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

DOE ZERO ENERGY READY HOME™

U.S. DOE ZERO ENERGY READY HOME 2019 WINNER Housing Innovation Awards

Mantell-Hecathorn Builders

Glacier Club Modern Home
Durango, CO

BUILDER PROFILE

Mantell-Hecathorn Builders
Durango, Colorado; M-HBuilders.com
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FEATURED HOME/DEVELOPMENT:

Project Data:

- Name: Glacier Club Modern Home
- Location: Durango, CO
- Layout: 3 bdrm, 3.5 bath, 2 fls + bsmt, 4,937 ft²
- Climate: IECC 5B, cold
- Completed: 2018
- Category: custom for buyer

Modeled Performance Data:

- HERS Index: without PV 46; with PV 20
- Projected Annual Energy Costs: without PV $2,550; with PV $1,000
- Projected Annual Energy Cost Savings: (vs typical new homes) without PV $1,400; with PV $2,900
- Projected Annual Energy Savings: without PV 2,400 kWh, 2,000 CCF; with PV 14,700 kWh, 2,000 CCF
- Added Construction Cost: without PV $43,200; with PV $60,100
- Savings in the First 30 Years: $138,400

Perched high on a mountainside in southwestern Colorado, the site offered commanding views and incredible challenges for the home builder. Mantell-Hecathorn Builders of Durango, Colorado, was up to the challenge, delivering a home that was both architecturally stunning and surpassed the builder's own goals for high performance by winning a Housing Innovation Award from the U.S. Department of Energy Zero Energy Ready Home program.

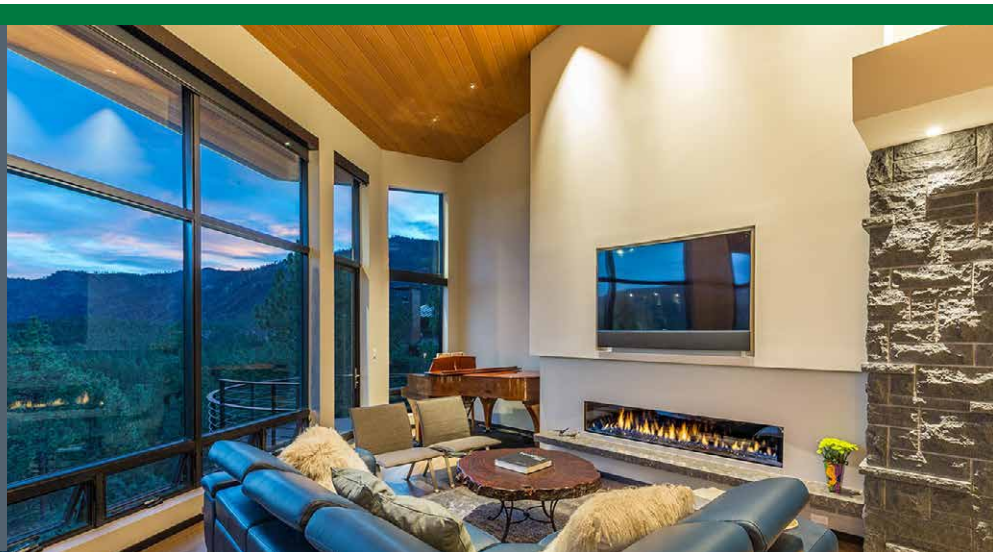
"This was by far the most challenging site and house design in Mantell-Hecathorn Builders' 44 years of building custom homes," said Hunter Mantell-Hecathorn, a principal in the custom home building company started by his parents Greg and Tara in 1975. "If ever there was a home that required constant innovation this was the home." Located on a half-acre site at 7,600 feet elevation, with a 40-degree rock slope, the site required blasting to nestle and anchor the foundation into the rocky mountainside. The builder also had to contend with heavy snowfalls that could accumulate on and around the house and a fractured rock substrate that allowed subsurface moisture to percolate upward through the rock fissures to the site's surface, especially during spring thaw and heavy summer rains. These issues added to the complexity of site excavation; the builder installed an all-encompassing system of French drains under and around the home as well as surface drains and radon trenches and pipes under the lower level. "The extremely complicated foundation plan required consistent and precise interaction with the surveyor, blasting subcontractor, excavator, concrete subcontractor, and engineers. The site topography and space constraints required extensive additional effort to simply achieve construction and provided significant challenges to successful attainment of the DOE Zero Energy Ready Home standards," said Hunter Mantell-Hecathorn.

By all accounts, Mantell-Hecathorn Builders was successful in meeting the challenge, implementing the innovative design by renowned regional architect Jon Pomeroy in a three-level 4,937-ft² home that achieved a Home Energy Rating System (HERS)

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. Every DOE Zero Energy Ready Home starts with ENERGY STAR Certified Homes Version 3.0/3.1/3.2 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.

Mantell-Hecathorn Builders of Durango, Colorado, built this 4,937-ft² three-story home at 7,000 feet up on a mountainside in southwestern Colorado. Despite the challenges of the mountainside site, the builder achieved certification to the high performance requirements of the U.S. Department of Energy's Zero Energy Ready Home program, including certification to ENERGY STAR and EPA's Indoor airPLUS, ensuring the home will have low utility bills, clean indoor air, and a durable structure, along with the great views.



What makes a home a DOE ZERO ENERGY READY HOME?

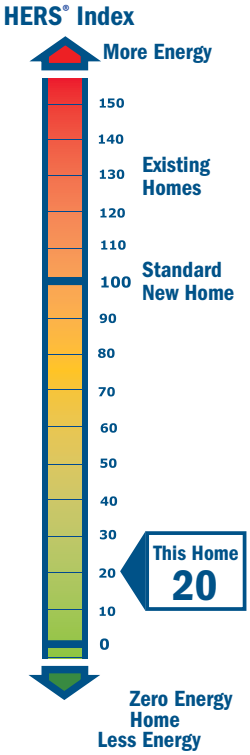
1 **BASELINE**
ENERGY STAR Certified Homes Version 3.0/3.1

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.

score of 46. A typical code-built home would score an 80 to 100 on the HERS score and a net zero home would score a 0. When the 7.2-kW solar photovoltaic system is included on this house, the HERS score drops to 20 and projected annual energy costs are more than cut in half, dropping to about $1,000 per year or less than $85 per month, which is far lower than most homeowners could expect to pay for heating and cooling a home one-third the size. Even without the PV, the annual energy costs are expected to be $2,500, a projected savings of $1,400 over a home just built to the local energy code, which is the 2009 International Energy Conservation Code (IECC).

Building to this level of energy efficiency is nothing new for Mantell-Hecathorn, a long-time ENERGY STAR builder in a state that has no licensing requirement for general contractors, in counties that don't inspect for energy efficiency, and in jurisdictions that until recently hadn't updated their energy code since the 2003 edition. La Plata County, where Durango is located, recently adopted the 2009 IECC and the City of Durango just adopted the 2015 IECC code this year, thanks in part to education by the Mantell-Hecathorns.

Mantell-Hecathorn Builders committed to building all of its homes to the DOE Zero Energy Ready Home specification in 2013 when the program started and has certified 14 homes so far. It is the only builder in southwest Colorado to make this 100% commitment. The DOE Zero Energy Ready Home program gives builders a road map to build homes that are more energy efficient, comfortable, and durable than current code requires, and a third-party verification process to help convey confidence to the homeowner that the home will deliver what it promises. That plan starts with certification to the program checklists of ENERGY STAR Certified Homes Version 3.0, 3.1, or 3.2 and the U.S. Environmental Protection Agency's Indoor airPLUS. Builders must also meet the hot water distribution requirements of the EPA's WaterSense program, the insulation requirements of the latest IECC, and other mandatory requirements of the DOE program. In addition, homes are required to have solar electric panels installed or have the conduit and electrical panel space in place for it.

Greg Mantell-Hecathorn stresses the value of the third-party verification required by the DOE program. It makes it known "that we are providing our clients and the community with homes that provide long-lasting value, greater comfort and performance, and which are tested to meet those high standards for superior quality and energy efficiency. We believe that the DOE Zero Energy Ready program provides the best verifiable platform for high performance standards, while allowing the flexibility to be adapted to the wide variety of custom homes that we build."

A self-adhered membrane completely covers the roof decks and fascia to help prevent water leakage under the metal roofs. The coated wall sheathing will be covered by two inches of rigid foam.

On this home, the builder took full advantage of the exceptional southern exposure of the site for optimal solar collection and passive solar heating potential. They installed a 7.2-kW array of solar panels on the standing seam metal roof and large amounts of glazing on the south-facing side of the home. All of the windows are triple-paned with an insulation value of U-0.19 (R-5.26). The windows have two low-emissivity coatings to help minimize radiative heat transfer through the glass. The windows are not gas filled due to the high altitude. All of the windows have aluminum-clad wood frames and most are fixed rather than openable, which provides unobstructed views, better resistance to wind pressures, and more air tightness. The windows have a high solar heat gain coefficient (SHGC) of 0.50 to allow in beneficial solar heat gain in the winter. Motorized blinds were installed on the interior side of the windows that can be scheduled to operate automatically to keep out unwanted summer solar sun. Deep overhangs and covered balconies also minimize heat gain from high overhead summer sun. Lighting controls are integrated with the home automation and energy management system.

The standing seam roof cladding covers a roof that is broken into multiple slanted, curved, and flat planes on this modern home. The roof structure consists of 12-inch I joists with no attic space. All of the upper level consists of cathedral ceilings that are insulated with 7 inches of closed-cell foam against the underside of the OSB roof sheathing plus R-19 of fiberglass batt. The sheathing is completely covered with an adhered ice and water barrier underlayment.

The walls consist of 2x6 at 24-inch on-center stud-framed walls that are filled with 2.5 inches of closed-cell spray foam which provides insulation, air sealing, and some structural rigidity to the walls. The remainder of the wall cavity is filled with 3 inches of loose-fill fiberglass. The walls are sheathed with a coated OSB product then topped with 2 inches of rigid foam. A rainscreen was installed behind the stucco and stone cladding and ¾-inch furring strips were installed behind wall sections with lapped siding. The walls have a total insulation value of R-38. In addition to the spray foam layer in the wall cavities and the underside of the roof deck, sections of the floor that were cantilevered were also insulated from underneath with spray foam. All wood-to-wood seams were sealed with caulk and tape and wood-to-concrete seams were caulked.

The below-grade walls of the basement were poured concrete that was protected on the exterior by a spray-on crystalline waterproofer, 2-inch rigid foam, and a plastic drainage board. The interior walls of the basement level were framed 2x4 24-inch on-center stud walls with 3 inches of closed-cell spray foam, giving the below-grade walls a total insulation value of R-23.

HOME CERTIFICATIONS

DOE Zero Energy Ready Home Program – 100% Commitment

ENERGY STAR Certified Homes Version 3.0

EPA Indoor airPLUS

"We are so pleased with our new home... The end product was a high quality, energy efficient, and comfortable home that we will enjoy for many years."
Homeowner

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.

Deep overhangs and automated interior blinds help block out solar heat gain in the summer.

The home achieved an air tightness of 1.5 air changes per hour at 50 Pascals. To provide ventilation, a heat recovery ventilator was installed to bring in fresh air through a MERV 13 filter and to exhaust stale air. The HRV was separately ducted to provide fresh air to every room in the house and to exhaust air from several locations including the kitchen and bathrooms, which have boost switches to more quickly remove steam.

A 96% efficient wall-hung boiler provides domestic hot water to the home and hydronic radiant floor heating to all three floors. Passive solar gain adds to the space heating. Cooling is provided by a SEER 22 heat pump.

ENERGY STAR appliances, LED lighting, and low-flow EPA WaterSense-labeled fixtures add to energy and water savings.

A main-floor master bedroom and elevator are among the aging-in-place features designed into the home. The home meets all of the requirements of the EPA Indoor airPLUS including the use of low and no-VOC and formaldehyde-free products.

While a beautiful home and low-energy bills are the result, Mantell-Hecathorn's attention to detail and focus on quality construction are what they are most proud of. "We focus on high performance, not just energy efficiency and lower utility costs, but also building durability, something homeowners can pass down to future generations," said Hunter Mantell-Hecathorn.

The company lives up to its motto, "personal attention to detail, one home at a time," limiting projects to two or three per year so that Hunter or Greg can personally be on site daily to ensure that quality standards are being met by the subcontractors and crews. Mantell-Hecathorn Builders employs five full-time carpenters who receive training, construction documents, and daily oversight. "We don't experience much turnover in our employees as we always have interesting, challenging, and fun projects to work on. They can feel pride in their work, and we treat them as valued, respected members of our company," said Hunter Mantell-Hecathorn. They put effort into finding subcontractors willing to meet their standards. Mantell-Hecathorn meets with subs during budget formation and plan development, provides written scopes of work for each trade detailing construction methods and materials, requests the best crews, and meets regularly with both the principals and the onsite supervisors for each subcontractor trade during construction. "Quality construction is something we take a lot of pride in and our company is known for that dedication," said Hunter Mantell-Hecathorn.

Photos courtesy of Mantell-Hecathorn Builders

KEY FEATURES

- **Walls:** 2x6 24″ o.c. advanced framing, R-38 total: ⅝″ drywall; in cavity - 2.5″ closed-cell spray foam plus 3″ loose-fill fiberglass; on exterior - coated OSB sheathing, 2″ rigid foam, rainscreen under stucco or stone, or ¾” furring strips under siding.
- **Roof:** Shed roof, ⅝″ coated OSB sheathing, ice-and-water shield, metal roof.
- **Attic:** Cathedral ceilings: ¾″ tongue-and-groove Douglas Fir, ⅝″ drywall, 11 ⅞″ I-joists, R-19 batt, 7″ closed cell spray foam.
- **Foundation:** Insulated basement, R-23 total: ⅝″ drywall, 2x4 studs 24” o.c.; 3″ closed-cell spray foam, 8″ poured concrete, water proofing, 2” rigid foam, drainage board.
- **Windows:** Triple-pane, low-e2, aluminum-clad wood fixed frames, interior motorized blinds, U=0.19, SHGC=0.50.
- **Air Sealing:** 1.5 ACH 50.
- **Ventilation:** HRV, continuous ventilation, boost switches in bathroom, MERV 13 filters.
- **HVAC:** Radiant floor heat from wall-hung gas boiler, 96% AFUE; 22 SEER AC; passive solar.
- **Hot Water:** Wall hung gas-fired boiler, 96% AFUE, 80-gal., push button recirculation pump.
- **Lighting:** 100% LED, integrated lighting controls.
- **Appliances:** ENERGY STAR dishwasher, clothes washer, and refrigerator.
- **Solar:** 7.2-kW PV system.
- **Water Conservation:** WaterSense fixtures; drought-resistant landscaping.
- **Energy Management System:** Smart thermostats, lighting automation, PV tracking.
- **Other:** Aging-in-place, all low-to-no-VOC and formaldehyde-free products.

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