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

DOE ZERO ENERGY READY HOME™

U.S. DOE ZERO ENERGY READY HOME 2020 WINNER Housing Innovation Awards

United Way of Long Island

Net Positive All Electric Home Port Jefferson Station, NY

BUILDER PROFILE

United Way of Long Island
Deer Park, New York; unitedwayli.org
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FEATURED HOME/DEVELOPMENT:

Project Data:

- Name: Net Positive All Electric Home
- Location: Port Jefferson Station, NY
- Layout: 5 bdrm, 2 bath, 2 fls, 2,500 ft^2
- Climate: IECC 4A, mixed-humid
- Completed: June 2020
- Category: Affordable Multifamily

Modeled Performance Data:

- HERS Index: without PV 37; with PV -2
- Annual Energy Costs: without PV $5,300; with PV $0
- Annual Energy Cost Savings: (vs typical new homes) without PV $2,200; with PV $5,250
- Annual Energy Savings: without PV 11,400 kWh; with PV 17,000 kWh
- Savings in the First 30 Years: without PV $91,100; with PV $218,800

Building information modeling (BIM) helped United Way of Long Island, New York, visualize success as the agency constructed a five-bedroom, two-bathroom, two-story 2,500-ft^2 home in Port Jefferson Station, New York, that earned a grand award in the U.S. Department of Energy's Zero Energy Ready Home 2020 Housing Innovation Awards.

"This is the first project United Way has constructed using BIM," said Rick Wertheim, senior vice president of Housing and Green Initiatives for the United Way of Long Island Housing Development Corporation, a nonprofit organization that builds or renovates about six homes per year for its nonprofit partners. The agency has constructed 21 homes certified to DOE's Zero Energy Ready Home program and has won six DOE Housing Innovation awards and five grand awards in the affordable homes category since 2015.

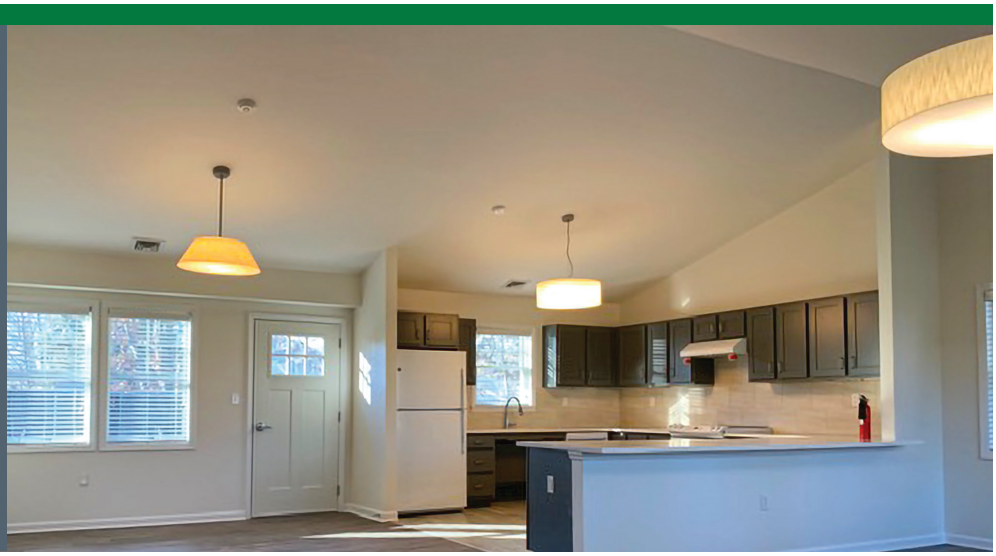
This year's winning home achieved a Home Energy Rating System (HERS) score of 37 without PV or -2 with PV, enough to power the home and an electric vehicle. The home is expected to save $5,300 a year in utility costs, which is critically important to the nonprofit agency that owns the home. "Long Island has one of the highest utility rates in the country, so operational costs and sustainability are becoming more of a driving force for decision making than upfront square-foot building costs," explained Wertheim. "Nonprofits have a responsibility to build homes that have low operational expenses, especially when using tax payer dollars to develop these units. The only way to insulate nonprofits from escalating energy costs is through significant energy efficiency. It costs LESS for nonprofits to own a DOE Zero Energy Ready Home than a code-minimum home due to the low energy bills and minimal maintenance costs."

Getting the details right was an important part of achieving the exceptional energy savings on this award-winning home. The design included a novel attic truss specifically designed to accommodate a ducted mini-split heat pump tucked into an insulated chase in the vented attic. Using the building information modeling tool was

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 3.0/3.1/3.2 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.

United Way of Long Island built this 2,500-ft² two-story home in Port Jefferson Station, New York, to the high performance requirements of the U.S. Department of Energy's Zero Energy Ready Home program. The whole home is certified through the EPA WaterSense program, which requires water-saving plumbing fixtures and irrigation and efficient hot water distribution. A heat pump water heater speeds hot water to each fixture via a central manifold and PEX piping.



What makes a home a DOE ZERO ENERGY READY HOME?

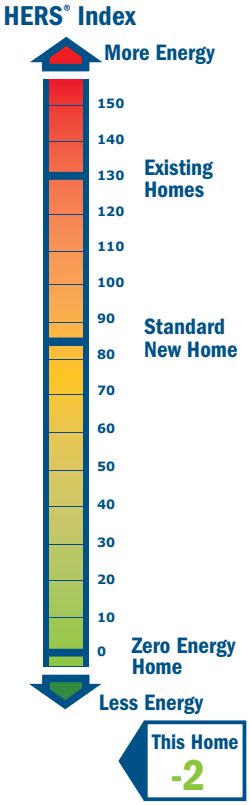
1 **BASELINE**
ENERGY STAR Certified Homes Version 3.0/3.1

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.

very helpful for getting everyone on the same page. The BIM produces integrated three-dimensional renderings of every aspect of the home, including framing, HVAC, plumbing, and electrical. By allowing all members of the construction team to visualize how the components fit together, team members got a better understanding of the end product and could see potential conflicts in sequencing of construction steps and potential problem areas such as maintaining a continuous air and thermal barrier around the home's conditioned space. "Using the building information modeling tool was very helpful for getting everyone on the same page regarding schedule and sequencing of trades and a great help in preparing for the pre-construction team meetings," said Wertheim who considered the meetings crucial to the project's success. The project team included Wertheim as the project manager, along with an architect who is certified in residential energy efficiency by the Building Performance Institute, the RESNET-certified HERS rater, the site supervisor, and the subcontractor crew chiefs.

Wertheim also uses a construction project management software. In this software, United Way has developed a "template" for quality assurance including a checklist that incorporates the program criteria for the DOE Zero Energy Ready Home program. The DOE program requires builders to meet the checklists for ENERGY STAR Certified Homes and the U.S. Environmental Protection Agency's Indoor airPLUS, as well as the hot water distribution requirements of the EPA's WaterSense program; the insulation requirements of the latest International Energy Conservation Code; HVAC and water heating efficiencies; third-party verified air sealing targets; installation of ENERGY STAR appliances, windows, and lighting; and ducts in conditioned space. In addition, homes are required to have solar electric panels installed or have the conduit and electrical panel space in place for it.

Construction team members have access to an online project management portal so the entire development team can share in the quality control process. In addition to visualizations, the BIM software can automatically generate a bill of materials and a critical path schedule that allows labor productivity to be tracked at an activity and trade level. The software sends out an automated text message to each individual trade foreman with a simple question at the end of each workday (i.e., "Is the second 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 a simple text-messaging interface. The builder and trade partners receive automated construction instructions and can see updated schedules.

The above-grade walls of this home are advanced framed with 2x6 24-inch on-center studs, then wrapped in rigid EPS foam board that is covered with half-inch OSB providing a solid surface to hang the high-performance thin triple-pane casement windows. In the wall cavities, a layer of closed-cell spray foam seals the rigid foam to the wall framing then the cavities are filled with blown fiberglass. A draining house wrap provides a drainage plane beneath the spruce and engineered wood siding and trim, protecting the home from stormy weather.

Every project is issued a unique identification number. When the new home is complete, the homeowner will have a cloud-based record of everything in the home, including product manuals, product names and colors, and maintenance tips. They can also check their solar production and energy usage through the portal.

This DOE Zero Energy Ready certified all-electric home should be low maintenance. The home's walls are sided with an easy-care engineered wood siding product as well as locally sourced sustainably harvested natural Spruce siding that is pre-finished with a long-lasting durable stain to ensure weather resistance. The walls are constructed of 2x6 studs installed at 24 inches on center and incorporating advanced framing techniques to reduce the amount of lumber needed and to provide more room for insulation. A 1-⅛-inch graphite-enhanced EPS rigid foam insulation board wraps the studs and is covered with ½-inch OSB sheathing that is installed with 3-inch construction screws for increased wind resistance in this high-wind-zone location. A coating of closed-cell spray foam is sprayed on the inside face of the EPS in every wall cavity. This foam air seals and adds structural rigidity to the walls so less strapping is needed and there will be less settling and fewer nail pops. The rigid foam, spray foam, and blown fiberglass in the wall cavities provide a total wall insulation value of R-33.

The builder achieved a low air leakage of 1.7 air changes per hour at 50 Pascals (ACH 50) with exceptional air sealing practices spray foaming the wall cavities, installing gaskets at the top and bottom plates, and installing rigid foam blocking between trusses at the eaves. All interior wall top plates were spray foamed after the ceiling gypsum board was installed. The floors were air-sealed at the rim joists with closed-cell spray foam where the gasketed plates and floor joists meet the foundation wall and all floor-to-floor penetrations and bypasses were gun foamed or fire caulked.

The exterior walls sit on 8-inch poured concrete foundation walls that are protected with a roll-on capillary break over the footings and an elastomeric foundation water proofing on the exterior of the walls, which are then wrapped with 2 inches of EPS graphite-enhanced foam insulation. The above-grade portion of the EPS is protected with fiberglass-reinforced panels. The interior of the basement was not finished but easily could be if needed; three egress windows were installed to meet code for future use of the space as living space.

The main gable roof is topped with architectural asphalt shingles over a coated 5/8-inch OSB sheathing product that is taped at all seams; ice and water shield provides additional protection at eaves and rakes. Two shed roof sections are topped

HOME CERTIFICATIONS

DOE Zero Energy Ready Home Program - 100% Commitment

ENERGY STAR Certified Homes Version 3.1

EPA Indoor airPLUS

DOE Zero Energy Ready Home Quality Management Guidelines

"Not only do you get superior energy savings and comfort, but DOE Zero Energy Ready Homes are detailed to provide better indoor air quality and a healthier indoor environment."

Rick Wertheim, senior vice president of Housing and Green Initiatives for the United Way of Long Island Housing Development Corporation

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.

Walls are "flash" sealed with spray foam, which also seals the attic ventilation baffles to the top plates.

with highly reflective standing-seam metal roofing over a full coverage of ice and water shield. The shed roof tops a vaulted ceiling with 18-inch parallel chord roof trusses at 24 inches on center with 14 inches (R-50) of fiberglass loose-fill insulation. The gable roof has raised heel roof trusses to allow full coverage of the 18 inches (R-65) of blown fiberglass over the top plates in the vented attic.

This attic space sits over a flat ceiling in the second floor and has uniquely designed roof trusses that provide a 2-ft by 4-ft attic chase just large enough to house a ducted mini-split heat pump with short ducts that reach to the second-story bedrooms. The chase is constructed of 5/8-inch drywall and encased in 3 inches of closed-cell spray foam plus R-30 of batt insulation for an R-50 insulated and air-sealed chase that is thermally connected to the living space of the home. A second ducted mini-split heat pump in the conditioned basement serves the main floor. Both heat pumps have a heating efficiency of 9.6 HSPF and cooling efficiency of 15.5 SEER.

A whole house dehumidification system was installed in the home for swing-season humidity control when the thermostat is not calling for cooling. Wertheim also explains the home's ventilation system, which includes an energy recovery ventilator and exhaust fans that are connected to each other and to sensors. "This is the first project where we used a whole home IAQ system connected to air sensors. The sensors trigger connected devices (bath fans, kitchen exhaust hood, and HVAC equipment) to cycle on if an air event presents itself. For example, if there is excess particulate in the home, the controller will cycle on ALL ventilation equipment in the home to remediate," said Wertheim. The ERV is ducted separately from the HVAC. The whole house dehumidification is ducted separately as well and communicates via a controller. In addition, the two heat pump air handlers have MERV 13 filters in the return boxes of each blower unit.

All lighting is LED based and motion sensored. Well-placed triple-pane, U-0.18, SHGC-0.22 vinyl-framed windows with argon fill and two heat-blocking low-emissivity coatings allow in plenty of daylight, which is conveyed to interior spaces through framed openings in interior walls. The refrigerator, dishwasher, and clothes washer are all ENERGY STAR qualifying. The kitchen range is an efficient and safe electric induction model. The home has a smart thermostat that is wifi, voice, and smartphone controlled. Designated switches are wifi and smart home connected.

The home meets EPA Indoor airPLUS and incorporates universal design cradle-to-grave features including with low-height door thresholds, a zero entry shower, elevated wall outlets, lower light switch heights, and wider door openings.

KEY FEATURES

- **Walls:** 2x6, 24″ o.c., R-33 total: closed-cell spray foam + blown fiberglass; 1″ rigid EPS topped by ½″ OSB, textured house wrap, spruce, and engineered wood siding and trim.
- **Roof:** Truss gable roof: coated taped ⅝″ OSB sheathing, ice & water shield fiberglass composite shingles, standing seam metal roof.
- **Attic:** Vented attic: 14″ R-50 blown-in fiberglass on flat ceiling, 18″ R-65 blown-in fiberglass in vaulted roof, trusses incorporate mechanical chase insulated to R-50 with 3″ spray foam and R-30 batt.
- **Foundation:** Insulated basement: 8″ concrete walls. Elastomeric water proofing, 2″ graphite EPS.
- **Windows:** Thin triple-pane, argon-filled, low-e2, vinyl, casement style, U=0.18, SHGC=0.22.
- **Air Sealing:** 1.7 ACH 50.
- **Ventilation:** ERV separately ducted, indoor air quality sensor. MERV 13 filters. Dehumidifier.
- **HVAC:** Ducted and ductless mini-split heat pumps, 9.6 HSPF, 15.5 SEER.
- **Hot Water:** Heat pump water heater, UEF=3.7, 80-gal. central manifold and PEX piping.
- **Lighting:** 100% LED with motion sensors. Daylighting with interior windows.
- **Appliances:** ENERGY STAR refrigerator, dishwasher, and clothes washer.
- **Solar:** 9.2 kW rooftop panels.
- **Water Conservation:** EPA WaterSense fixtures and toilets, drip irrigation, driveway.
- **Energy Management System:** Smart thermostat is Wi-Fi and voice controlled.
- **Other:** Accessibility features. All paint is low/no VOC, CARB compliant wood.

Photos courtesy of United Way of Long Island

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