

# TC Legend Homes

19th Avenue  
Seattle, WA



## BUILDER PROFILE

TC Legend Homes, Bellingham, WA  
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## FEATURED HOME/DEVELOPMENT:

### Project Data:

- Name: 19th Avenue
- Location: Seattle, WA
- Layout: 4 bdrm, 2.5 bath, 2 fl, 2,463 ft<sup>2</sup>
- Climate Zone: IECC 4C, marine
- Completion: May 2016
- Category: custom for buyer

### Modeled Performance Data:

- HERS Index: without PV 44, with PV -2
- Projected Annual Energy Costs: without PV \$1,053, with PV \$25
- Projected Annual Energy Cost Savings (vs home built to 2012 IECC): without PV \$811, with PV \$1,889
- Projected Annual Energy Savings: without PV 9,453 kWh, with PV 20,993 kWh
- Added Construction Cost: without PV \$0

When a net-zero-energy home can be built at a cost on par with traditional construction, everyone wins. TC Legend Homes is helping to usher in a new era of green construction in which home owners don't have to choose between cutting-edge efficiency and staying on budget.

“Over the last decade, we've developed practices that allow us to build net-zero-energy homes for the same price as traditionally constructed homes. Sometimes, we are able to build them for even less,” said TC Legend Homes' owner and lead Ted W. Clifton, Jr.

“We know we are doing something right because our services are in high demand,” said Clifton, who is headquartered in Bellingham, Washington, but also builds in the Seattle area.

One way TC Legend Homes is achieving net zero is by building to the high performance criteria of the U.S. Department of Energy's Zero Energy Ready Home program. DOE has honored the builder with four Housing Innovation Awards since 2013, including a grand award in 2014 in the affordable category and a 2016 award in the custom home category. The 2016 award-winner is a two-story, 2,463-ft<sup>2</sup> home located next to another TC Legend Home on an urban infill lot in Seattle.

The high-performance features of this home, combined with the 9.5-kW PV system and solar water heating, help the home achieve a Home Energy Rating System (HERS) score of minus 2. That equates to calculated annual utility costs of \$25 (counting service charges) or enough electricity to power the all-electric home. If the home performs better than calculated, it will cover the power for the electric car charging station in the garage as well. Even without the PV, the home would achieve a HERS score of 44, far better than the HERS 80 to 100 of typical homes.



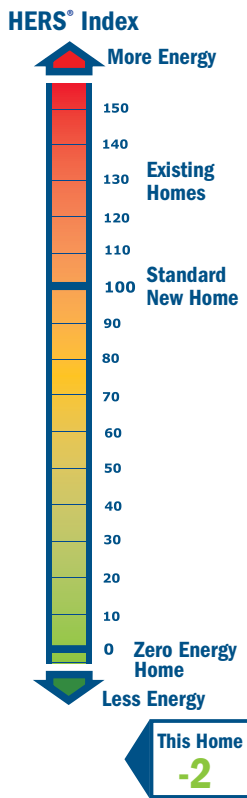
The U.S. Department of Energy invites home builders across the country to meet the extraordinary levels of excellence and quality specified in DOE's Zero Energy Ready Home program (formerly known as Challenge Home). Every DOE Zero Energy Ready Home starts with ENERGY STAR Certified Homes Version 3.0 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.

TC Legend Homes built this 2,463-ft<sup>2</sup> home in Seattle, Washington, to the performance criteria of the DOE Zero Energy Ready Home (ZERH) program. The two-story home has SIP walls and triple-pane windows for draft-free construction and high insulation values.



### 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.



Clifton is used to getting such scores. He has been certifying homes to the DOE Zero Energy Ready Home program since 2013. His previous winning homes have HERS scores ranging from -12 to 13 with PV or 34 to 43 without PV. Clifton has committed to building all of his future homes to the program.

The DOE Zero Energy Ready Home program requires homes to meet all of the requirements of ENERGY STAR Certified Homes Version 3.0 and the U.S. Environmental Protection Agency's Indoor airPLUS program as well as the hot water distribution requirements of the EPA's WaterSense program and the insulation requirements of the 2012 International Energy Conservation Code. In addition, homes are required to have solar electric panels installed or have the conduit and electrical panel space in place for future photovoltaic panel installation.

The 2016 award-winning home was situated on the northern edge of the lot to maximize southern exposure. "Our houses are designed from the ground up to take advantage of the sun. A passive solar layout like the one in this house means lots of windows facing south and few facing north," said Clifton. The long axis of the house is east to west to allow for maximized solar exposure for the PV and solar hot water systems and for passive solar heating. High-quality triple-paned, vinyl-framed windows were located on the south side of the house to maximize solar heat gain. The builder polishes and stains the concrete floor slab to use as the finished flooring; its thermal mass absorbs heat from the sun during the day and slowly releases it at night to provide beneficial passive solar heating.

Structural insulated panels (SIPs) were used for the walls and roofs. "We chose SIPs for their excellent insulation values, airtightness, and ease of construction," said Clifton. SIPs consist of two layers of OSB sandwiching a layer of rigid expanded polystyrene foam. They arrive from the factory as 4x8-foot sheets or precut for doors and windows as required for each wall. Clifton uses locally made panels that come precisely cut, allowing for fast construction, a strong, airtight shell, and practically zero jobsite waste. The TC Legend Homes crew is trained in SIPs construction, which helps assembly go smoothly. Clifton has used SIPs ever since he began constructing homes with his father, Whidbey Island builder and designer Ted L. Clifton, while in high school. Ted Clifton Jr. is on site daily to oversee every step of the TC Legend home construction process, allowing for any problems to be quickly fixed.



A solar hot water system and a highly efficient air-to-water heat pump provide in-floor radiant heating and domestic hot water for pennies a day. The sealed, stained-concrete floors absorb solar heat gain from large south-facing windows for free passive solar heating. LED lighting and ENERGY STAR appliances add to energy savings.

For the winning home's walls, Clifton specified R-29, 6-inch SIPs that are glued and taped at all interior and exterior joints. The panels are covered with house wrap that is overlapped and taped to serve as a drainage plane under the fiber cement siding. The roof decking consists of R-42, 10-inch SIPs, also taped at all interior and exterior joints. The whole roof deck is covered with self-adhering ice-and-water shield, which provides a weather-resistant layer under the asphalt shingles. There is no attic in the home. Because the SIP panels provide the insulation and roof decking in one layer, all of the home's upper-floor rooms can have vaulted ceilings.

The home has a slab-on-grade foundation with stem walls made of insulated concrete forms (ICFs) that wrap the sides of the slab in R-23 of insulation while an R-20 layer of rigid foam covers the ground under the entire slab. Seams are taped and the rigid foam layer serves as the vapor barrier between the ground and the home.

The concrete floor slab contains radiant floor loops. Water for the radiant floor heating is provided by the roof-mounted evacuated tube solar hot water system and by an ultra-efficient air-to-water heat pump with a coefficient of performance (COP) of 4.5. These systems also provide domestic hot water. The heat pump's indoor unit is centrally located on the main floor. Low-flow fixtures help cut water usage.

ENERGY STAR-rated appliances also reduce water and energy usage. All of the home's lighting is provided by LEDs, adding to energy savings.

The home was assessed by a home energy rater per DOE Zero Energy Ready Home requirements and showed air leakage of only 0.60 air changes per hour at 50 Pascals. That's equivalent to the Passive House Institute U.S. Standards and three times tighter than required by the newest energy code. (The 2015 International Energy Conservation Code requires 3 ACH 50 or less.)

To provide good ventilation for the home, the builder installed timered exhaust fans to provide spot ventilation in the four-bedroom home's 2.5 bathrooms. The range hood fan is timer controlled with a 200-cfm fan that pulls fresh air into the home through a vent located downstairs on the north side of the home. Both fans can be set to come on for balanced ventilation during the day and for night-time cooling in the summer.

## HOME CERTIFICATIONS

DOE Zero Energy Ready Home Program, 100% commitment

ENERGY STAR Certified Homes Version 3.1

EPA Indoor airPLUS



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.



House wrap provides a weather-resistant barrier and drainage plane behind the fiber cement siding.

Use of low- and no-VOC paints, finishes, and flooring and good moisture management practices like site grading and drainage were among the measures the builder installed to comply with the requirements of the EPA's Indoor airPLUS checklist.

In a “green” market like the Pacific Northwest, marketing DOE Zero Energy Ready Homes is easy. TC Legends has found it gets more than enough customers through these avenues: 1) referrals from other customers; 2) TC Legends’ website; 3) TC Legends’ presence on other websites, for example the DOE Tour of Zero and Housing Innovation Awards sites; and 4) participation in the annual Northwest EcoBuilding Guild’s Green Home Tour.

“Because TC Legend Homes builds custom homes, most of our potential customers approach us already wanting an energy-efficient home. We educate our customers about how our homes are different from most houses and about how we achieve net-zero energy and positive energy in the homes we build,” said Clifton.

“By conserving as much energy as possible, these homes will be able to offset more than 100% of their electricity usage with the roof-sized solar electric systems.” said Clifton.

By value engineering and fine-tuning their processes, TC Legends is able to achieve zero energy at surprisingly low cost. “We only do net zero energy construction, and for less than most builders in the area do regular construction. We average \$200/ft<sup>2</sup> including solar,” said Clifton.

*Photos courtesy of TC Legend Homes*

## KEY FEATURES

- **DOE Zero Energy Ready Home Path:** Performance.
- **Walls:** R-29, 6” SIP taped at all interior and exterior joints, fiber cement siding.
- **Roof:** R-42, 10” SIP taped at all interior and exterior joints. Ice-and-water shield, asphalt shingles.
- **Attic:** None.
- **Foundation:** R-23 ICF stem walls, R-20 rigid foam under slab.
- **Windows:** Triple-pane, vinyl-framed, low-e windows, U=0.21.
- **Air Sealing:** 0.60 ACH 50.
- **Ventilation:** Timered exhaust fans.
- **HVAC:** Evacuated tube solar hot water and 4.5 COP air-to-water heat pump for in-floor radiant hydronic heat.
- **Hot Water:** Air-to-water heat pump, COP 4.5.
- **Lighting:** 100% LED.
- **Appliances:** ENERGY STAR refrigerator, clothes washer, range hood; induction cooktop.
- **Solar:** 9.5-kW PV, evacuated tube solar hot water.
- **Water Conservation:** Low-flow fixtures; centrally located water heater.
- **Other:** Low-VOC paints and finishes. Electric vehicle charging station.