

**DOE CHALLENGE HOME  
CASE STUDY****New Town  
Builders**

Denver, CO

**BUILDER PROFILE****New Town Builders**

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**FEATURED HOME/DEVELOPMENT:****Project Data:**

- Name: The Hale Plan
- Location: Denver, CO
- Layout: 3 bedroom, 2.5 baths
- Conditioned Space: 3,560 ft<sup>2</sup> (with basement)
- Completion: May 2013
- Climate Zone: 5
- Category: Production

**Performance Data:**

- HERS Index without solar PV: 41
- HERS Index with solar PV: 3
- Projected annual utility costs: with solar \$-89, without solar \$1,146
- Projected annual energy cost savings (compared to a house built to the 2006 IECC): without solar \$1,812
- Annual energy savings: 18,753 kWh, 740 therms

For home builders, the mountain top is a net zero energy home—a home so energy efficient that, with the addition of a few solar panels on the roof, it will generate as much power as it uses each year. Denver area's New Town Builders has reached that summit. New Town announced in 2012 that every home it builds at Stapleton will earn a Challenge Home certification from the U.S. Department of Energy showing that it is a zero energy-ready home with a super-efficient building shell and all the wiring in place for installation of a rooftop solar photovoltaic system.

“The Challenge Home was the next step up for us,” said Bill Rectanus, vice president of homebuilding operations for New Town Builders. “We started as an ENERGY STAR builder, and we have gone through each upgrade of ENERGY STAR over the years. We put ourselves on a mission to continue to advance. This is why the DOE Challenge Home fits so well into what we are doing. It aligns with our goal of delivering zero energy-ready and zero energy homes to our customers.”

ENERGY STAR certification is a requirement for all of the houses built at Stapleton, a 7.5-square-mile planned community located on the old Stapleton International Airport site that will eventually include 4,600 homes, 9 schools, 150 shops and restaurants, and 1,100 acres of parks and trails. New Town Builders has sold over 500 homes in Stapleton since it opened in 2001; the builder plans to build 250 to 300 more over the next 7 to 10 years, all of them certified Challenge Home.

DOE's Challenge Home program requires third-party verification that homes meet a strict set of criteria for energy efficiency with high insulation levels and air tightness, as well as features to improve indoor air quality and water conservation and construction quality that ensures building durability and safety against natural disasters. All of these features are confirmed through testing and inspection by an independent verifier and the home's performance is modeled to calculate a Home Energy Rating System (HERS) score. New Town's first Challenge Home

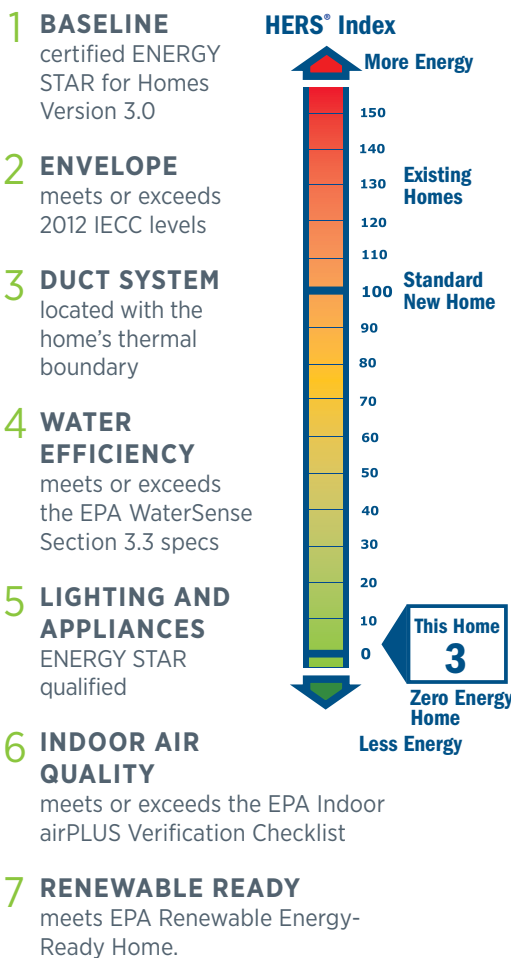


DOE Challenge Home builders are in the top 1% of builders in the country meeting the extraordinary levels of excellence and quality specified by the U.S. Department of Energy. Every DOE Challenge Home starts with ENERGY STAR for Homes Version 3 for an energy-efficient home built on a solid foundation of building science research. Then, even more advanced technologies are designed in for a home that goes above and beyond current code to give you the superior quality construction, HVAC, appliances, indoor air quality, safety, durability, comfort, and solar-ready components along with ultra-low or no utility bills. This provides homeowners with a quality home that will last for generations to come.

New Town Builders used the “house as a system” approach, traditional materials and building practices, and ENERGY STAR Version 3.0 as the baseline to take this home to the next level—a Challenge Home with a HERS 41 score without solar and HERS 3 with solar. Now, all New Town Builders’ single-family homes at Stapleton in Denver, CO, will be certified to the DOE Challenge Home. A 2.75-kW PV system is a standard feature on many of the homes and homeowners can add more PV panels if desired.



**CHALLENGE HOME CERTIFIED:**



received an impressive score of HERS 41; in comparison, a new home built to the 2006 IECC would score 100 and most existing homes score above 120. With photovoltaic panels added to the roof, New Town’s Challenge Home scores a HERS 3, with annual energy costs of negative \$89.

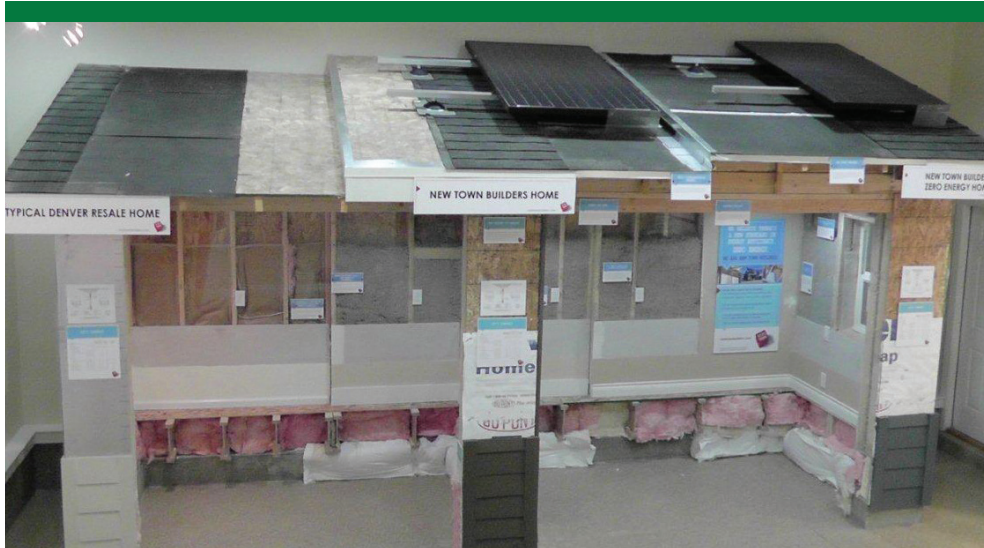
To achieve these impressive scores, New Town focused first on the building envelope—the home’s walls, roof, and foundation. “The envelope is key. You need to build the tightest, most well insulated envelope that you can get,” said Rectanus.

One notable thing about New Town’s construction is that they were able to achieve extraordinary performance levels with fairly ordinary construction materials.

“I think the remarkable thing about our envelope is that it is simple. It is built with standard construction materials that are used onsite every day. We are not having to retrain our subcontractors to use some new, high-tech product. These are standard building materials that are used every day that the contractors are familiar with,” said Rectanus. He estimated that the envelope costs only added about \$3 per square foot over costs for a home built to the builder’s standard, which exceeds code.

The builder chose 2x4 stick frame construction but instead of building one wall, they built two. The second 2x4 walls sits 2.5 inches in from the first wall, a technique known as double-wall construction. The outside wall is sheathed with OSB and the interior side of the inside wall is covered with netting forming a 9.5-inch wall cavity that was filled with blown-in fiberglass insulation providing an R-36 wall. The studs are separated by insulation and further separated by staggering their locations along each wall to prevent the thermal bridging that can happen when heat is transferred from inside to outside through the studs in a standard stud wall. The studs were spaced 24 inches apart and other advanced framing techniques including two-stud corners, open headers, and reduced framing at windows were employed to reduce lumber costs while allowing more space for insulation. The OSB sheathing is covered with housewrap and lapped fiber-cement siding. “This wall works well for our climate zone,” said Rectanus, “And every framer in town knows how to frame a 2x4 wall, so it helped us reach a competitive price point.”

New Town uses a standard vented attic with the insulation laid on the ceiling deck; however, they employ a raised heel truss, which raises the roof slightly above the walls so that in the critical area at the eaves there is more space to pile insulation above the top of the outside walls. New Town has been using a 10-inch raised-heel



The building science center within the company's sales office compares New Town's advanced framing techniques, raised heel trusses, insulation, and air sealing with a typical Denver resale home. The buyer can actually see the difference between a high-performing zero-energy home and a typical existing home.

truss for years. For the Challenge Home, they increased the heel height to 14 inches, allowing room for a full R-50 of blown-in fiberglass insulation to completely cover the attic floor all the way to the edges of the attic space.

The 9-foot-ceiling basement, within the conditioned space, is constructed with standard 8-inch poured concrete with damp-proofing sprayed onto the exterior of the wall and a capillary break between the footer and the foundation wall. Unfinished walls are insulated on the inside with an interior R-19 perforated vinyl drape, which New Town has had success with for several years in Denver's dry climate. The finished areas are framed with 2x4 wood studs and insulated with R-19 fiberglass batt insulation, then finished with drywall.

The windows are double-pane, argon-filled, and vinyl-framed, with an insulation U factor of 0.28 and a solar heat gain coefficient (SHGC) of 0.22. The windows have a low-emissivity coating that reduces heat loss during the cold Colorado winters and helps control heat gain during the sun-intense summers.

Blower door testing was conducted by an independent HERS rater to determine how much air leaks in and out of the building envelope (which is one measure of its energy performance). The Challenge Home tested at 2.11 air changes per hour at 50 Pascals pressure (ACH50), well within the 4 ACH50 required by code.

Although New Town came up with a fairly simple wall design, some sophisticated building science went into the decision making process. New Town Builders ran WUFI modeling analyses on several potential wall designs to look for potential moisture issues and determine insulation effectiveness.

This building science sophistication applied to the whole house design. "The lesson we learned is that you really need to concentrate on the house as a whole system," said Rectanus. "You need to start from the beginning with the integrated design process. This is crucial to being able to build the most effective energy-efficient home and to most easily meet the specifications of Challenge Home." New Town worked with several consultants who ultimately ran nine different scenarios through HERS software as well as 27 separate scenarios through the Passive House Planning Package design tool.

The whole house approach includes the equipment installed in the home. New Town chose a conventional gas furnace and central air conditioner but selected high-efficiency models – a 97.4% AFUE furnace and a 16 SEER air

## HOME CERTIFICATIONS:

DOE Challenge Home

ENERGY STAR Version 3

EPA Indoor airPLUS

New Town Builders won two prestigious awards in 2012: the Green Home of the Year from Green Builder Magazine and the Denver Home Builders Association's Major Achievements in Marketing Excellence (MAME) award for Green Home of the Year.



Every DOE Challenge Home combines building science specified by ENERGY STAR for Homes and advanced technologies and practices from DOE's Building America research program.

conditioner—that are well above the minimum standard levels of 80% AFUE and 13 SEER. The furnace and air conditioner air handler is located in the basement and the equipment is carefully right-sized using the Air Conditioning Contractors of America’s Manual J sizing calculations. All ducts are sized according to ACCA Manual D. The ducts are located in conditioned space and are air sealed to ENERGY STAR specifications. Testing shows these ducts leak less than 4 cfm/100ft<sup>2</sup> of conditioned floor area.

Over two decades of experience have taught New Town the value of considering duct layout early in the design process so that duct runs can be integrated into framing plans while there is an opportunity to make modifications if needed to allow for the shortest, most direct ducting possible. This, together with right sizing of the system, helps ensure the most efficiency and best performance in terms of comfort from the HVAC equipment. “It is essential to complete detailed duct planning and layouts in advance. It goes back to the integrated design process,” said Rectanus.

The tankless water heater (0.94 EF) provides hot water. The builder chose PEX (cross-linked polyethylene) piping for the water distribution system, citing its noise dampening, corrosion resistance, and condensation prevention properties. An on-demand recirculation feature installed in the furthest upstairs bath allows the homeowner to get nearly instantaneous hot water at the fixtures with the push of a button.

For ventilation, a continuously operating exhaust fan in a first-floor hallway meets the residential ventilation criteria of ASHRAE 62.2 as it pulls stagnant air and moisture out of the house. This and other features ensure that the home meets the indoor air quality requirements of the EPA’s Indoor airPLUS Verification Checklist.

New Town installed a 9.5-kW solar photovoltaic panel system on the roof of the Challenge Home, which covers nearly all of the home’s remaining electric use, bringing the home’s HERS score down to 3.

Several homebuyers at Stapleton have already selected the zero energy package. New Town is building two series of homes at Stapleton. The Solaris II series comes standard with a 2.75-kW solar system and earns HERS scores in the low 40s to high 30s. They offer a zero energy option on this series with increased envelope specs and a 9.5-kW solar system to bring the designed HERS score down to zero. The winning Challenge Home was one of these. New Town also offers their Z.E.N. (zero energy now) series homes, which have HERS scores of 40 with no solar. Adding 7 to 8 kW of solar to these homes brings the HERS scores down to zero. New Town has committed to 100% Challenge Home for both series moving forward.

“One thing we are really proud of is the way that we have been able to put together this package where we can offer zero energy on every home in a production atmosphere at an affordable cost,” said Rectanus.

## KEY FEATURES

- **Path:** performance
- **Above-Grade Walls:** double-wall, 2x4, 24-inch on-center, offset studs; 9.5 inches (R-36) blown-in fiberglass
- **Roof:** vented, R-50 blown-in fiberglass insulation on attic floor; 14-inch energy-heel trusses
- **Foundation:** basement with poured concrete walls; unfinished areas insulated on interior with R-19 perforated vinyl drape; finished areas include 2x4 wall framing, R-19 batt fiberglass insulation, and drywall
- **Windows:** double-pane, argon-filled, vinyl-frame, low-e, U=0.28, SHGC=0.22
- **Air Sealing:** 2.11 ACH50
- **Ventilation:** continuous exhaust fan
- **HVAC:** 97.4% AFUE furnace, 16 SEER air conditioner, ducts in conditioned space, transfer ducts at bedrooms
- **Water Heating:** tankless 0.94 EF
- **Lighting:** 100% CFL
- **Solar:** 9.5 kW PV
- **Appliances:** all ENERGY STAR, energy monitoring system
- **Water Conservation:** low-flow shower heads, drip irrigation, on-demand hot-water recirculation system
- **Other:** first production builder to use Colorado beetle kill lumber in all production homes

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy

For more information on the **DOE Challenge Home**,  
go to [www.buildingamerica.gov/challenge](http://www.buildingamerica.gov/challenge)

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[www.BuildingAmerica.gov](http://www.BuildingAmerica.gov)