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

DOE ZERO ENERGY READY HOME™

Housing Innovation Awards

Cobblestone Homes

2014 Model Home
Midland, MI

BUILDER PROFILE

Cobblestone Homes, Saginaw, MI
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FEATURED HOME/DEVELOPMENT:

Project Data:

- Name: 2014 Model Home
- Location: Midland, MI
- Layout: 4 bedrooms, 3.5 baths, 2 floors
- Conditioned Space: 2,745 ft² with basement
- Climate Zone: IECC 5A, cold
- Completion: May 2014
- Category: Custom

Modeled Performance Data:

- HERS Index: without PV 49, with PV 44
- Projected Annual Utility Costs: without PV $1,900, with PV $1,706
- Projected Annual Energy Cost Savings (compared to a home built to the 2009 IECC): without PV $440, with PV $634
- Annual PV production revenue: $194
- Builder's Added Cost Over 2009 IECC: without PV $6,000, with PV $18,000
- Annual Energy Savings: without PV 8,491 kWh, 799 therms natural gas, with PV 6,730 kWh

Having a homebuyer base dominated by scientists and engineers from one of the world's largest chemical companies has prompted Cobblestone Homes to stay on the cutting edge of building science. "Our homebuyers really do their research," laughs Melissa Wahl who, together with her husband Mark, founded Cobblestone Homes in Saginaw, Michigan, in 2003.

To stay ahead of their homebuyers, Cobblestone is constantly researching new home building technologies. Every year or so the company builds a prototype house to test new products and methods. In 2014, Cobblestone chose the U.S. Department of Energy's Zero Energy Ready Home criteria for its prototype home.

The DOE Zero Energy Ready Home program requires builders to meet a suite of energy, health, and durability requirements including ENERGY STAR Certified Homes Version 3.0, the U.S. Environmental Protection Agency's Indoor airPLUS and WaterSense requirements, additional DOE Zero Energy Ready Home efficiency requirements, and "renewable-ready" measures that ensure the home is ready for solar photovoltaic and water heating when the homeowner is ready to install them.

"We started out with ENERGY STAR in 2004 and that is now the minimum for every house we do. We've done an American Lung Association Healthy House and incorporated those guidelines. We did a DOE Builders Challenge Home and made it a true zero energy home with a -4 Home Energy Rating System (HERS) score," said Melissa. Cobblestone's first DOE Zero Energy Ready Home scored a HERS 49 without PV panels. "We will build more DOE Zero Energy Ready Homes. ENERGY STAR is no longer an option for us, it's assumed. I hope we will get to that point with DOE Zero Energy Ready Home," said Melissa.

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.

Cobblestone Homes' first DOE Zero Energy Ready Home features 100% energy-efficient LED or compact fluorescent-based lighting. The plumbing fixtures all meet the EPA WaterSense water-conserving criteria. The home's refrigerator, dishwasher, and ceiling fans are all ENERGY STAR-rated products.

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

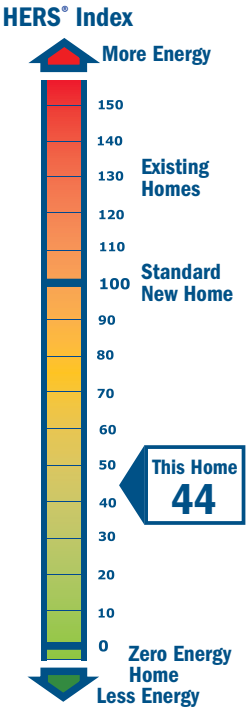
3 **DUCT SYSTEM**
located within the home's thermal boundary

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.



The family-run business of 15 full-time staff and over 125 dedicated subs builds about 50 to 60 homes a year. Cobblestone's first DOE Zero Energy Ready Home is a 2,745-ft^2, 4-bedroom, 3.5-bath home with a full basement. The home is located in Midland, Michigan, headquarters of DOW Chemical, which provided solar photovoltaic roofing shingles for the home and is conducting a year's worth of energy monitoring. The home is being used as a demonstration home while monitoring is going on, with displays of energy-efficient technologies set up in the garage.

Cobblestone has partnered with DOW and other building science researchers on previous homes. Cobblestone attempts to collect data every three years on each house they have built. They take the unusual step of offering a contest to their homeowners. Homeowners are asked to submit 12 months of energy bills. Cobblestone analyzes the bills and the homeowner who beats their estimated usage by the most wins $3,000 or a trip to Disneyland. "This contest allows us to verify after-occupancy performance," said Melissa.

More than 5,000 people toured Cobblestone's previous DOE Builders Challenge home. Over 400 people have already toured the DOE Zero Energy Ready Home between May and July 2014, including prospective homeowners, members of the media, realtors, college students in construction programs, other builders, vendors, boy scout troops, and interested members of the community.

Visitors to the home will notice the home's numerous double-pane, argon-filled, PVC-framed windows. They probably won't notice the windows' low-emissivity coatings, which minimize the amount of heat transferring through the glass. They are sure to notice the eye-catching modern folk art lighting fixtures. They may not know that they use 100% high-efficiency light sources, either LED or compact fluorescent lamps. And they may not suspect that each of the home's four ceiling fans are ENERGY STAR rated, as are the refrigerator and dishwasher.

Another barely visible but highly notable feature is the 1.4 kWs of photovoltaic (PV) roof tiles. The PV tiles are made of a flexible material that has the same dimensions and thickness as asphalt shingles. Rather than sit-on-top panels, the tiles are integrated with the shingles as part of the roofing layer. The home's roof structure and orientation on the lot were designed to allow room for up to 891 ft^2 of PV tiles and/or of solar thermal water heating panels should a solar water heating system be desired in the future.

The home's walls are filled with 2.5 inches of closed-cell spray foam, which provides exceptional insulating, air sealing, and sound-proofing qualities. Under the home's vinyl siding, an additional inch of rigid foam insulation is installed over the home's OSB exterior wall sheathing. The rigid foam has a vertically grooved surface to direct any rainwater that gets behind the siding down and out of the wall.

The plumbing fixtures in the kitchen and bathrooms are all compliant with the EPA WaterSense program's strict criteria for water efficiency. A button on the bathroom wall triggers a recirculation pump to ensure you won't wait more than 30 seconds for hot water at the tap.

The home's 96% efficient gas furnace and 2.5-ton 13 SEER air conditioner with variable-speed ECM motor are located in the basement. The furnace and water heater are sealed combustion, direct-vent appliances for safe, efficient operation.

Some of the most impressive energy-efficiency features of the home are the ones visitors never see. Beneath the 9-foot poured concrete foundation walls, the footings were covered with a painted-on water seal product to form a capillary break. The concrete walls were water-proofed on the exterior and then covered with a 1-in. vertically grooved moisture-resistant extruded polystyrene rigid foam, which serves as both a drainage board and insulation layer. The interior of the basement walls was insulated with the same 1-in. foam board to provide a total basement wall R-value of R-11.5. This board aids in directing water down to the perimeter drain tiles located both inside and outside of the foundation so that water can be directed away from the structure.

Cobblestone Homes would typically install 2 inches of rigid foam on the outside of the foundation wall and no foam on the inside in new construction, but they chose to put 1 inch on either side in the model home to show visiting remodelers the interior installation option. Cobblestone selected a foam product that does not require a "thermal break" ignition barrier. Most foam insulations must be covered with an ignition barrier like drywall because they can burn or melt when exposed to flame.

If visitors could peek into the above-grade walls, they would see that the 2x4 16 inch on center stud-framed exterior walls have 1 inch of XPS rigid foam installed over the OSB exterior wall sheathing. All of the seams in the foam are sealed with tape to form a water-tight barrier so house wrap is not needed, which saves the builder time and money. Cobblestone uses a felt paper house wrap and plastic mesh rain screen only on those portions of the exterior walls where brick and stone will be installed. The wall cavities are then insulated from the inside with 2.5+ inches of closed-cell polyurethane spray foam. The spray foam provides insulation, air sealing, and strength to the walls, which Cobblestone feels can help the home resist high winds. The wall framing is nailed and glued together with two beads of construction adhesive or caulk at every wood-to-wood joint.

HOME CERTIFICATIONS

- DOE Zero Energy Ready Home Program
- ENERGY STAR Certified Homes Version 3.0
- EPA Indoor airPLUS
- EPA WaterSense

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.

A foam sill seal stops moisture transmission between the foundation wall and the bottom plate. Cobblestone also employs an airtight drywall approach, applying a bead of construction adhesive under the drywall at all studs.

Because Cobblestone installed the HVAC equipment and ducts in the basement, they chose a vented attic where insulation is installed on the ceiling plane. Cobblestone designs their attics with a raised-heel truss so that there is more height at the eaves to pile more insulation over the tops of the walls. First, closed-cell polyurethane foam is sprayed into the eaves to air seal and insulate the space above the outer-wall top plates from the ceiling deck to the attic ventilation baffles. Then 15 to 16 inches of blown cellulose is piled onto the flat portion of the attic deck for an attic R-value of R-49.

The spray-foamed walls, top plate, and sill plate and additional air sealing of any holes through the ceiling provide for a very airtight building shell. Blower door testing showed the home had 1.65 air changes per hour at 50 Pascals of pressure difference, far below the 7 ACH 50 limit for whole-house air leakage set by the 2009 International Energy Conservation Code (IECC). To ensure that the home has fresh, healthy indoor air, an energy recovery ventilator (ERV) was installed in the basement. The ERV has ducts to bring fresh air in from outside and to exhaust stale air to the outside. The air streams cross in a heat exchanger that allows the warmer air path to transfer heat to the cooler path. The incoming air is routed to the HVAC system's central air handler for distribution through the home.

Melissa points to air sealing as an area that challenged Cobblestone's crews to improve their technique over the years. HVAC was another area where Cobblestone pushed for improvement. "Our HVAC contractor really fought us on heating and cooling equipment sizing. They said 'we've never put in a furnace that small.' We had to put in their contract that we would pay them to change out the furnace if there were any comfort issues. Now they are firm believers in what we are doing but it's taken 7 years."

Cobblestone enjoys the challenge of continuous improvement, which is one reason they were eager to try a DOE Zero Energy Ready Home. "We are always looking for something to push us," said Melissa. Cobblestone's comprehensive system of quality checks helps to ensure that new practices will be implemented successfully. Cobblestone goes beyond the thermal by-pass checklists. The project management team inspects daily with more formal inspections done at framing, insulation, drywall, rough in, finish mechanicals, and at the end of construction on fit and finish materials. "We meet twice a week to discuss schedule and improvement opportunities for process, production, and material usage," said Melissa.

During the construction process, homeowners participate in various home construction tours – two of which are strictly to educate the homebuyer on Cobblestone's building practices and on the care and maintenance of high-performance homes. "These formal tours give our homeowners a true understanding of their new home's exceptional construction quality," said Melissa. "They often share this experience with friends and colleagues. The majority of our business comes from these referrals!"

Photos courtesy of Cobblestone Homes.

KEY FEATURES

- **DOE Zero Energy Ready Home Path:** Performance
- **Walls:** 2x4 16-inch o.c. framing, 2.5 inches (R-12) closed-cell spray-foam cavity insulation; 1-in. taped, grooved XPS rigid foam over OSB sheathing
- **Roof:** Vented attic, raised heel trusses with closed-cell spray foam over top plate from ceiling deck to baffles, 15-in. blown cellulose
- **Foundation:** Poured concrete basement walls insulated on inside and outside with taped, grooved XPS rigid foam; waterproofing on exterior under rigid foam and separating footing from walls. 1-in. XPS rigid foam under the basement slab
- **Windows:** Double-pane, argon-filled, low-e, PVC-framed. U=0.28, SHGC=0.28
- **Air Sealing:** 1.65 ACH 50
- **Ventilation:** ERV connected to central HVAC
- **HVAC:** 96% effic, sealed combustion gas furnace and 2.5-ton 13 SEER AC with ducts in conditioned basement
- **Hot Water:** 60-gal tank water heater in basement, 0.63 EF, recirc loop, PEX piping
- **Lighting:** 100% LED and CFL
- **Appliances:** ENERGY STAR-rated dishwasher, refrigerator, four ceiling fans
- **Solar:** 1.44-kW roof-integrated PV shingles; conduit installed and roof designed with optimal orientation for solar thermal panels and additional PV panels
- **Water Conservation:** EPA WaterSense showerheads, faucets, toilets

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