

Healthy Communities

Walnut Farm
Williamsburg, VA



BUILDER PROFILE

Healthy Communities
Williamsburg, Virginia
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FEATURED HOME/DEVELOPMENT:

Project Data:

- Name: Walnut Farm
- Location: Williamsburg, VA
- Layout: 3 bdrm, 2.5 bath, 2 fls, 2,227 ft²
- Climate: IECC 4A, mixed-humid
- Completed: June 2020
- Category: Production

Modeled Performance Data:

- HERS Index: without PV 46; with PV 9
- Annual Energy Costs: without PV \$1,350; with PV \$400
- Annual Energy Cost Savings: (vs typical new homes) without PV \$1,150; with PV \$2,100
- Annual Energy Savings: without PV 9,700 kWh; with PV 17,400 kWh
- Savings in the First 30 Years: without PV \$48,500; with PV \$87,500

Walnut Farm, Virginia's first Zero Energy Ready Home community, is under construction in Williamsburg, Virginia. The 75 single-family production homes are one- and two-story midwestern craftsman designs that are loaded with big front porches and wood trim details outside and energy efficiency, durability, and indoor air quality details inside. All of the homes will be built to the high performance criteria of the U.S. Department of Energy's Zero Energy Ready Home program.

Builder Jay Epstein, owner of Healthy Communities, is no stranger to DOE ZERH. Epstein certified his first DOE ZERH home in 2016 and has since built 37 certified homes. In 2019 he committed to building all of his homes to the program criteria and he now has 117 DOE ZERH homes planned or under construction. Epstein has been interested in energy-efficient homes for several years, having won the first Energy Value Housing Award the first year it was offered in 1997. Epstein has certified his homes to other national and regional programs such as ENERGY STAR and Earthcraft but he sees the DOE ZERH program as the culmination of a lifetime of improving his craft. "Walnut Farm is unlike any community Healthy Communities has built in the last 40 years. Each previous community has been a building block and learning lesson that has brought us to today's "product." Walnut Farm is a collaboration of DOE Zero Energy Ready Home construction and digitizing the building process and home buyer experience," said Epstein.

The judges must have agreed with this assessment because they selected one of the homes at Walnut Farm, a two-story 2,227-ft², 3-bedroom, 2.5-bath home, for a 2020 DOE Housing Innovation Grand Award in the production home category.

Every DOE certified home must meet the requirements of the ENERGY STAR Certified Homes checklists. They must also be certified to the U.S. Environmental Protection Agency's Indoor airPLUS criteria and meet the hot water distribution requirements of the EPA's WaterSense program. Homes must also meet above-code



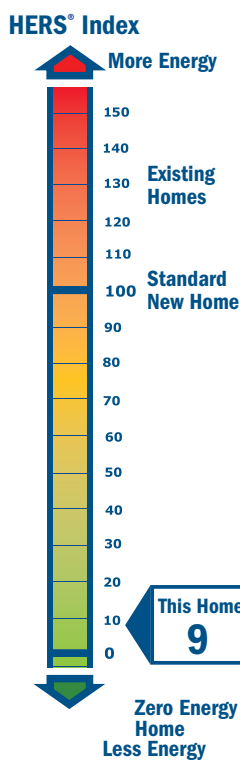
The U.S. Department of Energy invites home builders across the country to meet the extraordinary levels of excellence and quality specified in DOE's Zero Energy Ready Home program. Every DOE Zero Energy Ready Home starts with ENERGY STAR Certified Homes Version 3.0/3.1/3.2 for an energy-efficient home 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.

Healthy Communities built these 2,227-ft² two-story homes in Williamsburg, Virginia, to the high-performance requirements of the U.S. Department of Energy’s Zero Energy Ready Home program. An energy recovery ventilator is tied to the home’s high efficiency central heat pump to bring fresh air into the home while removing stale air. The air is drawn through a MERV 13 filter that removes up to 99.98% of the airborne allergens while the HRV’s heat exchanger tempers the air before distributing it to the home through the high-efficiency heat pump, providing occupants with clean conditioned air for a healthy indoor environment.



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.



insulation requirements, be blower door tested for air sealing, comply with moisture management guidelines, have ducts inside conditioned space, and use ENERGY STAR labeled windows, lighting, and appliances. Homes must also have solar electric panels installed or have the conduit and electrical panel space in place for future installation of solar panels.

Of the eight homes constructed to date at Walnut Farm, five of the home owners have chosen to install solar panels at construction including the award-winning home, which has a 5.94-kW array of 18 solar panels on the roof that should cover most of the home’s electric needs. With the PV installed, the award-winning home achieves a Home Energy Rating System (HERS) score of 9; even without the PV, the home scores a 46, far lower than typical new homes. With PV the home should save its owners an estimated \$2,100 compared to a home built to the state’s energy code, which is equivalent to the 2015 International Energy Conservation Code (IECC).

While the program doesn’t require solar installation at construction, Epstein does a lot to encourage it. For home buyers who add the solar at the time of construction, Epstein’s company guarantees that the total electric bill will be no more than \$1.50 a day averaged over the year. Homes at Walnut Farm are also offered an optional storage battery. The inverter is upgraded to allow for a plug-in electric vehicle and an inverter transfer module can be added to allow for battery or generator backup.

To achieve zero energy, power production is half of the equation; an energy-efficient home is the other half. Healthy Communities starts with a highly insulated thermal building envelope. Epstein uses a combination of insulation types in the home’s 2x6 advanced framed exterior walls. The wall cavities are either filled with sprayed cellulose, or a “flash and batt” technique is used consisting of spraying one inch of open-cell spray foam into the cavities to seal the framing to the exterior sheathing then filling the wall cavities with fiberglass batts, in this case R-19 batts that are compressed to R-16. The exterior sheathing is an OSB product that has R-3.5 of rigid foam adhered to the interior side and a plastic coating on the exterior side that, when the seams are taped, serves as a weather-resistant barrier and air barrier. The rim joists are also sealed and insulated with 5.5 inches of open-cell spray foam. Durable fiber-cement siding covers the walls. The sill plate is sealed to the foundation wall with a sill-sealing foam gasket and expansive caulk.

The sealed and conditioned crawlspace is insulated along the interior walls with R-11 fiberglass batts that are wrapped in a vapor barrier and draped over the concrete



Coated OSB with taped seams and tape flashing around windows and doors provides a continuous air and weather-resistant barrier to the home while the builder uses a flash-and-batt approach to fill the 2x6 wall cavities, first spraying in an inch of open-cell spray foam to seal the sheathing to the studs, then filling the remainder of the cavity with R-19 fiberglass batt or spray-in cellulose. Open-cell spray foam also fills the rim joists, providing R-23-insulated walls top to bottom.

block walls so they can be lifted for termite inspection. An 8-mil polyethylene vapor barrier covers the crawlspace floor. The crawlspace is constructed using all of the water-management techniques required of the EPA's Indoor airPLUS program including good site grading, footing drains, and exterior below-grade water proofing. "Conditioned crawlspaces virtually eliminate moisture problems experienced with conventional crawlspaces. We bring the crawlspace into the thermal envelope with a supply line from the air handler and a return and essentially convert it into a conditioned shallow basement. The crawlspace is now conditioned and dry, winter and summer," said Epstein.

The 8/12 pitch of the roof is an optimum angle for solar production and yields enough space to set two rows of vertically mounted solar panels on the south side. The roof trusses are 24 inches on center to align with the wall studs and the truss design incorporates some special features. The truss design is strengthened from 10 pounds to 15 pounds per square foot to accommodate solar panels. There is a storage cradle designed into the trusses to accommodate the R-49 of blown cellulose insulation with open storage space above. The trusses also incorporate a 14-inch raised heel to prevent the 14 inches of cellulose from being compressed at the eaves. Anywhere rooms are located above unconditioned space, such as above the garage or porches, the floor joists are insulated with 14 inches of open-cell spray foam. The roof itself is sheathed with plywood, ice and water shield, then 30-year architectural shingles. Ridge and soffit vents provide ventilation to the attic.

The vinyl-framed single-hung ENERGY STAR rated windows have low-emissivity coatings and an argon fill to slow heat transfer and they have been tested for air tightness by the manufacturer at Healthy Communities' homes. The double-pane windows provide an insulation U-factor of 0.28 and a solar heat gain coefficient of 0.22.

The central air source heat pump has a quiet multi-stage compressor that provides consistent temperature with maximum efficiency by automatically making precise, continuous adjustments in output, like an automobile going up or down hills with the cruise control on. The heat pump has a heating season performance factor (HSPF) of 10 and a cooling efficiency of 19.8 SEER. The central heating system also incorporates an optional air cleaning technology that can remove up to 99.98% of airborne allergens from the filtered air. The system filters down to 0.1 micron, or 700 times smaller than a human hair, so it can effectively remove spores, mold, pollen, pet dander, dirt and dust.

HOME CERTIFICATIONS

DOE Zero Energy Ready Home Program - 100% Commitment

ENERGY STAR Certified Homes Version 3.1

EPA WaterSense

EPA Indoor airPLUS

DOE Zero Energy Ready Home Quality Management Guidelines

"The temperature throughout our home does not change. Even on the hottest days we stay cool and on the coldest winter nights we stay warm."

Homeowner



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.



Blown fiberglass packs the wall cavities, which are first air sealed with an inch-thick coating of open-cell spray foam.

continuously at a preset lower level but are moisture sensor-activated to increase speed when needed.

A 50-gallon heat pump water heater is located in the garage as close to water fixtures in the home as possible. The ENERGY STAR certified water heater has an energy factor of 3.42. A push-button-activated recirculation pump helps speed hot water through the insulated pipes to reduce wait times.

The home is designed to support aging in place. All of the lighting is LED. The touch screen controls let you monitor and control your home's climate from anywhere. The smart home system can control lighting, security, shades, and the garage door. An ENERGY STAR dishwasher, refrigerator, washer, and dryer add to utility savings.

The most unique aspect of the homes at Walnut Farm is the way they are being designed. Epstein chose to use a computer modeling design system, Digibilt, that develops a model of each house before construction allowing the builder and trade partners to see conflicts before construction. The software creates a bill of materials in about 5 seconds. In 5 more seconds, a critical path schedule is produced that allows labor productivity to be tracked at an activity and trade level. The system automatically sends a text message to the individual trade foreman with a simple question at the end of each work day (i.e., "Is the 2nd floor interior framing 50% complete? Yes or No?). When they respond, the schedule is automatically updated. If the answer was "No", the follow-up question is "what percentage is complete?" followed by "what was the cause of the delay?" Every step from that point is automated via this simple text-messaging interface. The builder and their trade partners receive automated construction instructions and schedules are updated accordingly.

When a new home is complete, the homeowner gets access to a house-specific cloud-based record of everything in the home, including product manuals, product names and colors, and equipment maintenance guidance.

"Digitizing the building process has helped Healthy Communities reach a new level of building efficiency, limiting material waste, keeping trades accountable, giving ultimate transparency to homeowners, and solving design hiccups before they become issues," said Epstein. "The DOE Zero Energy Ready Home lays out a path to save up to 100% on energy use while substantially enhancing indoor air quality and providing our home owners with exceptional levels of comfort," said Epstein.

Ventilation is provided by an energy recovery ventilator (ERV) that brings ducted outside air to the air handler of the heat pump through a MERV 8 filter. The controls can be set on the ERV or can be managed through the heat pump management module, which controls temperature, humidity, and exhaust, it can be accessed through the internet. ENERGY STAR bathroom fans run

KEY FEATURES

- **Walls:** Walls: 2x6, 24" o.c., R-23 total: wall cavity: flash & batt 1" open-cell spray foam + R-19 fiberglass batt or spray-in cellulose, R-3.5 coated OSB exterior sheathing, fiber cement siding; open-cell spray foam in rim joists. Designed with 3D Building Information Modeling (BIM).
- **Roof:** Gable truss roof: R-49 insulation, plywood sheathing, fire and ice underlayment, ridge vent, architectural shingles. 14" raised heel trusses, $\frac{1}{2}$ pitch optimal for solar panels.
- **Attic:** Vented attic: 14" R-49 blown-in cellulose, 14" R-50 open-cell spray foam in attic floor above garage and porch.
- **Foundation:** Unvented crawlspace; CMU walls insulated on interior with R-11 batt. 8-mil vapor barrier over dirt floor; R-19 open-cell spray foam in rim joists.
- **Windows:** Double-pane, argon-filled, low-e, vinyl single-hung frames, U=0.28, SHGC=0.22.
- **Air Sealing:** 1.37 ACH 50; foam gasket and caulk at sill plates, open-cell spray foam in rim joists.
- **Ventilation:** ERV, MERV 8 or 13 filter. Supplies to return of central heat pump, pulls from two house locations.
- **HVAC:** Central heat pump, 10 HSPF, 19.8 SEER. Rigid metal ducts.
- **Hot Water:** Heat pump water heater, UEF 3.42, ENERGY STAR certified, 50-gal. Button-operated recirc pump.
- **Lighting:** 100% LED, Smart house system controls, daylighting.
- **Appliances:** ENERGY STAR dishwashers, clothes washer, clothes dryer, and refrigerator.
- **Solar:** 5.94 kW; 18 rooftop panels, central inverter.
- **Water Conservation:** EPA WaterSense fixtures. Drought-resistant landscaping.
- **Energy Management System:** Smart climate controls, smart thermostat, solar tracking.
- **Other:** Electric vehicle charging station, low VOC paints, Green Guard & Green Label Plus flooring, natural stone building material in bathrooms/entry.

Photos courtesy of Healthy Communities