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

DOE ZERO ENERGY READY HOME™

U.S. DOE ZERO ENERGY READY HOME 2014 WINNER Housing Innovation Awards

Sterling Brook Custom Homes

Village Park Eco Home
Double Oak, TX

BUILDER PROFILE

Sterling Brook Custom Homes, LLC
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Wayne Atkins
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FEATURED HOME/DEVELOPMENT:

Project Data:

- Name: Village Park Eco Home
- Location: Highland Village, TX
- Layout: 4 bedrooms, 3.5 baths, 2 floors
- Conditioned Space: 3,752 ft²
- Climate Zone: IECC 3A, hot-humid
- Completion: April 2014
- Category: Custom

Modeled Performance Data:

- HERS Index: without PV 44
- Projected Annual Utility Costs: without PV $2,000
- Projected Annual Energy Cost Savings (compared to a home built to the 2009 IECC): without PV $1,706, with PV NA
- Builder's Added Cost Over 2009 IECC: without PV $46,000
- Annual Energy Savings: without PV 12,702 kWH, 110 Therms

Custom home builder Wayne Atkins built his first U.S. Department of Energy-certified Zero Energy Ready Home with the hope of getting more people familiar with the concept of zero energy ready construction. By any measure, he's succeeded in getting the word out.

Since completion of the Village Park Eco Home in Highland Village north of Dallas-Fort Worth, Texas, in April 2014, more than 1,300 people have toured the home and thousands have visited the website or viewed YouTube videos of the home's construction. Consumers and builders have learned about the house through local and regional news stories and through social media including Facebook, Pinterest, Twitter, and Instagram.

Atkins attracted a bit of star power to the project by inviting a cohost of the local radio talk show "House Talk Today" Chris Miles, a veteran home builder, to be a consultant on the project. Atkins also had the collaboration of 8 presenting sponsors, 28 product sponsors, and 8 furnishings sponsors who donated supplies and technical support, and helped to spread the word about the home.

Other collaborators on the project included Wayne's wife, Cherri Atkins of Atkins Design Group, who created the house plan and a local interior design firm that decorated the home prior to the tours. A local graphic design firm painted one room in a jungle theme in honor of a young Dallas Make a Wish Foundation recipient who wanted to be a zoo keeper. These collaborations and marketing efforts generated a lot of excitement about the project. An offer was accepted on the home within a week of the first tour. More importantly, thousands of homeowners and builders got to see what is possible in zero energy-ready construction. As Phil Crone, executive officer for the Dallas Builders Association, noted, the home "is an outstanding learning lab."

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.

Engineered studs of wood mixed with resin provided very straight, strong studs for the 2x6 walls. Advanced framing techniques like 24-inch on-center stud spacing, single top plates, 2-stud corners, and open headers over windows allowed for more insulation in the walls while providing adequate strength.

What makes a home a DOE ZERO ENERGY READY HOME?

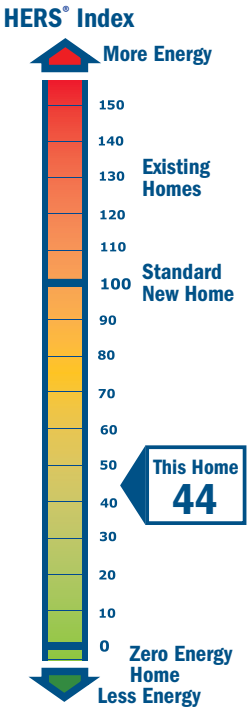
1 **BASELINE**
ENERGY STAR Certified Homes Version 3.0

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.

The home that everyone came to see presents an impressive suite of energy-efficiency components that work together to provide an award-winning home that should save its homeowners about $1,700 a year compared to a similar sized home built to code. The home was certified to the requirements of the DOE Zero Energy Ready Home program, which requires builders to meet a slew of energy-efficiency program requirements. Homes must meet the energy and durability requirements of ENERGY STAR Certified Homes Version 3.0, the insulation requirements of the 2012 International Energy Conservation Code, and the indoor air quality and water saving requirements of the U.S. Environmental Protection Agency's Indoor airPLUS and WaterSense programs. The home must also have solar photovoltaic panels installed or have the conduit and electric panel space in place for a PV system.

This was the first DOE Zero Energy Ready home for Atkins' company Sterling Brook Custom Homes, but the builder, who builds 3 or 4 homes per year, has been building progressively more efficient homes since attending a class on building science in 2004 taught by Joe Lstiburek, a research partner in DOE's Building America program.

To meet the DOE Zero Energy Ready Home requirements, Atkins starts with an advanced framed wall using 2x6 studs spaced at 24 inches on center instead of 2x4s at 16 inches on center to provide a deeper wall cavity providing more room for insulation. Other advanced framing techniques like 2-stud instead of 3-stud corners, ladder blocking at intersecting walls, insulated rather than solid wood headers over doors and windows, and single rather than double top plates at the tops of walls were employed to further reduce the amount of lumber in the walls, allowing more room for the open-cell spray foam that fills the wall cavities providing both insulation and air sealing. Atkins tested an engineered wood product provided by one of the project sponsors, that is composed of wood chips and resin. The composite studs are identical in dimensions to standard lumber but are straight and very strong, with enough resin to hold up well to water, even when studs are exposed to weather during construction."I'm testing a piece now that I've put up on the west side of my own house as a roof fascia board. It gets full sun and rain and it's holding up very well," said Atkins.

On the outside of the walls, instead of sheathing the entire walls with OSB or plywood, Atkins used 1-inch-thick (R-5) EPS rigid foam board for sheathing most of the walls. He used 4-ft wide sheets of OSB for sheathing along the corners to provide extra bracing, with 0.5 inch R-3 rigid foam board over it. The

Sterlingbrook Homes installed a sheathing of R-5 rigid EPS foam board over the studs. For bracing at the corners, R-3 rigid foam was installed over half-inch OSB. A water-resistant membrane was sprayed over the foam and took the place of house wrap to provide a weather-resistant air barrier. Inside, the wall cavities were filled with open-cell spray foam for a total wall insulation value of R-21 to R-23.

spray foam plus the rigid foam provided a combined wall R value of R-21 to R-23. Instead of house wrap, the exterior sheathing was covered with a spray-on membrane that served as a drainage plane and exterior air seal. Atkins is not a fan of tape to air seal rigid foam sheathing because of the difficulty in getting the foam surface clean enough for the tape to adhere well. Atkins likes the concept of the spray-on membrane drainage plane and noted that new products are coming out that require applying the sealant only at the seams, which can provide cost and time savings. Atkins had his crews install 7/16 spacers over the coated sheathing to provide an air space that permits the wall to dry out should any moisture get behind the local stone, brick, and board and batten siding.

A strip of polyethylene foam sill seal separates the sill plate of the wall from the concrete foundation stem wall to prevent ground moisture from wicking up into the wood. This foam gasket also keeps out air and bugs. Atkins uses sill seal under all of the interior wall bottom plates as well to separate them from the foundation slab.

The home employs an unvented attic with a hip roof design on most of the roof elevations, a hip roof is more resistant to uplift in high winds than a gable roof. The unvented soffits keep blown rain out of the attic. Sterlingbrook goes beyond code by including hurricane strapping to tie the bottom plate to the studs, the studs to the top plates and to the rafters, and the rafters to the ridge beam. Over the rafters, the roofers installed 7/16 OSB then overlapping layers of ice and water shield over the entire roof. The standing seam metal roof consists of 24-gauge, reflective grey-colored galvalume roofing with hidden fasteners.

On the underside of the roof decking, the insulators sprayed 5.5 inches (R-20) of open-cell spray foam over all conditioned areas for a fully encapsulated attic. An OSB roof decking with radiant barrier is used over the garage and porches.

Spray foaming the underside of the attic provides a cool, dry space to locate the home's HVAC equipment. This home has a 19 SEER air conditioner with four zones. Each zone is controlled by a programmable thermostat that is also tied to an electronic tablet for remote control. Air is distributed using flex duct with R-6 insulation. "We used to use a single-stage compressor and it didn't keep the humidity out. We do a two-stage compressor on most of our homes now. The Eco Home actually had a variable speed (six-stage) compressor that can run at a lower level for longer periods of time to dehumidify without overcooling," said Atkins.

HOME CERTIFICATIONS

DOE Zero Energy Ready Home Program

ENERGY STAR Certified Homes Version 3.0

EPA Indoor airPLUS

Green Built Texas

"We love using sealed, foamed attics in Dallas, as long as the foam completely air seals the attic and you have the AC sized properly to get the moisture out of the house. We can maintain the attic within 5 to 8 degrees of the temperature inside the house."

—Wayne Atkins, owner,
Sterling Brook Custom Homes

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 combination of spray-foamed attic and spray-foamed walls provides a very airtight shell. Blower door testing showed the home had an air leakage rate of 0.8 air changes per hour at 50 Pascals pressure difference (ACH 50). To provide fresh air to the home, Atkins installed a fresh air intake duct with a motorized damper and an electronic controller. All of the bathrooms are tied to an ENERGY STAR-rated central exhaust system with timers in each bathroom. The exhaust fan is tied to the controller so when the unit calls for fresh air, the damper opens and the exhaust fan comes on to accomplish balanced air exchange.

The home is equipped with two gas-fired tankless water heaters. One supplies hot water to the bathrooms; the other supplies hot water for the kitchen and laundry. Two were specified to reduce the hot water loop length. The water heater for the bathrooms has a hot water recirculation loop to reduce the time spent waiting for hot water at any fixture. Switches located at each vanity are used to start the pump to prime the hot water side of the system. All of the plumbing fixtures are low flow and the toilets are EPA WaterSense rated. On the exterior of the home, all of the plants are native. Drip irrigation is used in the planting beds and around the foundation of the home. The irrigation controller has a temperature and rain sensor to prevent irrigation from coming on during rainy or freezing periods.

All light fixtures in the house use LEDs. LED tape lighting is used for under-cabinet task lighting, for architectural lighting in the ceilings of the master bedroom and great room, and for bath vanity toe kicks as night lighting. The kitchen, great room, and entry lighting can be controlled by an iPad that has a docking station on the wall in the great room. A lighting sponsor provided the lights and design assistance for the lighting package, which also includes mini LED cans in the eaves of the house to accent some of the architectural details at night. The only non LED lighting in this home is the fluorescent lighting in the garage.

The home incorporates a real-time energy monitoring system. This unit monitors whole-house energy usage as well as usage on specific circuits and displays the information on one of the two iPads tied to the home. It also controls the HVAC, lighting, and audio/video equipment.

The high-efficiency appliances include an induction cooktop and ENERGY STAR-rated refrigerator and dishwasher. The home's window package consists of vinyl casement and picture windows. All are argon filled and have low-emissivity glass. The windows have a solar heat gain coefficient (SHGC) of 0.27 and an insulation U value of 0.29. On the east and west elevations, the windows were upgraded to triple glazing to further reduce the SHGC.

In keeping with the DOE Zero Energy Ready Home requirements, the home is pre-wired for photovoltaic as well as solar hot water panels.

"I like everything about the DOE Zero Energy Ready Home program," said Atkins. "We were able to talk with people about it on the tours. We could tell people that even though solar may not be cost effective now, in a few years it will be and we'll be ready for it. I would love to see every house built to be zero energy ready," said Atkins.

All photos courtesy of Sterling Brook Custom Homes.

KEY FEATURES

- **DOE Zero Energy Ready Home Path:** Performance
- **Walls:** 2x6 studs 24 in. o.c. advanced framed, engineered studs, R-5 rigid foam sheathing with OSB +R-3 for corner bracing. Open-cell spray foam in cavities for total wall R-21 to R-23. Spray-on membrane drainage plane. 7/16 furring strips for air gap behind rock, brick, wood and resin siding
- **Roof:** Ice and water shield over whole deck; 24-gauge reflective standing seam metal roof. Open-cell spray foam on underside of roof deck over conditioned areas, radiant barrier under decking over garage and porches
- **Foundation:** Uninsulated slab
- **Windows:** Argon-fill, Low-e, vinyl framed, SHGC=0.27, U=0.29. double-pane on north and south, triple-pane on east and west
- **Air Sealing:** 0.8 ACH 50
- **Ventilation:** Fresh air intake duct with motorized damper tied to central exhaust system with timers and electronic controller for balanced air exchange
- **HVAC:** 19 SEER HVAC unit with 4 zones, flex ducts in insulated attic
- **Hot Water:** Two gas tankless water heaters. Solar tube in master closet
- **Lighting:** 100% LED inside, fluorescent in garage
- **Appliances:** ENERGY STAR refrigerator and dishwasher
- **Solar:** Pre-wired for PV and solar thermal
- **Water Conservation:** recirc loop for bathroom fixtures; low-flow faucets; WaterSense toilets; drip irrigation, rain and frost sensors
- **Other:** Energy management/home automation system with two iPADs to control HVAC, lighting and audio/video equipment. Low and no-VOC paints and finishes. Recycled content drywall and glass countertops. Bamboo countertops, standing dead oak flooring. Disaster Resistance: 6-person storm shelter in garage floor, hurricane strapping, no soffit vents, hip roof