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 for Homes Version 3 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 company has gotten progressively more focused on energy-efficient and green construction over the years. “We are committed to trying to be the best builder we can be,” said Caldwell.

After earning an MBA from the University of California at Irvine and serving as a commissioned officer with the U.S. Marine Corps in Iraq, Dave Jr., returned to home building and earned certifications as a LEED Accredited Professional and a Certified Green Professional. He now serves as a board member of Housing Works Rhode Island (RI), a board member of Grow Smart RI, a residential advocate for the RI Green Building Council, and an instructor for the Certified Green Professional Program through the NAHB University of Housing. He also serves as Director of the RI Builders Association, and is active with the RI Chapter of the U.S. Green Building Council. Dave Sr., a veteran with the Naval Seabees, serves as an appointed member of the RI Building Contractors Registration and Licensing Board and a Director of the RI Builders Association, along with membership in a host of volunteer organizations.

While the Caldwells enjoy giving back to the community, when it comes to construction, they like being in the lead. “I like pushing the envelope,” said Dave Jr. “We are staying a step ahead of the competition.”

The DOE Zero Energy Ready Home they’ve built is a great example. The home has achieved a Home Energy Rating System (HERS) score of 46 without solar panels. For comparison a home built to the 2006 IECC code would earn a score of 100. The remarkably low HERS score was achieved with some ordinary construction methods carefully applied.

The walls are standard 2x4, 16-inch on-center construction with OSB sheathing. The wall cavities are filled with 3.5 inches (R-13) of open-cell spray foam. On the exterior, the walls are further insulated with 1.5 inches of rigid-foam polyisocyanurate that is foil-faced on both sides. The rigid foam is taped at the seams with a proprietary tape so that it can serve as the drainage plane. A high-grade vinyl siding covers the walls. All trim is made from long-lasting PVC.

### DOE ZERO ENERGY READY HOME CERTIFIED:

<table>
<thead>
<tr>
<th>1</th>
<th>BASELINE</th>
<th>certified ENERGY STAR for Homes Version 3.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>ENVELOPE</td>
<td>meets or exceeds 2012 IECC levels</td>
</tr>
<tr>
<td>3</td>
<td>DUCT SYSTEM</td>
<td>located with the home's thermal boundary</td>
</tr>
<tr>
<td>4</td>
<td>WATER EFFICIENCY</td>
<td>meets or exceeds the EPA WaterSense Section 3.3 specs</td>
</tr>
<tr>
<td>5</td>
<td>LIGHTING AND APPLIANCES</td>
<td>ENERGY STAR qualified</td>
</tr>
<tr>
<td>6</td>
<td>INDOOR AIR QUALITY</td>
<td>meets or exceeds the EPA Indoor airPLUS Verification Checklist</td>
</tr>
<tr>
<td>7</td>
<td>RENEWABLE READY</td>
<td>meets EPA Renewable Energy-Ready Home.</td>
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</tbody>
</table>

![HERS Index Chart]

- **HERS Index**
  - 150: More Energy
  - 46: This Home

![Home Energy Rating System (HERS) Score Chart]
The attic is sprayed along the underside of the roof deck with R-46 spray foam. The basement foundation walls are cast-in-place concrete. Because the basement walls are uninsulated, the basement is thermally separated from the house by spray foaming all holes through the subfloor and spray-foam insulating the rim joist and stairway, then insulating under the first floor with R-30 batts.

While spray foam has excellent insulating qualities, it also provides exceptional air sealing. When this home was tested for air leakage with a blower door test, it showed total air leakage of only 0.65 air changes per hour at 50 Pascals pressure, well below the 2.0 ACH50 maximum allowed by the DOE Zero Energy Ready Home requirements for the climate zone.

The windows are custom-made, locally built, double-pane, argon-filled, and vinyl-framed, with low-emissivity coatings, an insulating value of U=0.29, and a solar heat gain coefficient of 0.30.

For heating and cooling, the home is equipped with mini-split heat pumps, which have heating and cooling efficiency ratings of 9 HSPF and 15.25 SEER. The two indoor air handlers are ducted using flex ducts located in the conditioned attic; one heat pump serves the master bedroom and the great room and one serves the rest of the house. The ducts were tested for air leakage and showed 30 cubic feet per minute at 25 Pascals of total air leakage with 0 cfm leakage to the outside.

Because the home is so airtight, it was especially important to have a good ventilation system that brings fresh air into the home as well as exhausting stale air. The home was equipped with a heat recovery ventilator that has its own ducting, independent of the HVAC ducts. The home was also equipped with timered exhaust fans that are set for continuous low-speed operation but that can be switched to a higher speed after showering.

An air-source heat-pump water heater located in the basement provides hot water to the home.

HOME CERTIFICATIONS:

<table>
<thead>
<tr>
<th>DOE Zero Energy Ready Home</th>
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</thead>
<tbody>
<tr>
<td>ENERGY STAR Version 3</td>
</tr>
<tr>
<td>NAHB National Green Building Standard – Silver</td>
</tr>
</tbody>
</table>

Every DOE Zero Energy Ready Home combines building science specified by ENERGY STAR for Homes and advanced technologies and practices from DOE’s Building America research program.
Most of the home’s lighting uses LED sources; incandescent bulbs were used in a chandelier and a bathroom fixture at the homeowner’s request. ENERGY STAR appliances and EPA WaterSense-rated plumbing fixtures contributed to resource efficiency.

No solar panels were installed on the home, but electrical wiring was installed to prepare the home for the installation of an 11.64-kW photovoltaic system.

“There really isn’t anything exotic on this house. It’s a nice home that has been designed with good HVAC, good insulation, and good air sealing,” said Dave Jr. “I like this program (DOE Zero Energy Ready Home) because that is the point of it, you can get to a really high-performance home without a lot of extra effort. There is more of an emphasis on energy and air quality than on material selection and finishes.”

“Most of our business comes from word of mouth,” said Caldwell. “When the recession hit, we used that time to push our energy efficiency. And we’ve gotten a lot of notoriety because of it. We can document green construction. We have demanding customers and we can show them the energy efficiency.”

To provide fresh air to the remarkably air-tight home, a heat recovery ventilator was installed in the attic with its own supply and return ducts to the main living areas of the home. The HRV brings fresh air into the home. The incoming air is passed through a heat exchanger where it is warmed or cooled by outgoing air before being circulated through the home.

**KEY FEATURES**

- **Path:** performance
- **Walls:** 2x4 16-inch on-center framing, 3.5 inches (R-13) open-cell spray-foam cavity insulation and 1.5 inches (R-10) foil-faced polysiocyanurate rigid foam for R-23 total wall insulation. Vinyl siding, PVC trim.
- **Roof:** roof insulated along underside of roofline with R-46 open-cell spray foam
- **Foundation:** uninsulated concrete basement walls and slab. Spray foam at rim joists and all walls of staircase. Spray foam at all ceiling penetrations. R-30 batt between floor joists.
- **Windows:** low-E, double-pane, argon-filled, vinyl-framed. U=0.29, SHGC=0.30
- **Air Sealing:** 0.65 ACH50
- **Ventilation:** heat recovery ventilator in attic with supplies and returns to main living area, independent of HVAC ducts. Bathroom exhaust fans set up for continuous low-speed operation with a high-speed boost. HVAC has MERV 8 filter.
- **HVAC:** mini-split air source heat pump (9 HSPF, 15.25 SEER), 1 outside unit, two indoor units located in attic with supply ducts to all rooms and returns from the main living area. 30 cfm total duct leakage, 0 cfm leakage to the outside
- **Hot water:** 2.4 EF air-source heat-pump water heater in basement
- **Lighting:** >50% LED recessed lights
- **Appliances:** ENERGY STAR-rated clothes washer, dishwasher, refrigerator
- **Solar:** solar ready with wiring installed
- **Water Conservation:** timer-controlled irrigation
- **EPA WaterSense:** showerheads, faucets, toilets

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