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

DOE ZERO ENERGY READY HOME™

U.S. DOE ZERO ENERGY READY HOME 2024 WINNER Housing Innovation Awards

Addison Homes

Westbrooke Infill
Powdersville, SC

BUILDER PROFILE

Addison Homes
Greer, SC
www.addison-homes.com
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FEATURED HOME/DEVELOPMENT:

Project Data:

- **Project name:** Westbrooke Infill
- **Location:** Powdersville, SC
- **Layout:** 4 bdrm, 3.5 bath, 2 fl + bsmt, 3,682 ft²
- **Climate:** IECC 5A, cold
- **Completed:** August 2022
- **Category:** Affordable

Modeled Performance Data:

- **HERS Index:** without PV 36
- **Annual Energy Costs:** without PV $1,600
- **Annual Energy Cost Savings:** (vs typical new homes) without PV $2,300
- **Annual Energy Savings:** without PV 19,970 kWh
- **Savings in the First 30 Years:** without PV $95,800

Todd Usher, president of Addison Homes in Greenville, South Carolina, considers himself a semi-custom home builder, offering his home buyers a curated suite of house plans, interior, and exterior finish options. However, for the benefit of his home owners, there is one upgrade that Usher offers as standard on all of his homes. Every home is constructed to the high performance criteria of the U.S. Department of Energy (DOE)'s Zero Energy Ready Home program.

The DOE program has ENERGY STAR and EPA Indoor AirPlus home certification and the latest energy codes as its baseline so every home provides its home buyers with the health, resiliency, and utility bill savings these programs offer. Other Zero Energy Ready Home requirements help ensure water savings; HVAC and water heating efficiencies; and third party-verified air sealing to minimize drafts and keep out bugs, dust, smoke, and pollens. While homes aren't required to have solar electric panels, this voluntary program specifies installation of the electrical infrastructure and space in the home for future installation of PV, as well as electric vehicle chargers, heat pumps, and heat pump water heaters, offering homeowners the option and ease of future installation should they choose it.

Usher is unique in his market in focusing on DOE Zero Energy Ready Home construction. Addison Homes completed their first DOE Zero Energy Ready Home in 2015—one of the first in the state of South Carolina. Addison is currently the only South Carolina builder certifying homes to the requirements of the program. They have constructed 11 homes to the program standards, including six homes that have won DOE Housing Innovation Awards. In 2024, Addison was recognized with their second DOE Zero Energy Grand Award.

The four-level home is proof that DOE's Zero Energy Ready Home requirements may be a recipe but they aren't a cookie cutter. This home is unique for Usher in terms of both its layout and some of the technologies incorporated into the home.

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. Every DOE Zero Energy Ready Home starts with ENERGY STAR Certified Homes Version 3.2 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.

Addison Homes constructed this 3,682-ft² home in Powdersville, South Carolina, to the high performance criteria of the DOE Zero Energy Ready Home (ZERH) program. Extensive air sealing with tape, elastomeric caulk, and wide-spray canned foam helped the builder achieve an exceptionally tight home that showed an air leakage rate of 0.7 air changes per hour at 50 Pascals pressure differential, providing homeowners a draft-free home and contributing to an estimated annual utility bill savings of $2,300.

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

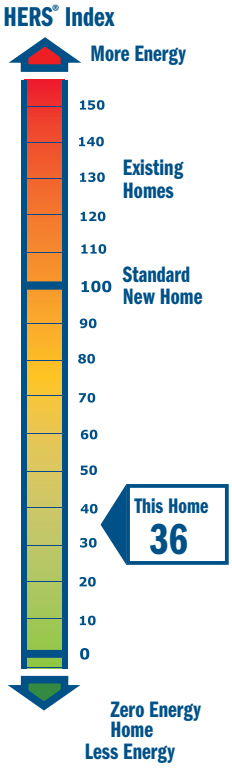
3 **DUCT SYSTEM**
located within the home's thermal boundary

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.



The narrow, sloping, wedge-shaped lot was the last available in a 30-year-old suburban neighborhood. The lot dimensions left little room to spread out, so Usher worked with the owners on a floorplan that went up, with two full stories plus a partial third floor to house the fourth bedroom, fourth bath, and playroom, while a walk-out basement below contains the garage, mechanicals, rec room, and storage.

While many past Addison homes have had an insulated crawlspace, the sloped lot of this home was ideal for a daylight basement, providing more living space within the compact 38.5-by-25.6-ft footprint. The basement walls were constructed of pre-cast concrete panels engineered specifically for the home. The concrete walls have waterproofing on the exterior while an integrated rigid foam layer wraps the inside surface of the walls and molded concrete studs. The foam-wrapped studs are faced with metal to provide an interior drywall nailing surface. The panels are made offsite in a factory in North Carolina and trucked to the home site where they can be set in place with a crane in less than a day. "Construction can begin immediately and we don't have to do anything other than run electrical through them and hang drywall," said Usher, who noted, "for us this is more cost effective than doing a poured concrete wall that then has to be cured waterproofed, insulated, and framed."

The stick-framed walls of the home were constructed with several advanced framing techniques including 2x6 studs at 24-inches on-center spacing, two-stud (not three-stud) corners with drywall clips, open and insulated headers, and ladder blocking rather than solid blocking at interior wall intersections. All of these steps reduce the amount of lumber needed for framing while increasing the amount of space in the walls for insulation. The walls were packed with R-19 unfaced fiberglass batts then sheathed with a coated OSB with a one-inch layer of polyisocyanurate foam glued to the inside surface. "This is the first home we built using a wall assembly construction of 2x6s at 24 inches on center and the R-6 coated sheathing," said Usher. "Moving from R-13 cavity insulation to R-19 makes the house far more energy efficient, with thicker, quieter walls, and did not add significant overall cost."

Usher credited the coated insulated sheathing with helping them achieve exceptional air tightness. "This product did not require the special nails and tape that other exterior insulation products have required. It saved us multiple labor steps since it includes sheathing, continuous insulation, and weather barrier in one product," said Usher. The product recently became available in Addison's area and Usher is already using it on other homes.

An 80-gallon heat pump water heater provides domestic hot water with an efficiency of 4.07 UEF. A "smart" recirculation pump speeds hot water to faucets for shorter wait times and less water loss. The heat pump water heater is Internet connected and has leak detection with an automatic shut off valve. ENERGY STAR lighting adds to electricity savings.

For the gable roof assembly, Usher used locally made engineered roof trusses and, as with previous homes, insulated along the underside of the attic with 8 inches of open-cell spray foam that covered all truss top chords, providing an attic insulation value of R-31 and an unvented conditioned attic space for ducting and living space. Addison incorporated a "vapor vent" along the ridge of the roof using a vapor-open house wrap beneath roof ridge venting to avoid potential condensation issues. All seams in the OSB roof sheathing were taped per the Insurance Institute for Building and Home Safety (IBHS) Fortified Roof standard to increase the home's hurricane resistance. The roof was topped with synthetic underlayment and asphalt architectural shingles.

"Offsite-manufactured components like roof trusses, floor trusses, and basement wall panels, and the accompanying engineering plans that specify the location for each component, are integral to our approach to quality construction, as they avoid framers having to make a lot of ad hoc decisions in the field," said Addison. "They also reduce labor time and waste for cost savings."

The ventilation system for the home consists of fresh air intakes on the ventilating dehumidifier and exhaust fans (not balanced). The central thermostats control the HVAC setpoint for heating and cooling, a humidistat for control of the dehumidifiers, and ventilation control based on ASHRAE 62.2. The bath exhaust fans are controlled by a humidity sensor, a timer, and a manual switch. The range hood is wired to open the fresh air damper when the range hood is in use to provide makeup air, although this is not required by code or the DOE Zero Energy Ready Home standard. Space heating is provided by two high-efficiency (9.2 HSPF2, 18.7 SEER2) variable-speed heat pumps: 1.5-ton for the basement and main level and 1 ton for the two upper floors. "That's just 2.5 tons for all 3,682 ft^2," said Usher. Both systems were sized using ACCA Manual S based on a Manual J load calculation. Transfer grilles were used to balance air pressures between rooms and return ducts. Usher selected a compact duct system using 3-inch and 4-inch-diameter uninsulated ducts that run through the floor cavities of the home. Each heat pump was paired with a ventilating dehumidifier to manage the latent load in the home and to provide fresh air ventilation.

"This is the first time we used thermostats with integrated controls for temperature, dehumidification, and ventilation fresh air," said Addison. The thermostats are connected to the internet where the homeowner can control the home's systems and monitor electrical usage of the whole house and individual circuits.

HOME CERTIFICATIONS

DOE Zero Energy Ready Home Program - 100% Commitment

ENERGY STAR Certified Homes Version 3.1

EPA Indoor AirPlus

"The small-diameter ducts were perfect for the space limitations of the compact home. This was the first home in South Carolina to use the [compact] duct system and it worked flawlessly."

–Todd Usher, President, Addison Homes

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 attic is insulated on the underside of the roof deck with 8 inches of open-cell spray foam, providing an insulated space for the small-diameter HVAC ducts as well as additional living space.

To get the kind of HVAC performance Usher wants, he has taken the unusual step of bringing all of his HVAC design in house. "We currently do the HVAC system design, procure the equipment and ductwork materials, then hire installers and provide them with step-by-step installation instructions," said Usher.

Usher, a recent PhD graduate and current professor in Clemson's Department of Construction Science and Management, has put his educator skills to use, not just with subcontractors but also with college students, code officials, and fellow builders. Addison is also a frequent speaker at conferences, a prolific blogger on LinkedIn, and recently a developer of building science YouTube videos.

One of his most appreciative audiences may be Addison Homes' clients. For every home buyer, Usher prepares a 75- to 100-page homeowners manual that includes explanations of all of the systems in the home with warranty and maintenance information.

He also makes house calls. "We are always available to past clients for questions and consultation. We have also started to offer home maintenance services, where we monitor and maintain the systems in our past clients' homes on service agreements," said Usher. "We firmly believe that continuing relationships and service after the sale is absolutely critical for zero energy homes because of the lack of understanding of high-performance homes in the market among contractors."

KEY FEATURES

- **Walls:** 2x6 24″ o.c. + 1″ Polyiso, R-25 total: advanced framed, R-19 unfaced fiberglass batt in cavity, 7⁄16″ coated OSB with taped seams; 1″ rigid polyiso; composite polymer siding.
- **Roof:** Gable truss roof, 7⁄16″ OSB roof sheathing, synthetic roof underlayment, asphalt architectural shingles.
- **Attic:** Unvented attic, 8″ R-31 open-cell spray foam on underside of roof deck. 10″ raised-heel trusses.
- **Foundation:** Insulated basement. Precast concrete wall system with adhered 2.5″ rigid polyiso on interior with metal facing over insulation-wrapped concrete studs; ½″ drywall.
- **Windows:** Double-pane windows, U=0.26, SHGC=0.19.
- **Air Sealing:** 0.70 ACH50; insulated sheathing sealed with tape; airtight precast foundation.
- **Ventilation:** Bath exhaust fans with humidity and timer controls. Ventilating dehumidifier w humidity controls & MERV 13 filters, tied to HVAC air handler. Fresh air intake tied to range hood.
- **HVAC:** Central variable-speed heat pump, 9.2 HSPF, 18.7 SEER; small-diameter compact ducts; MERV 16 filters; transfer grilles.
- **Hot Water:** Heat pump water heater, 80-gal, 3.45 COP; internet-tied auto leak detection and shutoff. Adaptive recirculation loop.
- **Lighting and Appliances:** LED lighting, ENERGY STAR appliances.
- **Solar:** None.
- **Energy Management System:** Electricity consumption and IAQ of whole house and specific circuits monitored and tracked.
- **Other:** Wired for an electrical vehicle charger.

Photos courtesy of Addison Homes

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