improve performance keeps us going.”

Photos courtesy of Evolutionary Home Builders

imaging to determine if there were any density issues in the insulation installation. Weiss’s crews also tested core samples of the fiberglass BIBs insulation and weighed them to ensure proper density. The home’s airtightness was tested by Weiss again with the blower door after drywalling to check for improvements following implementation of airtight drywall techniques.

Weiss also works with a third-party laboratory to do air quality testing. They run 24-hour tests to see if things are off gassing at different times of day because of sunlight. He has been air quality testing for four years and has noticed a big difference in products with more VOC-free products available. Although this home was not a Living Building Challenge project, Weiss has met that certification on a previous house and seeks to be implement some of the measures on all his homes.

KEY FEATURES

- **DOE Zero Energy Ready Home Path:** Performance.
- **Walls:** Advanced framing; 2x8; 24" on center; 2-stud corners; right sized headers; blown-in fiberglass; CDX plywood sheathing; liquid-applied weather-resistant barrier; two 2" layers of reclaimed polyiso rigid foam exterior; house wrap; .75" vented plastic furring strips; engineered wood siding.
- **Roof:** CDX plywood sheathing; 6' ice-and-water shield at eaves; 18" along all rakes, roof-to-wall joints, and roof ridges; all penetrations sealed and flashed; synthetic underlayment; 50-year asphalt shingles.
- **Attic:** Blown-in fiberglass over plywood attic floor (R-100); dropped drywall ceiling below plywood for an air-sealed duct service cavity; all framing and ceiling joints sealed with tape and gaskets.
- **Foundation:** 4" XPS outside basement walls; 2" XPS inside basement walls; 4" under slab; 2" between slab edge and stem; liquid-applied water proofing.
- **Windows:** Triple-pane; argon-filled; UPVC framed; low-e; U=0.08; SHGC=0.5.
- **Air Sealing:** 0.33 ACH 50.
- **Ventilation:** Continuously running ERV; MERV 15 filters.
- **HVAC:** Two air-to-air heat pumps; SEER 14.1; HSPF 9.6; COP 2.7; EER 9.3.
- **Hot Water:** Heat pump water heater (COP 2.4).
- **Lighting:** 100% LED.
- **Appliances:** ENERGY STAR-rated refrigerator, clothes washer, dishwasher, and ceiling fans.
- **Solar:** Ready.
- **Water Conservation:** All EPA WaterSense-rated fixtures.
- **Other:** GreenGuard certified products; wired for back-up generator; low-VOC.