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

The Imery Group

Proud Green Home
Serenbe, GA

BUILDER PROFILE

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Rater: LG Squared, Inc., Chris Laumer-Giddens
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FEATURED HOME/DEVELOPMENT:

Project Data:

- Name: Proud Green Home at Serenbe
- Location: Serenbe, GA
- Layout: 3 bedrooms, 2.5 baths, 2 floors
- Conditioned Space: 2,811 ft²
- Completion: August 2013
- Cimate Zone: IECC 3A, mixed-humid
- Category: Custom

Modeled Performance Data:

- HERS Index: without PV 40, with PV -10
- Cost over 2009 IECC: with PV $100,000
- Projected Total Annual Energy Cost Savings (compared to a house built to 2009 IECC): without PV $870, with PV $1,903
- Projected Annual Utility Costs: without PV $1,082, with PV $49
- Annual PV production revenue: $1,033
- Annual Energy Savings: without PV 10,257 kWh, with PV 24,413 kWh

Home builder Luis Imery has built a home any homeowner would be proud of, the first U.S. Department of Energy-certified DOE Zero Energy Ready Home in the state of Georgia. The home, completed in August 2013, was a collaborative effort by builder Louis Imery of The Imery Group, architect and building science consultant Chris Laumer-Giddens of LG Squared, Inc., and Residential Design and Proud Green Home.com, an online publisher of green home information. Proud Green Home.com asked Imery to construct its first "Proud Green Home" and brought in a dozen building products manufacturers as project partners. These partners supplied some of the high-performance and resource-efficient products used in construction of the 2,811 ft² modern home.

The Proud Green Home was constructed in Serenbe, a 1,000-acre community located 30 minutes south of Atlanta that aims to be a national model for balanced development focused on land preservation, agriculture, energy efficiency, green building, and walkability with a land plan that calls for preservation of at least 70% of the natural hill country acreage, while accommodating at least as many homes as a traditional subdivision which would disturb nearly 80% of the acreage. All of the 200 plus single-family detached and attached homes at Serenbe must meet the criteria of EarthCraft, a regional efficient-homes certification program developed and administered by DOE Building America research partner Southface Energy Institute that requires builders to meet energy- and resource-efficient criteria, including the requirements of ENERGY STAR Certified Homes Version 3.0 for its gold and platinum levels.

The Proud Green Home goes beyond EarthCraft to meet the exceptional performance requirements of the DOE Zero Energy Ready Home program, which requires that builders meet the energy efficiency requirements of ENERGY STAR Version 3.0, as well as the indoor air quality and moisture management requirements of EPA Indoor airPLUS, the water conservation criteria outlined in

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.

Deep overhangs, structural awnings, and a porch trellis provide protection from summer sun while allowing winter sun to enter the space. The high-performance double-pane windows have coated aluminum clad frames; the glazing has a U-factor of 0.29, a solar heat gain coefficient (SHGC) of 0.20, and low-emissivity coatings. All 42 of the home's recessed can lights are LED fixtures and 34% of the lighting is CFL pin-based. The appliances and ceiling fans are ENERGY STAR rated.

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

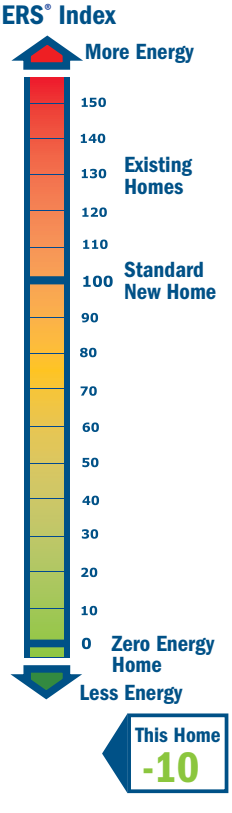
3 **DUCT SYSTEM**
located within the home's thermal boundary

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 EPA's WaterSense guidelines, insulation levels that meet or exceed those stated in the 2012 International Energy Conservation Code (IECC), and additional DOE Zero Energy Ready Home criteria for building airtightness, HVAC, lighting, and window performance. Imery stated that these performance criteria helped the home reduce energy consumption by 60% when compared to a similar home built to the current energy code, which in Georgia is equivalent to the 2009 IECC. The home achieves a Home Energy Rating System (HERS) Index of 40. When the 10-kW photovoltaic panels are counted in the calculation, the home's HERS score drops to -10. A score of -10 means that the home is operating as a true net zero energy home, one that produces more energy than it consumes in a year. This home is the first zero energy home at Serenbe.

"The Proud Green Home was a real opportunity to build a very high-performance and sustainable home in one of the nation's leading sustainable communities," said Imery. "The vision of the Proud Green Home is to convey a simple message to consumers and tradesmen about the benefits of building green. This is my company's vision as well. We are implementing a lot of advanced, high-performance building techniques and we have been showing these as we go through the construction process. We have held open houses and invited local trade organizations to come by to see the house at different stages of construction. What we are showing is that it is not rocket science; it is just paying attention to the details and planning for the future."

Imery and designer Laumer-Giddens kept the site's lot orientation and slope in mind when designing the home. The house has a raised slab foundation. Because the lot slopes, the foundation wall varies in height from 2 to 6 feet. Dirt was backfilled against this wall to form a level surface that was covered with gravel and compacted. Then a polyethylene vapor barrier was laid over the gravel. A slab was poured over this vapor barrier to keep ground moisture and soil gases from rising through the slab. Perimeter drainage is provided at the foundation footing by a perforated drain pipe wrapped in a landscape fabric "sock" filled with Styrofoam pebbles to keep the perforations free of dirt while allowing water to seep into the pipe and be carried away.

The above-grade walls are 2x6 walls constructed 24 inches on center. Advanced framing techniques were used including two-stud corners, where the wall corners are framed with two studs rather than three or four, allowing room for insulation in the corners. Headers over windows are constructed with one 2x8 flush with the

The walls were sheathed with an OSB product with a waterproof exterior coating and 1.0 inch of rigid foam adhered to the interior side for an insulating value of R-6.6. All seams are taped with a proprietary tape to provide a weather-resistant barrier that takes the place of house wrap. A yellow plastic mesh rain screen is installed over the OSB to provide a 0.25-inch ventilation and drainage gap between the sheathing and the siding. The exterior edge of the raised foundation slab is covered with a waterproofing coating, 1.5 inches of rigid foam fiberglass insulation, drainage board, and brick for an R-7 foundation.

outside edge of the wall which provides adequate structural strength while leaving more room for insulation than traditional solid wood headers consisting of two 2x8s and a sheet of plywood. The wall cavities were filled with open-cell spray foam to R-20. The walls were sheathed with a coated insulated OSB and covered with a mesh rain screen to provide a ventilation gap under the fiber cement and corrugated metal cladding.

Engineered I joists were used between floors and in the flat roof, which was insulated on the underside of the roof deck with R-32 open-cell spray foam. Over the coated OSB roof sheathing were installed a waterproofing membrane, 1x2 furring strips, and a 26-gauge standing seam metal roof.

The home is heated with a mini-split heat pump system. These minisplit systems are ideal for the low heating and cooling loads of very energy-efficient homes. The Proud Green Home's heating load is 22,020 Btu/h, equivalent to a 1.5- to 2-ton air conditioning system. Most standard central furnaces and cooling systems would be oversized for that load. Because minisplit heat pumps have variable speed compressors and fans, they can better match low cooling or heating load conditions, thus increasing their efficiency. The heat pump's heating seasonal performance factor (HSPF) is 8.20 and its cooling efficiency is 14.30 SEER (seasonal energy-efficiency ratio) or 10.10 EER (energy efficiency ratio). For comparison, the current minimum federal standards for heat pumps is 7.7 HSPF and 13 SEER.

The Proud Green Home's mini-split heat pump system consists of one outdoor compressor/condenser unit connected to three indoor units, with one upstairs in the attic and two downstairs in dropped ceilings in closets. The outdoor unit is roughly 2 ft. by 4.5 ft. by 1 ft. and is mounted on a concrete pad or on an exterior wall. The ducted indoor air handler units are roughly 34 in. x 18 in. x 10 in. Rigid metal, smaller-diameter R-6 insulated ducts are routed between the floor joists to direct air from the indoor air handler units to adjoining rooms. Imery installed transfer grilles in the bedrooms providing an air path to the main return register upstairs. Downstairs there is one return for the living room and the kitchen and one return inside the master bedroom.

DOE's Zero Energy Ready Home program requires that homes be tested for airtightness with a blower door, with air leakage limits ranging from ≤ 3 air changes per hour at 50 Pascals pressure (ACH 50) in IECC climates zones 1 and

HOME CERTIFICATIONS

DOE Zero Energy Ready Home

ENERGY STAR Certified Homes Version 3.0

EPA Indoor airPLUS

EPA WaterSense

DOE Zero Energy Ready Home Quality Management Guidelines

EarthCraft House, platinum level

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 2x6 walls were advanced framed to reduce lumber use leaving more space for the open-cell spray foam which provides R-20 worth of insulation in the wall cavities and R-31 on the underside of the flat roofs.

2 to ≤ 1.5 ACH 50 in the extremely cold climate zone 8. Imery conducted two blower door tests – one after insulating with spray foam but before drywalling, the second when the home was finished. The home tested at 0.72 ACH 50 in the first test and at 0.21 ACH 50 in the second test. Both were well below the ≤ 2.5 ACH 50 required for the home's climate zone 3 location and the final score was even well below the Passive House standard of 0.60 ACH 50.

With a home this airtight, intentional ventilation is a necessity and is usually provided by a heat recovery ventilator (HRV). HRVs have ducts that bring in fresh outside air and supply it to several locations in the home while other return ducts pull stale household air from vents at several locations and exhaust it to the outdoors. The incoming and outgoing air paths cross in a heat exchanger where the exhaust air heats or cools the incoming air, which is also filtered before being distributed to the home. Energy recovery ventilators (ERVs) are a form of HRV that also transfer some humidity from the high humidity path to the low humidity path. Imery installed an ERV in the Proud Green Home that supplies air to all of the bedrooms and main living areas and exhausts air from all the bathrooms and the kitchen at a constant rate, with a heat recovery efficiency of about 90%. With such efficient heat transfer, even during a cold winter day, the incoming fresh filtered air is typically warmed to within 10 to 15 degrees of the inside temperature before it is reaches the rooms. The 3-inch ERV ducts are small enough to run through the walls and floors and the ERV itself is located in the attic.

A 95% efficient solar thermal water heater with an 80-gallon storage tank provides 100% of the home's hot water needs. The solar thermal system with electric backup is 2.5 times more efficient than a conventional electric or gas water heater. The water tank is centrally located and PEX piping is routed from a central manifold directly to each faucet to reduce wait times and water waste. All plumbing fixtures are WaterSense qualified.

All paints and cabinetry are low- or no-VOC emitting. The flooring on the first floor is sealed concrete, the second floor is pre-engineered bamboo.

Photos courtesy of Imery Group.

KEY FEATURES

- **DOE Zero Energy Ready Home Path**: Performance
- **Walls**: Above-grade walls 2x6 advanced frame, R-20 open-cell spray foam plus R-6.6 coated OSB with 1.5-inch adhered rigid foam; mesh rainscreen; fiber cement and corrugated siding
- **Foundation**: Raised slab edge with waterproofing, R-5 fiberglass rigid foam, and brick
- **Roof**: ENERGY STAR 24 gauge aluminum standing seam metal roof, 1x2 spacer, waterproof membrane, OSB. R-32 open-cell spray foam on underside of roof deck, plus R-5 rigid insulation above deck, sealed attic
- **Windows**: Coated aluminum clad, dual-pane, low-e, U=0.29, SHGC=0.20
- **Air Sealing**: 0.21 ACH 50
- **Ventilation**: 90% efficient ERV
- **HVAC**: Mini-split heat pump with 1 exterior unit, 3 interior units ducted to rooms, 8.20 HSPF, 14.30 SEER, 10.10 EER
- **Hot Water**: solar thermal, with 80-gal. tank and electric backup, 0.95 efficient.
- **Lighting**: 63% LED, 32% CFL, two ENERGY STAR ceiling fans
- **Appliances**: ENERGY STAR
- **Solar**: 10-kW PV system
- **Water Conservation**: All fixtures EPA WaterSense; central manifold distribution with PEX piping to each faucet
- **Electronic Monitor:** System tracks PV and solar thermal; has ERV, HVAC, and lighting controls
- **Other**: Low- or no-VOC paints and finishes; programmable thermostats; shading provided to all windows; durable, non-rot, low-maintenance fascia, soffit, and trim; native and drought tolerant plants; rain sensor for irrigation system; perimeter subgrade drain system

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