

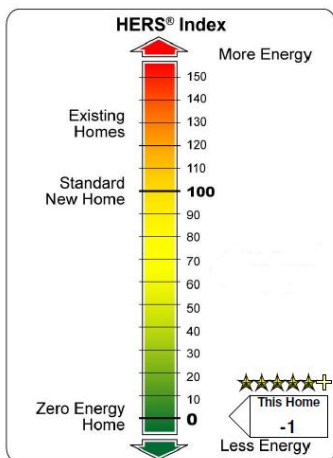
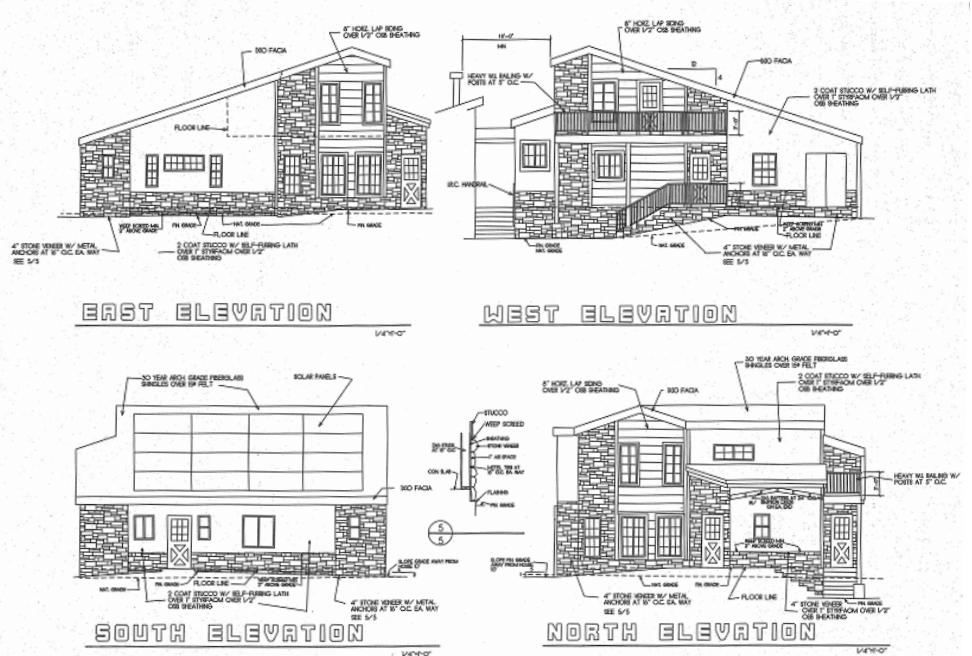
# Anatomy of a “Zero Net Energy” MeadowRidge House | Prescott, Arizona

## An Overview of a High-performance Home Capable of Generating All the Electrical Power It Consumes

In 2011, Prescott Green Builders completed a 1736 ft<sup>2</sup> “Zero Net Energy” guest house in Prescott, AZ. This means that the home was constructed to be as energy efficient as possible and then supplemented with grid-tied photovoltaic solar panels to generate all the power that it consumes. The home was certified by an independent RESNET home-energy rater to be -1 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.

The home also meets the EPA Energy Star and DOE Builder’s Challenge home-performance program standards which includes categories in energy efficiency, resource efficiency, indoor air quality, and water efficiency.

The home is unique in its design and construction (see details which follow) and when coupled with its 6.5kW photovoltaic system, make it only one of several in the Prescott area to be able to claim the “Zero Net Energy” status.



## Features of the Zero Net Energy MeadowRidge House

<b>Project</b>	Project Name	MeadowRidge Zero Net Energy House
	City, State	Prescott, Arizona IECC Climate Zone 4B
<b>Team</b>	Architect/Designer	The Design Source, Prescott Valley AZ
	General Contractor	Prescott Green Builders LLC; Prescott AZ
	Home Energy Rater	E3 Energy LLC; Flagstaff AZ
<b>General</b>	Time Line	Started: March 2011 Completed November 2011
	Floor Area	1,736 ft <sup>2</sup> Conditioned Space
	Construction Type	Slab-on-grade with wood frame walls
	Layout	Single-family detached housing: 1 <sup>st</sup> floor: 2 bedrooms, 2 bath, office, kitchen, living room, dining room, laundry/mudroom 2 <sup>nd</sup> floor: recreation room
<b>Certifications</b>	RESNET Home Energy Rating System (HERS) Index	57 before photovoltaics; -1 after photovoltaics
	International Energy Conservation Code	In compliance (IECC 2006, 2009, and 2012)
	EPA EnergyStar Program	Qualified
	DOE Builder's Challenge Program	Qualified
	APS EnergyStar Homes Program	Qualified

<b>Energy Efficiency Details</b>	<ul style="list-style-type: none"> <li>• XPS rigid foam insulation on foundation perimeter and slab edge (1" thick R-5 on 6 inch CMU and 2" thick R-10 extending 16" vertically)</li> <li>• Exterior 2"x6" frame walls fully insulated to R-26:             <ul style="list-style-type: none"> <li>- 1" thick layer of XPS rigid foam insulation (R-5) on all exterior wall surfaces separating controlled environment spaces from uncontrolled environment</li> <li>- 2"x6" frame wall cavities have blown-in cellulose insulation (R-21)</li> <li>- 2nd floor 2"x6" frame wall insulated with blown-in cellulose insulation to R-21</li> </ul> </li> <li>• Rim joist (separating 1<sup>st</sup> level from 2<sup>nd</sup> level) cavities insulated to R-19 with polyurethane spray foam</li> <li>• Vaulted ceiling insulated to R-32 with spray foam and R-19 batt insulation in knee wall cavities)</li> <li>• 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</li> <li>• Thermal bypasses behind tubs/showers adjacent to exterior walls were insulated and sealed with an air barrier material (polyurethane spray foam)</li> <li>• High-performance EnergyStar Windows installed:             <ul style="list-style-type: none"> <li>- Double pane, Low E glass, thermally broken, argon gas filled, vinyl windows</li> <li>- Windows coefficients: SHGC=0.30 U=0.29</li> <li>- Windows operable to allow for natural ventilation</li> </ul> </li> <li>• Tight building envelope (blower door test measured 407 Cubic Feet Per Minute at 50 Pascals_CFM<sub>50</sub>; equivalent to 1.85 Air Changes Per Hour at 50 Pascals_ACH<sub>50</sub>)             <ul style="list-style-type: none"> <li>- Exterior walls have multiple continuous air-infiltration barriers (OSB glued to studs and housewrap seams taped and caulked top/bottom to OSB)</li> <li>- Exterior wall penetrations all properly air sealed</li> <li>- Metal ductwork sealed with mastic and Duct Blaster leakage measured 27 CFM at 25 Pascals (1.5% of floor area)</li> </ul> </li> <li>• HVAC system requirements calculated, sized appropriately, and installed correctly             <ul style="list-style-type: none"> <li>- High-efficiency 95 AFUE forced-air natural-gas fired furnace installed for heating; no system installed for cooling</li> <li>- Single-zone system with programmable thermostat controls</li> <li>- Supply only fresh air intake</li> <li>- Jump ducts between all large rooms provide pressure balancing throughout</li> </ul> </li> <li>• Energy Star kitchen appliances include dishwasher and refrigerator</li> <li>• Light fixtures are EnergyStar with CFL bulbs</li> <li>• Multiple ceiling fans</li> </ul>
<b>Renewable Energy Generation</b>	<ul style="list-style-type: none"> <li>• 650 ft<sup>2</sup> (6.5kW) of roof-mounted, south-facing photovoltaic solar panels (system sized to match the modeled home-energy usage on an annual basis)</li> </ul>

<b>Indoor Water Efficiency Details</b>	<ul style="list-style-type: none"> <li>• Low-flow toilets, faucets, and showerheads</li> <li>• Water-conserving EnergyStar dishwasher</li> <li>• Recirculation pump to accelerate hot water to individual taps</li> </ul>	
<b>Resource Efficiency Details</b>	<p>Enhanced Durability and Reduced Maintenance</p>	<ul style="list-style-type: none"> <li>• Comprehensive foundation water management strategies implemented: <ul style="list-style-type: none"> <li>– 4” subslab gravel for capillary break</li> <li>– foundation drains</li> <li>– damp-proofing of sub-grade stemwall</li> <li>– polyethylene sill gasket for capillary break</li> </ul> </li> <li>• Building envelope moisture management strategies implemented: <ul style="list-style-type: none"> <li>– above grade wall system composed of materials that are vapor permeable</li> <li>– windows and doors properly flashed</li> <li>– rain gutters direct water away from foundation</li> <li>– housewrap properly lapped, seams taped, and sealed to the wall sheathing with caulk</li> </ul> </li> <li>• Roof overhang calculated (including gutter projection) to minimize damaging UV entry in summer</li> <li>• Low-maintenance pre-colored siding with a 50-year warranty (material) and 15 year warranty (finish)</li> <li>• All building materials kept dry and covered. Exterior wood primed and painted before installation, joints caulked during installation</li> </ul>
<b>Indoor Air Quality Details</b>	<p>Site Elements</p>	<ul style="list-style-type: none"> <li>• Excellent ambient air quality in the central Arizona area</li> <li>• No pesticides broadcast on the soil prior to construction</li> <li>• Building materials with organic content kept dry to minimize mold potential</li> </ul>
	<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"> <li>• Below grade portion of the foundation stemwall damp-proofed</li> <li>• Finish grade is a minimum 5% sloped away from the house</li> <li>• Foundation drains around entire house perimeter</li> <li>• Slab penetrations for plumbing sealed with expanding foam</li> <li>• Flexible polyethylene foam sill sealer under all exterior wall bottom plates</li> <li>• Exterior wall materials designed to dry to both exterior and interior</li> <li>• Properly flashed and sealed exterior door and window openings limit potential for water intrusion into the wall system and associated mold growth potential</li> <li>• Low Volatile Organic Content (VOC) paints and construction adhesives used within the building envelope</li> <li>• Tight building envelope; blower door test value of 407 CFM at 50 Pascals (equivalent to 1.85 ACH<sub>50</sub>, and 0.23 CFM/ft<sup>2</sup>)</li> </ul>

<b>Indoor Air Quality Details</b> (continued)	Finishings and Furnishings	<ul style="list-style-type: none"> <li>• Only hard-surfaced flooring (tile) in the house.; no carpet is installed to limit dust accumulation and VOC outgassing</li> </ul>
	Mechanical Equipment	<ul style="list-style-type: none"> <li>• HVAC system right-sized according to Manual J and D calculations and installed correctly</li> <li>• No building cavities were used in the forced air distribution system</li> <li>• Central air handler equipped with a MERV-8 or higher filter</li> <li>• Furnace and gas-fired water heater units are sealed combustion</li> <li>• Carbon monoxide detectors are installed outside of each sleeping area</li> <li>• Whole-house fresh air provided by exterior intake integrated with the HVAC ductwork</li> <li>• All ductwork is located within the conditioned space and all duct joints were mastic-sealed (duct leakage measured at 27 CFM)</li> <li>• Exhaust fans in each bathroom (50 CFM) and the kitchen rangehood exhaust fan (200 CFM) is vented to the exterior</li> <li>• Clothes dryer vented directly to the outdoors</li> </ul>