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

DOE ZERO ENERGY READY HOME™

Housing Innovation Awards

Palo Duro Homes

Most DOE Zero Energy Ready Homes Built Albuquerque, NM

BUILDER PROFILE

Palo Duro Homes, Inc., Albuquerque, NM
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www.palodurohomes.com
Rater: E3 Energy, Justin Erickson
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FEATURED HOME/DEVELOPMENT:

Project Data:

- Name: Palo Duro
- Location: Albuquerque, NM
- Layout: 3 bedrooms, 2.5 baths, 1 floor
- Conditioned Space: 2,654 ft^2
- Climate Zone: hot-dry, 2B
- Completion: September 2013
- Category: Production

Modeled Performance Data:

- HERS Index: without PV 55, with PV 15
- Projected Annual Utility Costs: without PV $1,641, with PV (6.72 kW) $577
- Projected Annual Energy Cost Savings (compared to a home built to the 2009 IECC): without PV $1,064
- Builder's Added Cost Over 2009 IECC: without PV $8,000, with PV $28,000
- Annual Energy Savings: without PV 7,585 kWh, 84 gal, with PV 19,348 kWh, 84 gal

Palo Duro continues to lead the pack in 2014, constructing more U.S. Department of Energy (DOE)-certified Zero Energy Ready Homes than any other builder in the country—five times more certified homes than the next closest builder.

By July 2014, Palo Duro had completed 152 homes since the program began in 2013 (under the original program title DOE Challenge Home), all of them certified to the stringent efficiency requirements of DOE's Zero Energy Ready Home program.

To complete even one DOE Zero Energy Ready Home puts you in the top 1% of U.S. home builders according to DOE Chief Architect Sam Rashkin. Palo Duro has gone beyond that, committing to building *all* of its future homes to meet the high-performance requirements of the DOE program.

A DOE Zero Energy Ready home must be ENERGY STAR Certified Homes Version 3.0 labeled and must meet the water saving and air quality requirements of the U.S. Environmental Protection Agency's WaterSense and Indoor airPLUS programs. It must go beyond ENERGY STAR 3.0 to meet the insulation requirements of the 2012 International Energy Conservation Code. There are additional DOE requirements including making sure all heating and cooling ducts are in conditioned space and installing solar photovoltaics or making the home ready for PV by installing conduit and making space on the electrical panel.

Palo Duro meets all of these requirements and more. High-performance construction is not a new endeavor for the Albuquerque-based builder. Palo Duro's president Tom Wade and his father Jerry Wade, founder of Artistic Homes, have been working with DOE's Building America program for nearly 20 years, seeking to build progressively more efficient homes.

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.

Palo Duro Homes uses advanced framing techniques including constructing on a 2-foot grid with 2x6 studs spaced 24 inches apart, open or insulated headers over windows, two-stud corners, single top plates and ladder blocking at intersecting walls. These measures reduce the amount of lumber and thermal bridging in the walls while increasing the space for insulation. All of the ducts for the home's central heat pump are located in conditioned space in dropped soffits in hallways and other central locations to minimize duct length, reducing heat loss and improving system air flow.

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

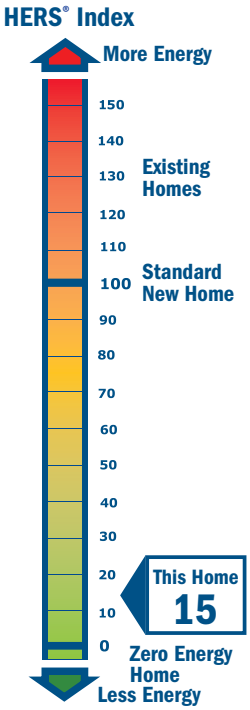
3 **DUCT SYSTEM**
located within the home's thermal boundary

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.



When Jerry Wade founded Artistic Homes in 1986, the company's aim was to give first-time homeowners a decent house for a decent price, but building code-minimum homes like all of the other builders in Albuquerque soon lost its appeal for the Wades. Tom and his father got tired of call backs. So they set out to find a better way to build. They became one of the first production builders in the state of New Mexico to build ENERGY STAR homes. When DOE research partner Building Science Corporation contacted Artistic in 1998 as part of an initiative to work with early adopters to incorporate building science and high efficiency into their construction methods, Artistic jumped at the opportunity.

When DOE launched its first home certification program, Builders Challenge, Artistic signed on and certified 235 homes between 2008 and 2013. Palo Duro has continued the commitment with the DOE Zero Energy Ready Home program.

Palo Duro meets the target in multiple climate zones, from the cold climate of northern New Mexico to the hot, dry deserts of the south, and under varying municipal codes, like Santa Fe where Palo Duro has just started sales in a subdivision of 400 new homes. "Palo Duro is committed to improving. Tom and I are on the phone almost weekly talking about new approaches and ways to improve efficiency," said Justin Ericson, the long-time energy rater for Palo Duro and Artistic.

Artistic built its first net zero energy home in 2008 and was the first production builder in the country to offer a net zero energy upgrade on every home it builds, an option that Palo Duro continues to offer. To make that offer, the builder has to start with a very efficient building envelope, so that net zero can be achieved with a reasonable amount of PV panels on the roof. Palo Duro is now achieving Home Energy Rating System (HERS) scores of 48 to 58 on all of its homes, before PV is added. For comparison, a home built to the 2006 IECC would score about 100 and most existing homes score well over 120. Palo Duro has stopped actively promoting solar installation prior to closing on home purchases due to a significant decrease in state and local PV incentives, a utility company requirement that all utilities be in the homeowner's name before the final inspection is conducted, and a new utility fee for homeowners who install PV panels. However, the builder continues to push the limits on energy efficiency.

Although HERS scores of 48 to 58 are very impressive, Palo Duro makes it look easy, choosing, familiar construction methods done well. Palo Duro builds standard stick-framed walls but uses 2x6 studs spaced 24 inches on-center rather

Palo Duro Homes achieves HERS ratings of 48 to 58 by stuffing walls with R-22 of blown fiberglass and carefully air sealing at top and bottom plates, around windows and doors, and at any outlets, wiring or plumbing holes.

than 2x4 studs spaced 16 inches on-center for a deeper wall cavity with less studs, providing more room for the R-22 of blown fiberglass insulation. Other advanced framing techniques are used to further reduce lumber use and increase space for insulation. Corners are constructed with two studs rather than three studs, and the studs are positioned to allow for insulation between the stud and the wall surface. Walls have single rather than double top plates. Headers over doors and windows are engineered to use only as much wood as is necessary, allowing space for insulation rather than having solid wood headers, which create cold spots on walls in winter. Reducing the number of studs in the wall reduces thermal bridging, the transfer of heat through the wall, which occurs when a wood stud or other conductive material contacts both the inside and outside of a wall. The houses are designed on a 24-inch grid, which minimizes waste because plywood, OSB, and other lumber and sheet goods usually come in 24-inch not 16-inch denominations. Windows and doors are aligned with this grid to minimize the need for extra studs for window supports.

The homes have a slab foundation. A 1-ft by 1-ft trench is dug and a conventional stem wall is poured, then insulated along the inside with R-5 of rigid XPS foam. Perforated pipe is laid along the inside perimeter of the stem wall in a bed of large aggregate for radon and soil gas collection. The pipe connects to a vent stack that goes out through the roof. This passive radon removal system can easily be converted to an active system with the addition of an in-line electric fan if later testing should reveal the accumulation of radon in the home. After backfilling, a vapor barrier is laid over the soil and extended up to the top of the stem walls, then 4x8 sheets of 4-inch-thich, R-10 rigid XPS foam are laid along the inside perimeter of the stem wall. This is covered by a 4-inch concrete floor slab.

The homes have a ventilated attic with R-50 of blown-in fiberglass piled on the ceiling deck. The roof uses asphalt shingles. Underneath, a peel-and-stick ice and water shield is applied 4 feet up from the edges and in all the valleys and hips. The rest of the roof decking is covered with 30-lb felt.

Despite the standard construction methods, Palo Duro is able to achieve an airtightness of 2.0 air changes per hour at 50 Pascals pressure when tested with a blower door (quite a bit tighter than the maximum 7.0 ACH 50 specified by the 2009 IECC). To achieve this level of airtightness, Palo Duro assigns a project manager whose responsibility is to ensure the homes are air sealed and they purchase an advanced air sealing package from the insulation contractors.

HOME CERTIFICATIONS

DOE Zero Energy Ready Home program, 100% commitment

ENERGY STAR Certified Homes Version 3.0

EPA Indoor airPLUS

EPA WaterSense

"Every year we look ahead to see what we'd like to do in the coming year. The question always comes up, should we cut back on the energy performance and offer a cheaper house? We always decide we just can't do it. If we have a 2,000-ft^2 home with 800 cfm of air leakage, it makes me sick because I know we can build it with 600 or 300 cfm of air leakage. And we laugh because a few years ago that same house was coming in at 1,500 cfm."

- Tom Wade, Palo Duro Homes

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.

All top and bottom plates are caulked under the drywall. All holes for plumbing and wiring are caulked and foamed. The DOE Zero Energy Ready Home program requires builders to conduct a blower door test for whole house building leakage. Palo Duro also tests for air leakage between the home and the garage.

In many communities Palo Duro installs a central air source heat pump, which provides heating at 8.7 HSPF efficiency and cooling at SEER 15 efficiency. To ensure good indoor air quality, an energy recovery ventilator is installed. The ERV has ducts to the outside to bring in fresh air and exhaust stale air. The two airpaths cross in a heat exchanger that transfers heat from the warmer path to the cooler path. Palo Duro uses an ERV with a very efficient electronically commutated motor (ECM) to minimize energy use because the ERV is set to run continuously. The ERV supplies air to the supply side of the air handler for distribution through the HVAC ducts; air is returned to the ERV through separate, dedicated ducts from the laundry and bathrooms.

In the Santa Fe community, Palo Duro is installing mini-split ductless heat pumps with one outside unit and three inside units. These units are rated 16 SEER and 9.5 HSPF for efficiency. The attic insulation was also increased to R-6 in this higher elevation climate.

An energy rater assessment of a Palo Duro 2,654 ft^2 home in Albuquerque showed the home would save its owners about $1,060 per year in energy costs compared to a home built to the 2009 IECC. Palo Duro is happy about the energy savings but even more important for them is defect-free, quality construction. Said Ericson, "It's a home that will last and we are pretty proud of that."

To help homeowners get the most from their high-performance homes, Palo Duro prepares a complete homeowners manual for each home. The binder includes a description of the equipment and systems in the home, an explanation of the home's energy performance, copies of all of the home's certifications, and model numbers for appliances. One of the most thoughtful additions to the manuals is a series of photos showing each wall of the home before drywall is installed with wiring, plumbing pipes, and shafts labeled, so if there are ever future remodeling or repair projects that require cutting into walls, the homeowner or contractor will know what's there before they cut.

Thoughtful details like this set the Wades apart from other builders. "We build this way because it's important to us," said Tom Wade. "We don't just sit down with the checklist and say, how can we check the boxes? We look at the list and say how can we build a better home?"

All photos courtesy of Palo Duro, Inc.

KEY FEATURES

- **DOE Zero Energy Ready Home Path:** Performance
- **Walls:** 2x6 24 in. oc. advanced framing, extra air sealing, R-22 blown fiberglass cavity insulation
- **Roof:** Asphalt shingles, peel-and-stick underlayment up 4 feet plus all valleys and hips, rest of field is 30 lb felt
- **Attic:** Blown-in fiberglass, R-50
- **Foundation:** Slab with R-5 rigid foam separating slab edge from stem wall; R-10 rigid foam under slab first 4 feet. Passive radon pipe at inside perimeter
- **Windows:** Double-pane, argon-filled, U=0.29, SHGC=0.23, low-e windows
- **Air Sealing:** 2.0 ACH 50
- **Ventilation:** ERV with ECM motor
- **HVAC:** Central air source heat pump 15 SEER, 8.7 HSPF, ducts in dropped soffits; ERV supply to air handler, separate returns
- **Hot Water:** 95% effic. tankless gas water heater
- **Lighting:** 90% LED, 10% CFL
- **Appliances:** ENERGY STAR dishwasher, clothes washer, refrigerator, 4 exhaust fans
- **Solar:** 6.72-kW PV
- **Water Conservation Features:** All EPA WaterSense

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