The U.S. Department of Energy’s (DOE’s) Building America program has been a source of innovations in residential building energy performance, durability, and affordability for nearly 20 years. This world-class research program partners with many of the top U.S. home builders, contractors, and manufacturers to bring cutting-edge construction and design solutions and resources to market.

The most recent goal of the Building America program is to demonstrate how cost-effective strategies can reduce home energy use by more than 30% in new homes, in all climate regions, by 2015. As part of the strategy to prove that this level of performance is achievable in the market, DOE created a labeling program called the DOE Zero Energy Ready Home (ZERH) program.

Working together, the Building America and the ZERH programs have created a series of optimized solutions to demonstrate how builders have achieved, and often exceeded, these high savings goals. These optimized solutions provide guidance to all builders to cost effectively meet the 30% energy savings goal in their climate zones.

Building America’s five major climate regions include cold/very-cold, mixed-humid, hot-humid, hot-dry/mixed-dry, and marine. These climate regions are outlined in Figure 1, along with a map of the International Energy Conservation Code (IECC) climate zones for comparison. This document outlines the Building America recommendations for achieving 30% in the hot-dry climate region.

Due to the tradeoff decisions that are made when building a home, there are hundreds of ways to meet the 30% performance goal. The performance levels listed in the hot-dry table below, show just one way to cost effectively meet this goal. The far right column provides options for common building practices that could also be used to meet the performance goal.

Photo (top left): Centex is a Building America builder at Windemere in San Ramon, CA.
### Table 1. Building America Optimized Solution: 30% Savings for the Hot-Dry Climate

<table>
<thead>
<tr>
<th>Measure</th>
<th>Performance</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>THERMAL ENCLOSURE</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| High-R Ceiling | R-38 | - Unvented Attics  
  - Spray Foam Underside Roof  
  - Spray Foam and Permeable Insulation  
  - Exterior Rigid Insulation Over Sheathing  
  - SIP Roof  
  - Vented Attics  
  - Blown-in Insulation  
  - Batt Insulation |
| High-R Walls | R-13 cavity | - Single-Wall Cavity Insulation with Advanced Framing  
  - Spray Foam  
  - Spray Foam and Permeable Insulation  
  - Exterior Rigid Insulation  
  - Double-Wall Cavity Insulation  
  - SIP Walls  
  - Insulated Concrete Walls |
| Slab Foundation | Uninsulated | | |
| High-R Window | R-2.5 | - ENERGY STAR® Certified Window  
  - R-5 Window recommended |
| Air Tightness | 2 ACH50 | - Air Sealing  
  - Air Barriers |
| **HVAC SYSTEM** | | |
| Heating Equipment | 80% AFUE (Gas), or 8.2 HSPF (Electric) | - Direct Vent Gas Furnace  
  - Air-Source Heat Pump  
  - Geothermal Heat Pump  
  - Ductless Mini-Split Heat Pump |
| Cooling Equipment | 18 SEER | - Air-Source Heat Pump/Air Conditioner  
  - Geothermal Heat Pump  
  - Ductless Mini-Split Heat Pump |
| Whole-House Ventilation | ASHRAE 62.2 | - Exhaust-Only Ventilation  
  - Supply-Only Ventilation  
  - Balanced Ventilation |
| **ENERGY EFFICIENT COMPONENTS** | | |
| Water Heating | EF>0.8 | - Gas Storage  
  - Gas Tankless  
  - Heat Pump Water Heater  
  - Solar |
| Lighting | ENERGY STAR | - CFL  
  - LED |
| Appliances | ENERGY STAR | | |
| Exhaust Fans | ENERGY STAR | - Individual Room  
  - Central Exhaust |
| Ceiling Fans | ENERGY STAR | | |

In depth descriptions, installation guidance and code compliance information for most of the options listed in Table 1 are available on the Building America Solution Center website (basc.energy.gov).
The case studies in this section show real-world examples of builders meeting the 30% goal. These case studies show that builders can reach the 30% savings target even if they don’t meet all of the recommendations in Table 1. Tradeoffs are often based on local materials, labor costs, and market preferences.

**Palo Duro Homes, Inc.: Albuquerque, NM**

Palo Duro Homes, Inc., certified its first home to the U.S. Department of Energy Zero Energy Ready Home program criteria in late 2012, and as of September 2013, the New Mexico production home builder has already certified 65 Zero Energy Ready Homes, far more than any other builder in the program.

The efficiency starts with an ordinary wood-framed wall done very well, with 2x6 rather than 2x4 framing and studs spaced 24 inches rather than 16 inches apart, so the wall is sturdy but has a deeper cavity for insulation. Other advanced framing measures like open headers above windows and doors on non-load-bearing walls, 2-stud rather than 3-stud corners, and single top plates and bottom plates mean there is less wood framing in the walls. This allows more space for insulation and causes less thermal bridging (which occurs when wood studs transfer heat through the wall). The wall cavity is filled with R-21 of blown-in formaldehyde-free fiberglass insulation. Less framing is used, which results in lower lumber costs.

See the full case study online:

**Wathen Castanos Hybrid Homes: Clovis, CA**

Building science and energy efficiency have enabled Wathen Castanos Hybrid Homes to prosper even when the California housing market plunged. As its competitors cut prices and features, Wathen Castanos chose to improve its building processes by working with the U.S. Department of Energy’s Building America research team IBACOS. The result: high-quality, energy-efficient homes at competitive prices. Instead of the projected 140 Fresno-area homes, the company sold and closed 196 homes, all of which meet the Zero Energy Ready Home criteria.

Wathen Castanos achieves significant energy savings through tight sealing of the thermal enclosure, plus high-efficiency HVAC, water heating, windows, appliances, and lighting. Exterior walls are sheathed with taped, caulked rigid foam; the 2x4-inch bottom plate is wrapped with a 6-inch-wide sill seal. Holes are caulked and foamed, drywall is glued to the top and bottom plates.

Wathen Castanos involves architects and trade partners in its ongoing initiative to improve performance. Its intensive value engineering sessions examine trade-offs on each aspect of the home to maximize energy performance, quality, and cost efficiency. Wathen Castanos, which has been in business for 27 years, no longer builds standard code-minimum homes. “We cannot go back,” says company president Mike Nimon. “People come in looking for our hybrid home. Our energy efficiency puts dollars and cents in their pockets.”

See the full case study online:
KB Home: San Marcos, CA

KB Home, based in Los Angeles, CA, has made a corporate commitment to build all of its homes nationwide to meet the ENERGY STAR for Homes Version 3 specifications. In 2012 this resulted in more than 6,200 new ENERGY STAR-certified homes for the builder, who ranked fifth in the nation on Builder Magazine’s 2012 Top 100 ranking of U.S. home builders based on number of housing starts. In 2013 KB Home took high performance to the next level by building its first U.S. Department of Energy (DOE) Zero Energy Ready Home. The home is one of KB Homes’ ZeroHouse 2.0 models, a net-zero-energy home that produces more energy each year than it consumes.

The whole-house approach includes tightly sealed and highly insulated walls. The 2x4 24-inch on-center stud walls are air sealed with a non-hardening sealant that is applied with a proprietary powered applicator. A ¼-inch bead is applied along the surfaces of all top and bottom plates, corner studs, and door and window framing to form a compressible gasket-like seal between the studs and the drywall. The sealant is also used to seal holes around piping and wiring and joints at rim joists and between top and bottom plates and exterior sheathing. To insulate the walls, the wall cavities were filled with R-15 fiberglass batts then covered on the exterior with R-4 of continuous rigid foam insulation.

See the full case study online:

Through targeted research, industry partnerships, and collaboration with related DOE residential initiatives, Building America works to make cost-effective, energy-efficient homes a reality for all Americans.

Along with energy savings, the program also focuses on solutions that lead to:

- Risk identification and mitigation
- Improved indoor air quality, which can benefit occupant health
- Higher comfort levels in all rooms throughout the home
- Durable and moisture-resistant building designs and renovation
- Increased builder profitability through reduced construction time
- Opportunities for new product designs that save energy, material, and installation costs.

---

1 Compared to the most recent House Simulation Protocols, roughly consistent with IECC 2009 and updated lighting, appliances and miscellaneous electric loads: http://energy.gov/sites/prod/files/2014/03/f15/house_simulation_protocols_2014.pdf
2 A detailed description of Building America climate regions is available at http://energy.gov/eere/buildings/climate-zones