

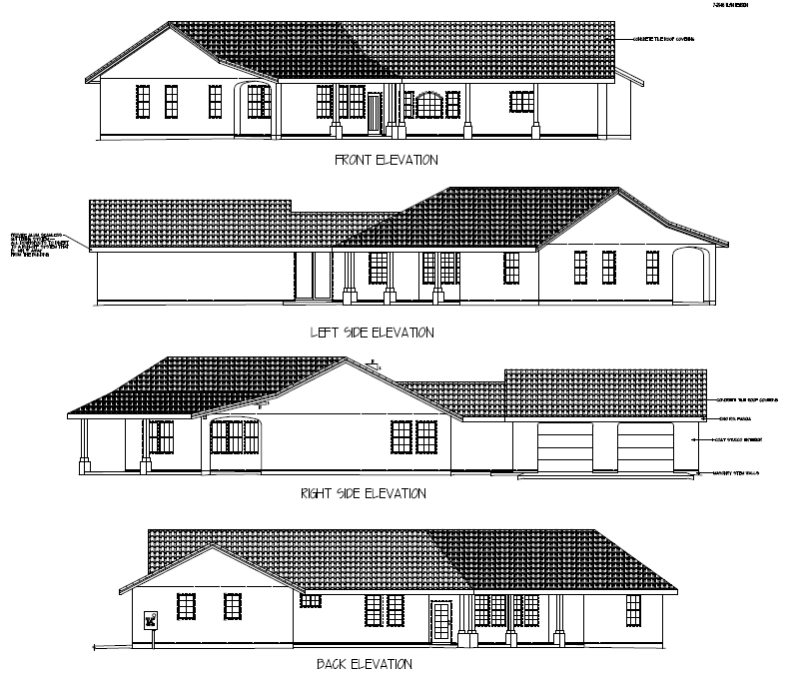


Achieving Energy Star® and Beyond

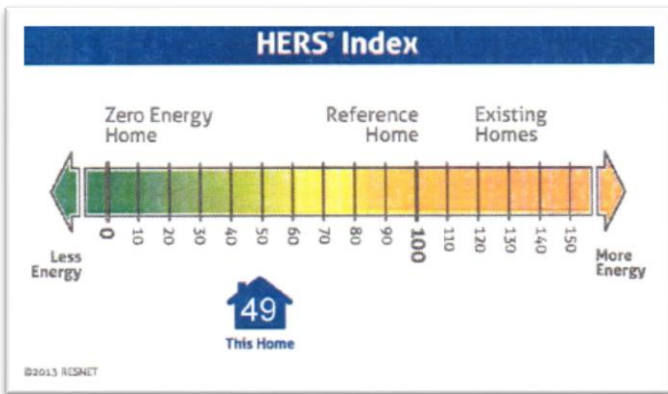
Cielo Azul Vineyard Residence | Chino Valley, AZ

An Overview of a High-performance Home in a Mixed-Dry Climate

In 2017, Prescott Green Builders completed a 2200 ft² residence for the owners of Cielo Azul Vineyard in Chino Valley, Arizona (about 20 miles north of Prescott). The residence was designed and constructed to meet high standards for energy efficiency and durability. To verify these high standards, the construction process was monitored and on completion was certified as an EPA Energy Star® home by an independent RESNET home-energy rater. The home achieved a 49 on the Home Energy Rating System (HERS) index, where 0 represents parity between energy use and energy generation, and 100 represents the “standard” U.S. new home (see graphic).



The following table summarizes the features which were factors in achieving a safe, comfortable, healthy, affordable, durable and energy efficient home.



High-performance Features of the Cielo Azul Vineyard Residence

Project	Project Name City, State	Cielo Azul Vineyard Residence Chino Valley, Arizona IECC Climate Zone 4B
Team	Architect/Designer General Contractor Home Energy Rater	Blue Line Design, Prescott, AZ Prescott Green Builders LLC; Prescott AZ E3 Energy LLC; Flagstaff AZ
General	Time Line Floor Area Construction Type Layout Construction Cost	Started: August 2016 Completed: June 2017 2,212 ft ² Conditioned Space 990 ft ² Unconditioned (garage, mechanical room, sun room) Slab-on-grade with wood frame walls Single-family detached housing One floor: 3 bedrooms, 2 baths, kitchen, living room, dining room, laundry, attached 2-car garage separated by a sunroom; mechanical room \$150 per square foot as a hybrid home (owner participation in the construction process)
Certifications	RESNET Home Energy Rating System (HERS) Index International Energy Conservation Code EPA EnergyStar Program	49 In compliance (IECC 2012) Qualified

Energy Efficiency Details

- XPS rigid foam insulation between the foundation stemwall and concrete slab (2" thick R-10 extending 16" vertically along the formed concrete stemwall)
- Exterior 2"x6" frame walls fully insulated to R-26:
 - 1" thick layer of EPS rigid foam insulation (R-4.5) on all exterior wall surfaces
 - 2"x6" frame wall cavities have 3.5" polyurethane foam insulation (R13) and 2" of wet-spray cellulose insulation (R7)
 - Full OSB shear (R1/2), concrete stucco (R1/2), interior drywall (R1/2)
- Bottom of roof deck insulated to R-29 with 8" of polyurethane spray foam
- Garage and unconditioned spaces insulated with 4" polyurethane spray foam (R14) in walls and the bottom of the roof deck; garage door insulated to R13 with high-density foam
- Window and door headers sized for proper loads, set to the exterior to create an interior cavity for insulation, and insulated with cellulose during wall spray
- Thermal bypasses behind tubs/showers adjacent to exterior walls were insulated with polyurethane spray foam
- High-performance EnergyStar Windows installed:
 - Double pane, Low E glass, thermally broken, argon gas filled, fiberglass windows
 - Windows coefficients: SHGC=0.28 U=0.28
 - Windows operable to allow for natural ventilation
 - Window flanges properly flashed with housewrap and peel/stick tape
- Tight building envelope (blower door test measured 439 Cubic Feet Per Minute at 50 Pascals (CFM50); leakage equivalent to approximately 44 sq. inch space or a 3 ft sliding glass window open 1-1/4"
 - Exterior walls have multiple continuous air-infiltration barriers (OSB glued to studs and housewrap seams taped and caulked top/bottom to OSB)
 - Exterior wall penetrations all properly air sealed
 - Metal main trunk ductwork and flex duct secondary runs sealed with mastic; Duct Blaster total leakage measured 76 CFM at 25 Pascals (equivalent to 3.4% of floor area)
- HVAC system requirements calculated, sized appropriately, and installed correctly
 - High-efficiency 18 SEER cooling/9.0 HSPF heating 2-stage heat pump
 - Single-zone system with programmable thermostat controls
 - Balanced ventilation system continuously exhausts stale air and supplies exterior fresh air
 - Energy Star ventilation fans in wet areas and bathrooms
- Energy Star kitchen appliances include dishwasher and refrigerator
- Hybrid (heat pump) hotwater heater system with 66-gallon tank for excess storage capacity; hotwater recirculation pump on a timer to limit standby heat loss through underslab plumbing
- Total LED lighting in ceiling can lighting and light fixtures
- Ceiling fan in each bedroom and living room
- Garage on west side of home buffers conditioned space from summer heat gain; deep patio on south-facing long dimension and eave overhangs limit direct sunlight entry through windows

Renewable Energy Generation	<ul style="list-style-type: none"> • None at this time in the residence, planned in a future development phase • Pump in vineyard well powered by 650 watt solar panels 	
Indoor Water Efficiency Details	<ul style="list-style-type: none"> • Low-flow toilets, faucets, and showerheads • Water-conserving EnergyStar dishwasher • Recirculation pump to accelerate hot water to individual taps 	
Resource Efficiency Details	<p>Enhanced Durability and Reduced Maintenance</p>	<ul style="list-style-type: none"> • Foundation water management strategies implemented: <ul style="list-style-type: none"> – damp-proofing of sub-grade stemwall – polyethylene sill gasket for capillary break • Building envelope moisture management strategies implemented: <ul style="list-style-type: none"> – above grade wall system composed of materials that are vapor permeable – windows and doors properly flashed – rain gutter extensions direct water away from foundation – housewrap properly lapped, seams taped, and sealed to the wall sheathing with caulk • Roof overhang (including gutter projection) minimizes sunlight and damaging UV entry through windows in summer • Low-maintenance pre-colored acrylic stucco • Concrete tile roof provides long-lived roof protection • Peel-and-stick roofing underlayment provides a high level of protection for water entry through the roof • All building materials kept dry and covered. Exterior wood fascia primed and stained before installation, joints caulked during installation
Indoor Air Quality Details	<p>Site Elements</p>	<ul style="list-style-type: none"> • Excellent ambient air quality in the north central Arizona area • No pesticides broadcast on the soil prior to construction • Building materials with organic content kept dry to minimize mold potential
	<p>Building Enclosure Elements</p>	<p>Multiple redundant techniques designed to keep the house dry (thereby inhibiting mold growth) and to maintain control of the interior environment:</p> <ul style="list-style-type: none"> • Below grade portion of the foundation stemwall damp-proofed • Finish grade is a minimum 5% sloped away from the house • Slab penetrations for plumbing sealed with expanding foam • Flexible polyethylene foam sill sealer under all exterior wall bottom plates; interior and exterior of bottom plate caulked where it meets the slab • Exterior wall materials designed to dry to both exterior and interior • Properly flashed and sealed exterior door and window openings limit potential for water intrusion into the wall system and associated mold growth potential • Tight building envelope; blower door test value of 439 CFM at 50 Pascals (equivalent to 0.91 ACH₅₀ [air changes per hour at 50 pascals] and 0.20 CFM/ft²)

Indoor Air Quality Details (continued)	Finishings and Furnishings	<ul style="list-style-type: none"> • Only hard-surfaced flooring (stained concrete) in the house.; no carpet is installed to limit dust accumulation and VOC outgassing
	Mechanical Equipment	<ul style="list-style-type: none"> • HVAC system right-sized according to Manual J and D calculations and installed correctly • No building cavities were used in the forced air distribution system • Carbon monoxide detectors are installed outside of each sleeping area • Balanced energy recovery ventilation system supplies continuous fresh air to the interior and expels stale air to the exterior • All ductwork is located within the conditioned space and all duct joints were mastic-sealed (duct leakage measured at 27 CFM) • Exhaust fans(80 CFM) in each bathroom and the laundry room and the kitchen rangehood exhaust fan (200 to 685 CFM) is vented to the exterior • Clothes dryer vented directly to the outdoors