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

DOE ZERO ENERGY READY HOME™

U.S. DOE ZERO ENERGY READY HOME 2015 WINNER Housing Innovation Awards

Charles Thomas Homes

Anna Model
Omaha, NE

BUILDER PROFILE

Charles Thomas Homes, Omaha, NE
Tim Lowndes
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Rater: American Energy Advisors
Jesse Krivolavek, krivo@aeadvisor.com

FEATURED HOME/DEVELOPMENT:

Project Data:

- Name: Anna Model
- Location: Omaha, NE
- Layout: 3 bedrooms, 3 baths, 1 floor, unfinished basement
- Conditioned Space: 4,353 ft²
- Climate Zone: IECC 5A, cold
- Completion: December 2013
- Category: Custom

Modeled Performance Data:

- HERS Index: without PV 48
- Projected Annual Utility Costs: without PV $1,089
- Projected Annual Energy Cost Savings (compared to a home built to the 2009 IECC): without PV $1,217
- Builder's Added Cost Over 2009 IECC: without PV $10,000
- Annual Energy Savings: without PV 118 MMBtu

During the recession, while other builders were cutting corners to cut costs, Charles Thomas Homes decided on a different approach, energy-efficient homes that might cost a little more but would provide a lot more in terms of performance. The builder has now committed to building all of its new semi-custom homes to the high-performance criteria of the U.S. Department of Energy's Zero Energy Ready Home program.

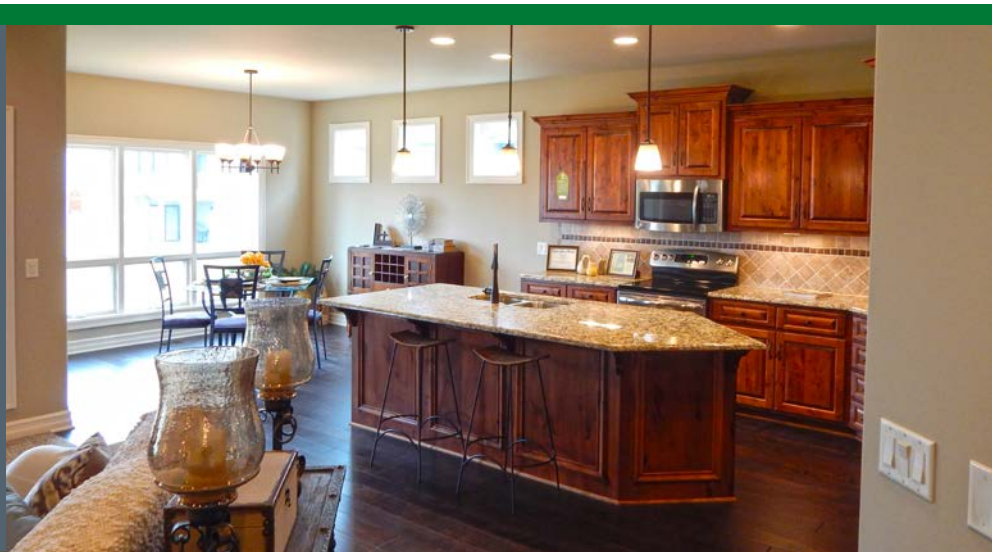
Builder Tim Lowndes started Charles Thomas Homes in 2009 with the goal of building high-performance homes. "I had been building since 2002, but just to-code homes. When the market was really slow, all the competitors were selling based on price. If a builder drops his price $5K, the only way he can cut is to take things out of the house that home owners can't see, like insulation and air sealing. Then you start getting all these call backs—'my pipes froze, my bathroom floor is freezing.' I just didn't want any more of those kinds of calls. So I said, let's go the other way. Let's figure out what is the best way to insulate, to waterproof, to frame. My homes are a little more expensive than my competitors' but we have a market now where people who come to us want the energy efficiency and they are willing to pay more for it."

Lowndes began building to ENERGY STAR and certified the award-winning home as his first DOE Zero Energy Ready home in April 2015. Soon after, he made a commitment to build all of his homes to the program criteria. The DOE Zero Energy Ready Home program requires homes to meet all of the requirements of ENERGY STAR Certified Homes Version 3.0 and the U.S. Environmental Protection Agency's Indoor airPLUS, as well as the hot water distribution requirements of the EPA's WaterSense program and the insulation requirements of the 2012 International Energy Conservation Code. In addition, homes are required to have a solar electric system installed or have the conduit and electrical panel space in place for it, if feasible based on location.

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.

Charles Thomas Homes built this semi-custom one-story home plus basement in Omaha, Nebraska, to the strict performance criteria of the U.S. Department of Energy's Zero Energy Ready Home program. ENERGY STAR appliances and LED lighting add to energy savings in the high-performance home.



What makes a home a DOE ZERO ENERGY READY HOME?

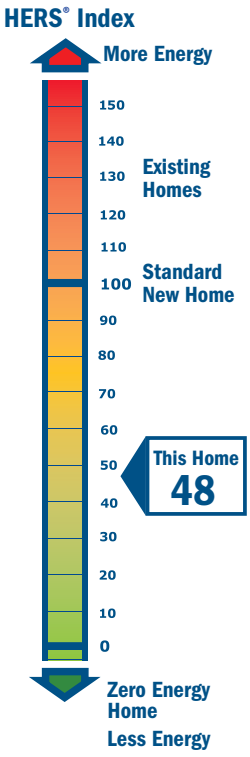
1 **BASELINE**
ENERGY STAR Certified Homes Version 3.0

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.

Lowndes is a firm believer that it's what's behind the walls, what the home owner can't see, that matters. The builder won a 2015 Indoor airPLUS leadership award from the EPA and appreciates that Indoor airPLUS certification is part of the DOE Zero Energy Ready Home criteria. "Health is a big issue. A lot of people are sick from their homes," said Lowndes.

Lowndes noted that the air sealing requirements of the program mean there is less dust in the air and that is one way to improve health. He added that Nebraska has the second worst radon levels in the United States, after Iowa. "Radon attaches to dust so the less dust, the less radon you get in your lungs," said Lowndes. To prove his point about the dust, Lowndes said Charles Thomas kept a hutch on display in the model home, portions of which were undusted for one, two, or three years. Many visitors commented that they saw more dust in their homes in a week than the hutch showed after two years.

In addition to air sealing, the builder installs an active radon system in the home. First, 4 inches of gravel is laid down, then drain pipe is installed at the perimeter inside and outside the foundation wall and the foundation area is covered with a 6-mil visquene under the basement slab. The drain is connected to the radon stack pipe, which vents through the roof and has a continuous fan operating 24/7 in the attic. This pulls soil gasses from under the slab and also helps to keep the foundation drier.

Another benefit to the air sealing is that there are fewer pests in the home. "You just don't have the pests you have in other homes. Spiders can't get in under the sealed sill plate," said Lowndes who noted they still take the extra precautions of treating the soil and using termite-resistant materials.

For safety in tornado-prone Nebraska, Lowndes installs full basements and offers optional storm shelters. The 9-foot poured concrete walls have frost-protected footings. The tops of the footings are sealed with water proofing spray before pouring the foundation walls and the exterior walls are also covered with a spray-on water proofing product. The basement walls are insulated on the interior. If the basement is unfinished, as was the case for the award-winning home, then R-11 vinyl-lined fiberglass blanket insulation is installed. The fire code requires that the walls be finished with drywall or vinyl facing. If the basement is finished, then 2x4 24-inch on-center framing is installed 1.5 inches away from the concrete wall and the space behind the framing is filled with 1.5

The high-efficiency furnace and heat pump water heater are located in a mechanical room in the insulated, unfinished basement.

inches of closed-cell spray foam. Then the framing cavity is filled with blown-in fiberglass with netting stapled to the face of the studs, to hold it in place until the drywall is installed, for a total wall R-value of R-23. There is no insulation underneath the slab.

The walls are 2x6 wood studs at 24 inches on center framed using advanced framing techniques including stacked framing, California (3 stud) corners, and insulated headers. The walls are filled with R-23 blown-in fiberglass blanket insulation. Closed-cell spray foam is used to air seal exterior walls prior to drywall at hard-to-insulate spots such as behind the tubs and shower surrounds. The home is sheathed with a coated OSB product that is sealed at the seams with a proprietary tape to serve as a protective water and air barrier, in place of house wrap. Fiber cement siding and trim provide a durable exterior.

Open-cell spray foam was used to insulate and air seal the rim joists between the basement and first floor; the foam completely air seals and provides a thermal barrier. Open-cell foam was also used in areas of the attic that are hard to reach, such as at the base of the roof trusses where it air sealed the top plates and served as a soffit dam to hold the soffit vent baffles in place. Attic partition walls were also air sealed with open-cell spray foam.

The engineered roof trusses had raised heels so the R-50 attic insulation can extend to the eaves with full height over the top plate.

The home's double-pane windows have low-emissivity coatings and argon gas fill and insulation values that exceed ENERGY STAR criteria.

The home was tested for air leakage per the program requirements and showed air leakage of 1.30 air changes per hour at 50 Pascals pressure difference. To put this in perspective, according to Lowndes, a standard house would have whole house air leakage equivalent to having a hole the size of a hula hoop in the wall. The Charles Thomas house has the equivalent of an 8-inch hole.

Lowndes is a firm believer in the testing requirements of the DOE Zero Energy Ready Home program. He remembers the first home he certified to ENERGY STAR. The home was already drywalled when Lowndes found a rater and asked about getting the home certified. "I thought I was building a tight house, I was pretty confident that the rater was going to be impressed. It was a disaster. I had twice the air infiltration I should have had. The rater and I were in the attic until

HOME CERTIFICATIONS

DOE Zero Energy Ready Home Program, 100% commitment

ENERGY STAR Certified Homes Version 3.0

EPA Indoor airPLUS

EPA WaterSense

National Green Building Standard, gold level

Home Building Professionals of Greater Omaha Certified High Performance Home

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 builder meets EPA Indoor airPLUS requirements including low- and no-VOC paints and finishes, moisture-resistant construction details, and whole house ventilation.

3 am while he showed me with the IR camera what I did wrong and where I needed to fix things."

The builder provides fresh air to the home with an energy recovery ventilator (ERV) that brings in filtered incoming air while exhausting equal amounts of stale air. A heat exchanger transfers heat from the warmer path to the cooler path to provide energy savings along with the ventilation.

The home is equipped with a 95% efficient gas furnace and a SEER 14 air conditioner. A 5-inch MERV 11 filter on the return plenum helps to clean the circulating air. The programmable thermostat has a humidity controller.

The home has a 50-gallon heat pump water heater. A hot water recirculating pump recirculates the cold water in the hot water lines on demand for hot water savings. Dual-flush toilets save 10,000 gallons of water per year. EPA WaterSense-rated faucets were installed throughout the home. Outside, the builder used native plants and met WaterSense criteria for irrigation.

All of the home's lighting is ultra-efficient LED based. The home has an ENERGY STAR rated dishwasher and ceiling fans.

The energy efficiency built into the home should help homeowners save about $1,217 annually on their utility bills compared to a home built to the 2009 International Energy Conservation Code, even without solar panels installed. The builder's cost to achieve these savings over just to-code construction is about $10,000 per home.

Lowndes was so smitten with high-efficiency construction that he wrote a book on it, *Sold on Building Science, How the High Performance New Home Will Make all Other Homes Obsolete*. Among other things, the book details the practices he employed to keep costs down.

Lowndes relies on very detailed written specifications that accompany the detailed plans to help inform his subcontractors. He uses an online system where all of his subcontractors can log in and obtain the documents at any time. They build using components that are framed off site in a controlled environment. "Our goal is to be able to compete with builders who build code-minimum homes so our homes must have similar design and interior features to other local builders. We constantly say in our model home that it's what you can't see that matters," said Lowndes.

Photos courtesy of Charles Thomas Homes

KEY FEATURES

- **DOE Zero Energy Ready Home Path:** Performance.
- **Walls:** Advanced framing; 2x6 24″ on center stacked framing; California corners, insulated headers; blown-in fiberglass (R-23); open-cell spray foam at rim joists; closed-cell spray foam behind tubs and showers; coated and taped sheathing; fiber cement siding.
- **Roof:** 7/16″ OSB roof deck, 15-lb felt, ice and water shield to 24″ above exterior walls, 30-year architectural shingles.
- **Attic:** Raised heel trusses; blown-in fiberglass (R-50); open-cell spray foam at top plate-baffle seam; spray foam attic kneewalls.
- **Foundation:** 9′ poured concrete basement walls; frost-protected footings; blown-in fiberglass cavity insulation; (R-23) above grade; (R-11) below grade.
- **Windows:** Double pane; argon filled; low-e.
- **Air Sealing:** 1.30 ACH 50.
- **Ventilation:** ERV; ENERGY STAR-rated bath fans on timers; MERV 11 filter.
- **HVAC:** 95% efficient gas furnace; 14 SEER AC.
- **Hot Water:** 50-gallon heat pump water heater.
- **Lighting:** 100% LED
- **Appliances:** ENERGY STAR-rated dishwasher and ceiling fans.
- **Solar:** Charles Thomas was exempted from the solar requirement based on the solar index for the Nebraska location.
- **Water Conservation:** EPA WaterSense-rated fixtures; on-demand recirculating pump; dual-flush toilets; insulated hot water lines; native landscaping.
- **Other:** Formaldehyde-free wood products; active radon mitigation system; no-VOC paint.

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