

**DOE CHALLENGE HOME
CASE STUDY****Clifton View
Homes**

Coupeville, WA

**BUILDER PROFILE****Clifton View Homes**

Builder: Ted L. Clifton, Coupeville WA
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FEATURED HOME/DEVELOPMENT:**Project Data:**

- Name: Isler Residence
- Location: Coupeville, WA
- Layout: 3 bedrooms, 3.5 baths, 2 floors
- Conditioned Space: 2,908 ft²
- Completion: July 31, 2011
- Climate Zone: 4 Marine
- Category: Systems

Performance Data:

- HERS Index without solar PV: 34
- HERS Index with solar PV: -6 (designed in, not yet installed)
- Projected annual utility costs: without solar \$1,156, with solar \$-171
- Projected total annual energy cost savings (compared to a home built to the 2006 IECC): without solar \$1,532, with solar \$2,850
- Annual PV production revenue: \$1,884
- Annual energy savings: without solar 15,435 kWh/yr; with solar 26,429 kWh/yr

While homeowners ooh and ahh over the views from their new custom homes on Whidbey Island in Washington State's scenic Puget Sound, builder Ted Clifton saves his admiration for the passive solar thermal mass floors, structural insulated panel (SIP) walls, and innovative ventilation designs that allow these homes to be heated and cooled for pennies a day.

Clifton, founder of Clifton View Homes, achieved an impressive Home Energy Rating System (HERS) score of 34 (without solar panels) on a two-story structure completed in July 2011 that also earned him his first Challenge Home certification from the U.S. Department of Energy. Clifton, who was one of a group of builders who provided suggestions to DOE for formulating the Challenge Home program, has committed to the Challenge Home criteria on all of his new homes.

"I feel like I'm cheating my customer if I don't give them a house that is net zero ready; it's just the right way to build," said Clifton, who builds about five new homes a year and performs at least that many energy-efficient remodels. Clifton preaches what he practices, offering a six-hour class in net zero energy home construction through the National Association of Home Builders.

So many class graduates asked Clifton for design recommendations that in 2008 he started Zero Energy Home Plans LLC, a design firm that now occupies more of his time than construction. Clifton came up with a 12-step plan that's "like a recipe" for constructing zero energy homes, but his design approach isn't cookie cutter. "Every site is unique and we don't sell the same house plan in every climate zone," said Clifton.

Understanding climate has helped Clifton achieve remarkable energy savings in his projects. On the Whidbey Island Challenge Home, the homeowners should achieve an estimated \$1,500 in annual energy cost savings over a similar house built to code.



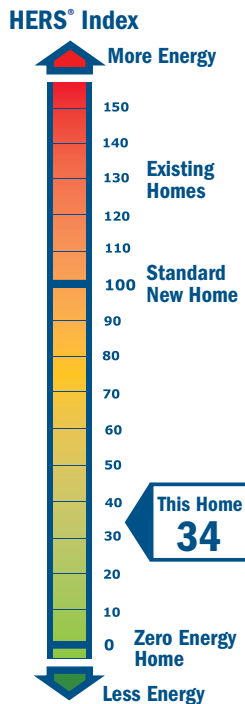
DOE Challenge Home builders are in the top 1% of builders in the country meeting the extraordinary levels of excellence and quality specified by the U.S. Department of Energy. Every DOE Challenge Home starts with ENERGY STAR for Homes Version 3 for an energy-efficient home built on a solid foundation of building science research. Then, even more advanced technologies are designed in for a home that goes above and beyond current code to give you the superior quality construction, HVAC, appliances, indoor air quality, safety, durability, comfort, and solar-ready components along with ultra-low or no utility bills. This provides homeowners with a quality home that will last for generations to come.

SIP panels form the roof and walls for a highly insulated shell without the thermal bridging and cold spots that can occur with other types of wall cavity insulation. SIPs provide the added benefits of sound proofing, structural strength, and air-tight construction.



CHALLENGE HOME CERTIFIED:

- 1 BASELINE**
certified ENERGY STAR for 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.



Although the Northwest is famous for its drizzly grey winters, sunny summers have tempted many Northwest builders to install central air conditioners. Clifton has bucked the trend with a unique ventilation system that takes advantage of the region's night-time temperature drops to cool the home for pennies a day. Two exhaust fans installed “backwards” in the gable walls on the north and west sides of the house pull air into the home, while two bath fans located in rooms at the opposite sides of the house draw air out of the home. All of the fans can be timer controlled. By setting the fans to come on simultaneously at about 4:30 am on the hottest days of the summer, they can replace all of the air in the home in 80 minutes, completely cooling the house at a cost of about 3 cents per hour to operate.

“This is all the air conditioning this house needs, at a total annual cost of less than \$1 per year,” said Clifton. When the fans aren’t operating, the fresh air intakes are dampered to allow air in but not out to provide passive fresh air all the time. Clifton prefers the timered fans for fresh air intake and exhaust ventilation rather than a heat recovery ventilator or energy recovery ventilator, which, according to Clifton “use more energy than they save in this climate.”

The two ENERGY STAR-rated intake fans draw in air at a rate of 240 cfm each, through MERV 19 HEPA-rated filters, which remove dust, pollen, mold, and other contaminants. The bath exhaust fans remove air at rates of 100 and 120 cfm. Because the air comes in at a higher rate than it leaves, the home is slightly pressurized, which helps keep air from being drawn into the home from undesirable locations such as through the walls, from the garage, or when the door is open. A motion sensor-activated fan in the garage ventilates the space while keeping it at a negative pressure in relation to the house to further minimize the chance of drawing dirty air into the home.

Clifton took advantage of the intermittent sunlight the Whidbey Island location receives even during the rainy seasons, by designing the home with most of the window area facing south. Overhangs block out some of the high overhead summer sun while low window sills and sliding doors allow low winter sun to warm up the concrete slab floors. The builder took the unique step of installing concrete floors on both the first and second floor. The concrete, which is scored and stained to look like large floor tiles, serves as a thermal mass, absorbing solar heat during the day and radiating it back into the living space during the night. In the summer, the fan ventilation system removes residual Btu’s of heat in the early morning to balance the Btu’s gained by the thermal mass during the day so that the home doesn’t overheat.



Large south-facing windows allow any available sunlight to warm up the concrete flooring on the first and second floors. These thermal mass floors absorb solar energy during the day and radiate the heat into the space throughout the night. Deep overhangs block out high summer sun and an innovative ventilation system that uses multiple timed exhaust fans to pull air into and out of the house can remove unwanted heat during the early morning hours in the summer.

In winter the passive solar heat gain is enhanced by radiant floor loops in both the first and second floors. The heat source is a ground source heat pump, which provides all of the hot water for both the radiant floor heat and the domestic hot water at very high efficiencies (14.67 HSPF, COP = 4.3).

A tight, well-sealed building enclosure ensures that heating and cooling loads are low. The walls and roof are made of SIPs. The walls are 5-5/8 inch thick with an R value of R-26 and the pitched roof is 9-3/8 inch thick with an R value of R-41, while flatter roof sections are 11-3/8 inch thick with an R value of R-50. The slab is well insulated with R-20 of rigid XPS foam under the entire slab and R-10 rigid XPS foam installed vertically on the interior side of the foundation walls.

In addition to providing insulation with almost no thermal bridging, the SIP enclosure contributes to an exceptionally airtight enclosure. In this case the home measured 1.32 ACH50 with a blower door test. SIP panels also provide sound proofing, structural stability (no nail pops), and shear strength, which is a consideration in coastal areas like the Puget Sound where wind storms are a more-than-annual event. The roof is covered with 40-year composition shingles that are dark colored because light-colored shingles will not warm up enough in the typically cool climate to soften the tar to self-seal the shingles.

The windows are triple-pane, argon-filled, and fiberglass-framed, with low-emissivity coatings to reduce solar heat gain and loss. The insulation value ranges from $U=0.18$ to 0.22 and the solar heat gain coefficient (SHGC) varies from 0.26 to 0.31 SHGC. Higher SHGC windows were selected for the south side to increase passive solar heat gains in the concrete flooring.

Lighting and appliances add to the energy efficiency—10% of the light fixtures are LED-based and 90% are fluorescent while the home's three ceiling fans are ENERGY STAR rated. The dishwasher, clothes washer, and refrigerator are not only ENERGY STAR rated but also the lowest energy-use products in their respective categories.

These measures combined to give the home a very respectable HERS score of 34. If a 9.1-kW solar photovoltaic (PV) system were included, the home would achieve a HERS score of -6. The solar panels have not been installed but the home is PV-ready with wiring and conduit in place. The space is also roughed-in for an electric car charging station.

HOME CERTIFICATIONS:

DOE Challenge Home

ENERGY STAR Version 3
(Northwest version)

EPA Indoor airPLUS

Built Green 5-Star



Every DOE Challenge Home combines building science specified by ENERGY STAR for Homes and advanced technologies and practices from DOE's Building America research program.

“We began our commitment to net-zero-energy homes in 2006, and every home we have designed and built since has been at least net-zero-ready,” said Clifton.

All of the plumbing fixtures (including the shower heads, bathroom faucets, and toilets) are EPA WaterSense-certified. The landscaping is all native and drought-tolerant; Clifton describes it as 100% xeriscaped—no irrigation is needed.

In addition to achieving the DOE Challenge Home certification, which includes certification to ENERGY STAR Version 3 and EPA Indoor airPLUS, the home also achieved a 5-star rating from the Skagit/Island Counties Builders Association, which oversees the Built Green® program for the Skagit and Island Counties area.

To achieve these high performance levels, especially with the somewhat outside-the-box technologies he uses, Clifton requires all of his sub-contractors to participate in pre-construction meetings. To help maintain the savings, Clifton also provides his homeowners with a comprehensive owner’s manual explaining the home’s heating and cooling systems.

Although SIP walls and geothermal heat pumps may be somewhat uncommon, Clifton emphasizes that a lot of the technologies he uses to get exceptional results are “affordable, off-the-rack stuff that is main stream enough that your average Joe next door can afford to do it.” The exhaust fan cooling system and concrete floors are good examples of everyday materials applied in clever ways to enhance energy savings.



A ground-source heat pump heats water for the radiant floor heating loops in the first- and second-floor slabs. The heat pump also heats all of the home’s domestic hot water.

Clifton learned construction from his father, a builder and school teacher who had lived through the Depression. “He knew all about recycling and conserving energy long before it was trendy,” said Clifton.

Clifton is passionate about sharing this knowledge with other builders. Through his NAHB training course, talks at local workshops and national conferences, and his Zero Energy Home Plans company, Clifton is helping hundreds of other builders learn how to save energy too.

KEY FEATURES

- **Path:** performance
- **Walls:** SIP 5-5/8-inch (R-26) panels; corrugated house wrap
- **Attic:** 9-3/8-inch (R-41) SIPs and 11-3/8-inch (R-50) SIPs
- **Foundation:** slab on grade with R-20 XPS rigid insulation under slab and R-10 XPS on interior of foundation walls
- **Windows:** triple-pane, argon-filled, fiberglass-framed, Low-e windows with U=0.18 to 0.22 and 0.26 to 0.31 SHGC (higher SHGC on south side for passive solar gains)
- **Air Sealing:** 1.32 ACH50
- **Ventilation:** four timer-controlled fans to bring in and exhaust air, HEPA MERV 19 filters
- **HVAC:** ground-source heat pump, provides hot water for radiant floor heating of 1st and 2nd floor plus all domestic hot water at 14.67 HSPF, COP=4.3
- **Hot Water:** ground-source heat pump with desuperheater
- **Lighting:** 10% LED; 90% CFL; 3 ENERGY STAR ceiling fans
- **Appliances:** ENERGY STAR dishwasher, clothes washer, refrigerator; all lowest energy use in their categories.
- **Solar:** solar ready with branch panel located in attic.
- **Water Conservation:** 100% xeriscaped with native drought-tolerant plants (no irrigation needed)
- **EPA WaterSense Fixtures:** all shower heads, lav faucets, toilets
- **Other:** thermal mass concrete floors, passive solar design
- **Electric Car Charging Cstation:** not installed but roughed in