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

DOE ZERO ENERGY READY HOME™

Green Extreme Homes & Carl Franklin Homes

First DOE Zero Energy Ready Home Retrofit Garland, TX

BUILDER PROFILE

Green Extreme Homes CDC
greenextremehomes.com, Jean Brown
214-906-1085
Carl Franklin Homes, LLC
Lewisville, Texas
Steve Brown, stevebcfh@cs.com
972-977-7398
www.carlfranklinhomes.com
Rater: Eric Johnson, TexEnergy Solutions

FEATURED HOME/DEVELOPMENT:

Project Data:

- Name: First DOE Zero Energy Ready Home Retrofit
- Location: Garland, TX
- Layout: 3 bedrooms; 1 bath; 1 floor
- Conditioned Space: 1,270 ft^2
- Climate Zone: IECC 3A, Hot-Humid
- Completion: May 2014
- Category: Affordable

Modeled Performance Data:

- HERS Index: without PV 59
- Projected Annual Utility Costs: without PV $480
- Projected Annual Energy Cost Savings (compared to a house built to the 2009 IECC): without PV $582
- Builder's Added Cost Over 2009 IECC: $38,000

A 1953 suburban home in Garland, Texas, has become the nation's first renovated home to be certified to the high performance requirements of the U.S. Department of Energy's Zero Energy Ready Home program, thanks to a successful collaboration between the non-profit community development corporation Green Extreme Homes (GEH) and for-profit builder Carl Franklin Homes of Lewisville, Texas. The 60-year-old, 3-bedroom rancher is expected to save its homeowner more than $1,000 a year in utility bills compared to a home built to the current 2009 International Energy Conservation Code. Carl Franklin Homes conducted the comprehensive retrofit. Green Extreme Homes worked with vendors, businesses, and local organizations to acquire the grants and volunteers to make the project possible.

The DOE Zero Energy Ready Home program is a home labeling program that seeks to bring homes to such high levels of performance and low levels of energy use that a small amount of solar panels on the roof could make the home a true net zero energy home, one that produces as much energy as it consumes in a year. The program is typically aimed at new homes, but DOE Building America Chief Architect Sam Rashkin mentioned to a long-time builder friend, Steve Brown, his desire to try the criteria on a retrofit home. Brown's company, Carl Franklin Homes, has been building and retrofitting affordable and entry-level homes in the Dallas area since 1993, working for the past four year with Green Extreme Homes CDC, a Texas-based 501c-3 non-profit focused on efficient affordable housing.

GEH and Carl Franklin Homes jumped at the challenge of renovating the foreclosed home, which was donated to GEH by the Bank of America. Although the exterior did not change much, except for a new paint job, new roofing, and trim, the inside was completely redone, giving the home and its owner, a disabled American veteran, a fresh start.

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.

The original 1953 home had absolutely no insulation in the walls, attic, or floor. Carl Franklin Homes and Green Extreme gutted the home down to the bare studs, then applied a latex-based sealant followed by closed-cell spray foam in the wall cavities, across the ceiling deck, and under the subfloor to insulate and air seal the entire building envelope.

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

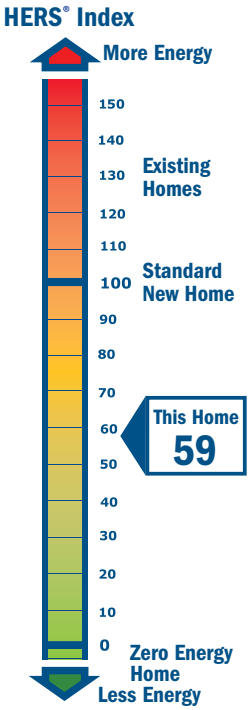
3 **DUCT SYSTEM**
located within the home's thermal boundary

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.



To meet the high performance requirements of the DOE Zero Energy Ready Home program, the home had to be brought up to ENERGY STAR Certified Homes Version 3.0 levels, meet the U.S. Environmental Protection Agency's WaterSense and Indoor airPLUS criteria, have insulation meeting the 2012 International Energy Conservation Code, and made ready for solar water heating and PV by installing a new meter base on an outer wall, with conduit adjacent to the meter base leading to the roof for future photovoltaic panel installation.

The team, along with volunteers from CitiBank and Home Depot, set to work pulling out appliances, carpet, cabinetry, and drywall, gutting the house down to its studs. In fact, one of the few things to be saved inside the home was the hard-wood oak flooring, which ironically may have been milled at a wood flooring company owned by Brown's family in the 1950s.

Team members used a sprayer-applied sealant to seal all the seams where framing members met or joined exterior siding. The 2x4 framed wall cavities were then filled with 3.5 inches of closed-cell spray foam for an R-value of R-20. In the attic, 5.5 inches (R-39) was sprayed over the ceiling deck, completely air sealing and insulating the ceiling. The insulation contractors then went into the crawlspace and sprayed an additional 5.5 inches of closed-cell spray foam along the underside of the floor, insulating it to R-39.

"The house is like a stryrofoam cooler. If you cool it down it stays cool, if you get it warm, it stays warm," said Brown. Texas had a 10-day cold snap during construction, with temperatures below freezing. Although Brown had the heat off, he said the temperature never varied by more than 3 degrees.

Brown said his company prefers to use closed-cell rather than open-cell foam due to the high humidity in central Texas. The spray foam air seals the structure, keeping humid air out and conditioned air in. Brown also commented that the two-pound foam is so rigid, it adds structural strength to the home.

The home is heated and cooled with a ductless mini-split heat pump that has one outside compressor-condenser unit connected to five inside heads. The highly efficient unit has a seasonal energy efficiency ratio (SEER) of 18.4 and a heating season performance factor (HSPF) of 9.8. The heat pump also uses variable refrigerant flow technology, adjusting power to the needs of the home, with the ability to ramp up to 2.5 tons of capacity. The homeowner primarily uses just two of the five indoor air handlers and has plenty of heating and cooling.

More than 3.5 inches of closed-cell spray foam filled the walls for an insulating R-value of 22. The home's windows were replaced with high-performance, double-pane, vinyl-framed, argon gas-filled windows with low-emissivity glass coatings to resist heat loss. ENERGY STAR-rated appliances including a clothes washer, dishwasher, and refrigerator, light fixtures, and ceiling fans were installed.

A centrally located, highly insulated electric water heater provides hot water to the home with short plumbing runs to the kitchen and bathroom that meet the DOE Zero Energy Ready Home hot water distribution requirements.

New ENERGY STAR appliances were installed including a washer, refrigerator, and dishwasher. All of the ceiling fans and 90% of the light fixtures are ENERGY STAR-rated. All of the fixtures are equipped with compact fluorescent lights.

To provide good ventilation, the home has an energy recovery ventilator (ERV), which has two ducts to the outside – one brings in fresh air and one exhausts stale air. The two air paths cross in a heat exchanger, which transfers heat from the warmer air stream to the cooler air stream so the incoming air is slightly heated or cooled, depending on the season.

The builder met all of the EPA Indoor airPLUS requirements including those for low- and no VOC-emitting paints, finishes, carpets, and cabinets. The builder also met guidelines for the Enterprise Foundation Green Communities Criteria, a green building program similar to LEED but geared toward low-income housing.

Brown oversaw the production and met with each sub-contractor prior to construction to discuss procedures for an efficient rehab. Contractors worked in unison, along with trainees from a Capitol One-funded job training program implemented by Green Extreme Homes, to complete the task in just over four weeks. Volunteers from Home Depot and CitiBank participated in the project. Green Extreme Homes also enlisted aid from the City of Garland and corporate sponsors Mitsubishi, Tempo Mechanical, and Home Depot.

Sam Rashkin of DOE, Mark Brezina, Regional Director for the U.S. Department of Housing and Urban Development, Ron Curry of the U.S. Environmental Protection Agency, and representatives from the City of Garland, Home Depot, and CitiBank were on hand for the ribbon cutting May 13, 2014, which can be seen at http://www.youtube.com/watch?v=awW7NvUM08M&feature=youtu.be

Perhaps no one is happier with the new home than homeowner Bonnie Sanchez, a veteran who had never owned a home before and now has an exceptionally high-performing energy-efficient home that should have utility bills of about $40 or less per month.

HOME CERTIFICATIONS

DOE Zero Energy Ready Home program, 100% commitment on new homes

ENERGY STAR Certified Homes Version 3.0

EPA Indoor airPLUS

Enterprise Foundation Green Communities

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 high-performance ductless heat pump provides all of the home's heating and cooling.

This is the second home Brown and GEH have built to the DOE Zero Energy Ready Home requirements, but Brown is no stranger to energy-efficient, affordable housing. After starting Carl Franklin Homes in the early 1990s, Brown realized there was nothing setting him apart from the other builders around Dallas. "I was sticks and bricks like everyone else," said Brown. So, he did his research and began attending energy-efficient housing conferences and courses conducted by DOE Building Building America research partners like Building Science Corporation.

In 1993 Brown began using structural insulated panels (SIPs) for his new construction projects. SIPs consist of two sheets of OSB sandwiching a 4- to 8-inch layer of foam insulation. The manufactured panels are straight and square with very high shear strength. Because the panels are pre-cut to order at the factory, they arrive at the job site ready for quick assembly with very little waste. With proper caulking of the interlocking seams, the panels help make a very airtight structure and the continuous layer of foam insulation inside the panels provides a near-complete thermal barrier around the home. Brown continues to use SIPs for new construction projects, for both high-end and low-income buyers.

"Back in the 90s when no one else cared about energy efficiency, I started experimenting with energy-efficient construction for 'workforce housing,' 3-bedroom, 2-bath homes for low-income and working-class families – those buyers with the least expendable income," said Brown. He has partnered with Green Extreme on dozens of affordable, subsidized housing, and neighborhood stabilization projects for cities and non-profits.

Brown, along with GEH, constructs about 25 new homes and 25 to 30 retrofits a year. "We are now moving into senior and multifamily housing, as well as housing for veterans," said Brown. "Even with affordable housing, people may be able to buy it but that doesn't mean they can afford to live in it, because of the high utility bills. We take their utility bills from $300 a month to $30-40 per month, and that makes a huge difference if you are on a fixed income."

His work has attracted the attention of HGTV, the Discovery Channel, and other media outlets, along with upscale buyers who want high-efficiency homes.

"People really want these Zero Energy Ready homes. We don't advertise and we have customers lining up for our market-rate homes. Everything we do now will be DOE Zero Energy Ready on all of our new homes and we will try to offer it on the retrofits as well."

All photos courtesy of Carl Franklin Homes, LLC.

KEY FEATURES

- **DOE Zero Energy Ready Home Path:** Performance
- **Walls:** 2x4 stud, sprayer-applied air sealant; 3.5 in. R-22 closed-cell spray foam
- **Roof:** Vented, 5.5-in; R-39 closed-cell spray foam on attic floor
- **Foundation:** Pier and beam with 5.5-in. of R-39 closed-cell spray foam under floor deck
- **Windows:** SHGC=0.31; U=0.28
- **Air Sealing:** 7 ACH 50
- **Ventilation:** ERV
- **HVAC:** Ductless mini-split; 1 outside unit; 5 indoor air handlers; SEER 18.4, 9.8 HSPF
- **Hot Water:** High-effic. electric tank
- **Lighting:** All CFL bulbs; 90% ENERGY STAR fixtures; ENERGY STAR ceiling fans
- **Appliances:** ENERGY STAR washer; dryer; refrigerator; dishwasher
- **Solar:** Meter and conduit installed for PV
- **Water Conservation:** Low-flow fixtures and toilet; drought-tolerant landscaping
- **Other:** All paints and sealants were no VOC

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