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

DOE ZERO ENERGY READY HOME™

U.S. DOE ZERO ENERGY READY HOME 2016 WINNER *Housing Innovation Awards*

Imery & Co

High-Performance Bungalow
Roswell, GA

BUILDER PROFILE

Imery & Co, Athens, GA
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FEATURED HOME/DEVELOPMENT:

Project Data:

- Name: High-Performance Bungalow
- Location: Roswell, GA
- Layout: 3 bdrm, 2.5 bath, 1 fl, 2,194 ft²
- Climate Zone: IECC 3A, mixed-humid
- Completion: October 2015
- Category: custom for buyer

Modeled Performance Data:

- HERS Index: without PV 41, with PV 6
- Projected Annual Energy Costs: without PV $650, with PV $202
- Projected Annual Energy Cost Savings (vs home built to 2009 IECC): without PV $1,281, with PV $1,896
- Projected Annual Energy Savings: without PV 21,353 kWh, with PV 31,610 kWh
- Added Construction Cost: without PV about 5%

Luis Imery, owner of Imery & Co. LLC and two-time winner of a U.S. Department of Energy's Zero Energy Ready Housing Innovation Award, can tell you that achieving a zero energy home doesn't just happen; it's the result of a lot of planning and collaboration. The home owner of Imery's 2016 DOE Housing Innovation Award winning home sought out Imery after hearing about the Zero Energy Ready home he had constructed at Serenbe, Georgia, which had won a 2014 Housing Innovation Award.

To construct his 2016 DOE Zero Energy Ready home to perform as a net zero home (one that produces as much energy as it consumes in a year), Imery worked with the same architect he had worked with on the 2014 home, LG Squared Inc., to design a home that incorporated passive solar design features and maximized solar photovoltaic production potential. Imery also worked closely with his trades to make sure that all of the building energy-efficiency details were correctly implemented.

Imery held kick-off meetings with each trade as they moved through the phases of construction. "At these kick-off meetings we reviewed ALL construction details, specifications, and lay out for the project's goals. We also provided them with hand outs and green program worksheets," said Imery. He also hired an independent structural engineer to review the framing once it was completed to ensure the integrity of the structure. During construction Imery hired a third-party green rater to verify compliance with the DOE Zero Energy Ready performance criteria. The rater conducted a pre-drywall blower door test to help the builder troubleshoot any "leaky" areas. Imery had an insulation manufacturer partner on the project, who sent staff to conduct multiple site visits to train the concrete, framing, air sealing, and insulation crews. This was followed by a final inspection that included visual and diagnostic testing.

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.

Imery & Co constructed the High Performance Bungalow, a 2,194-ft² home in Athens, Georgia, to the performance criteria of the DOE Zero Energy Ready Home (ZERH) program. Natural daylight is filtered through double-paned windows with a U-value of 0.35 and a solar heat gain coefficient of 0.25, keeping warmth in during the winter and out during the summer.

What makes a home a DOE ZERO ENERGY READY HOME?

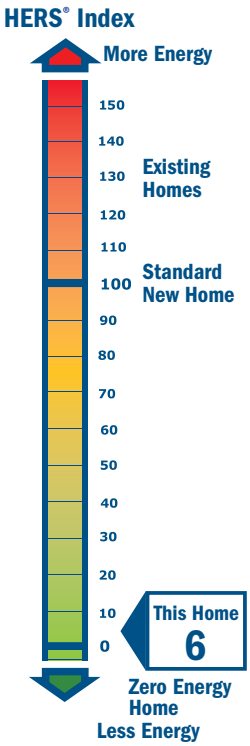
1 **BASELINE**
ENERGY STAR Certified Homes Version 3.0

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.

Third-party testing is a requirement of the DOE Zero Energy Ready Home Program. The program also requires every home to be certified to ENERGY STAR Certified Homes Version 3.0 and the U.S. Environmental Protection Agency's Indoor airPLUS program. Each home must meet the hot water distribution requirements of the EPA's WaterSense program and the insulation requirements of the 2012 International Energy Conservation Code. The program also requires homes to have solar electric panels installed or at a minimum to have the conduit and electrical panel space in place for future PV installation.

In addition to meeting the host of certifications required by the DOE Zero Energy Ready Home program, the home was also certified through the regional EarthCraft House program, at their platinum level. "We actually far exceeded the minimum point requirement for their platinum level. We did not stop short; our goal was to do it right regardless of the scoring sheet," said Imery.

Imery's attention to quality paid off. The home achieved a Home Energy Rating System (HERS) score of 41 without photovoltaic (PV) panels installed and an essentially net zero HERS score of 6 when the 6.3-kW PV system is installed. With all of the efficiency measures installed in the 2,194 ft² 1-story home, the home owner is expected to cut nearly $1,300 a year in energy costs compared to calculated energy costs for a home built to the 2009 IECC. When the PV is added, annual energy savings go up to an estimated $1,900 per year, while monthly energy bills drop to an average of about $17/month.

The high-performance features of the home started with a slab foundation wrapped with R-10 of rigid foam between the slab edge and the stem wall as well as an R-10 layer extending beneath the entire slab. Although the lot was sloped, the home owner desired a single-story home so the architect designed a raised slab with stem walls that extend 7 feet on the sloped side.

The 2x6 wood-framed walls employed several advanced framing techniques to reduce lumber use and make room in the walls for insulation. These include spacing the wall studs at 24 inches on center rather than 16 inches on center, using 2-stud rather than 3-stud corners, insulated rather than solid wood headers over doors and windows, 1-stud rather than 3-stud interior-exterior wall intersections, and limited studs around windows.

To prevent cool air from escaping through the roof in the summer months, this home's roof is insulated twice. On the underside of the roof decking, R-38 of blown fiberglass is held in place with netting attached to the roof rafters. Above the deck, two layers of rigid foam cover the coated sheathing to provide a combined roof insulation of R-45. The insulation is covered with a moisture protection layer of ice-and-water shield, topped with battens to provide a ventilating air gap under the reflective white standing-seam metal ENERGY STAR-rated roof.

The wood-framed walls were filled with R-23 of blown fiberglass and sheathed with two layers of ½ inch XPS rigid foam sheathing for a continuous R-5 layer that stops thermal bridging or heat transfer through the wall studs. The rigid foam was taped at the seams to serve as an air and weather-resistant barrier then Imery's crews installed 1x4 furring strips over the foam to provide a drainage gap. A cladding of fiber-cement panels and battens was installed over the furring strips and the whole exterior surface was painted with latex paint.

The unvented attic was insulated with R-38 of blown-in fiberglass insulation that was held in place by netting. The roof decking consisted of coated OSB sheathing that was taped at the seams, then topped with two layers of foam insulation. An ice-and-water shield membrane covered the foam. Furring strips on top of this provided a venting layer under the cool metal standing-seam roof.

Wood and fiberglass-framed, double-pane, low-e3 windows with an insulating U-factor of 0.35 and a solar heat gain coefficient (SHGC) of 0.25 completed the thermal envelope.

Extra air sealing details included the use of specialty air-sealing tapes around doors and windows and a stretch tape product around all through-the-wall penetrations such as for piping. Stretch tape was also used for sill flashing at windows. Tape flashing was used at top plates and a liquid flashing product was used around penetrations through the foundation slab. The roof-to-wall intersection was spray foamed at the seam along the interior side of the attic.

The entire home was heated and cooled with a ducted mini-split zoned heat pump system that was installed in the insulated attic with insulated rigid ducts. All duct work was either in the insulated attic or between the floor joists. The high-performance heat pump has a cooling efficiency of 16 SEER and a heating efficiency of 9.2 HSPF.

The snug enclosure tested at only 0.51 air changes per hour at 50 Pascals of pressure (ACH 50). To provide ventilation, Imery used a unique system that involved installing a fresh air intake that brings outside air into the attic and dumps it near the open return of the ducted mini-split heat pump system. The fresh air mixes with and is tempered by air inside the unvented attic before being drawn into the heat pump where it is filtered and distributed throughout the house. The sealed attic essentially serves as a return plenum for the HVAC system. The in-line exhaust fan runs continuously; a control knob next to the

HOME CERTIFICATIONS

DOE Zero Energy Ready Home Program

ENERGY STAR Certified Homes Version 3.0

EPA Indoor airPLUS

Earthcraft, platinum

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 ducted mini-split heat pump in the conditioned, unvented attic provides efficient heating and cooling for the entire home.

home owner's bedroom allows the home owner to adjust the fan's flow rate. To provide make-up air when the kitchen vent hood is used, a barometric damper was added to another ducted air intake. "The purpose here is to always keep the home at neutral or positive pressure, even when exhaust fans are running inside the home," said Imery. The bathrooms have exhaust fans that duct directly outside to provide local exhaust; they are equipped with humidity sensors to help keep the home's relative humidity in check in this mixed-humid climate.

A heat pump water heater with a 50-gallon tank provides hot water at an efficiency of 2.4 EF.

Most of the home's interior and exterior lighting is provided by high-efficiency CFLs. The refrigerator, dishwasher, and clothes washer are all ENERGY STAR rated. The home meets all of the requirements of the EPA WaterSense program including the hot water distribution requirements and the low-flow specifications for the plumbing fixtures; however, the home did not get certified because there was no local rater who was qualified to provide the WaterSense label.

The home was designed so that the main axis would run east-west to provide a maximum south-facing roof for the 6.3 kW worth of PV solar panels.

Imery hopes to build 100% of his future homes to the DOE ZERH requirements. He is fully committed to the idea of energy-efficient construction. Imery is a founding board member of the Georgia Building Performance Association, which hosts educational and networking events. Imery has spoken at "lunch and learn" sessions for the Athens Area Home Builders and Board of Realtors. Imery used this home as a teaching opportunity for the local building community by creating a stand-alone Facebook page for the project where weekly updates provided pictures and descriptions of the high-performance features. Imery held pre-drywall and final open houses and sent invitations to local trade organizations, non-profits, city inspectors, and council members, subcontractors, and neighbors. During the open houses, Imery led tours of the home to describe its energy-saving features and posted extensive signage throughout the home providing even more details on these features. Imery also worked with the insulation contractor to publish a white paper on the home.

While Imery can take pride in a quality-built home, the biggest reward for him is "seeing the smiles of my clients once they start getting utility bills and realize we really have built them a Zero Energy Ready Home."

Photos courtesy of Imery & Co

KEY FEATURES

- **DOE Zero Energy Ready Home Path:** Performance.
- **Walls:** 24″ o.c., advanced framed, R-23 blown fiberglass, 2 layers of R-5 foam sheathing, 1x furring behind cladding.
- **Roof:** Coated sheathing, two layers rigid foam above deck, ice-and-water shield, furring strips, ENERGY STAR cool metal roof.
- **Attic:** Unvented attic, R-38 blown fiberglass netted to underside of roof deck; ice-and-water shield, furring strips, ENERGY STAR cool metal roof.
- **Foundation:** R-10 rigid foam under slab and at slab edge.
- **Windows:** Wood-fiberglass-framed, double-pane, low-e3, U=0.35 and SHGC=0.25.
- **Air Sealing:** 0.51 ACH 50.
- **Ventilation:** Spot exhaust ventilation plus balanced ventilation with powered fresh air intake.
- **HVAC:** Ducted mini-split heat pumps, 16 SEER, 9.2 HSPF, in conditioned attic.
- **Hot Water:** 50-gal heat pump water heater, 2.4 EF.
- **Lighting:** 50% CFL.
- **Appliances:** ENERGY STAR refrigerator, dishwasher, clothes washer.
- **Solar:** 6.3-kW PV.
- **Water Conservation:** WaterSense fixtures.
- **Energy Management System:** Internet monitoring.
- **Other Measures:** EPA Indoor AirPlus.

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