

Philgreen Construction

REVIVE Sustainable
Multifamily Living
Fort Collins, CO



BUILDER PROFILE

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FEATURED HOME/DEVELOPMENT:

Project Data:

- Name: REVIVE Sustainable Multifamily Living
- Location: Fort Collins, CO
- Layout: 2 bdrm, 1.5 bath, 3 fl, 1,160 ft²
- Climate Zone: IECC 5B, cold
- Completion: March 2016
- Category: multifamily

Modeled Performance Data:

- HERS Index: without PV 42, with PV 5
- Projected Annual Energy Costs: without PV \$824, with PV \$155
- Projected Annual Energy Cost Savings (vs home built to 2012 IECC) without PV \$952, with PV \$1,586
- Projected Annual Energy Savings: with PV 15,928 kWh
- Added Construction Cost: without PV \$0, with PV \$8,000

Photocopies of home owner utility bills may not be a common marketing handout, but Dave Phillips, president of Philgreen Construction, considers them to be one of the company's best sales tools. "We keep copies of utility bills from home owners in the sales office to show prospective buyers. People will take copies of the energy bills with them because they are so unbelievable." As an example, Phillips points to a recent monthly bill; "the home earned \$91.55 and carried a \$322.58 credit."

The home is one of 55 townhomes and single-family homes that Philgreen is building to the high energy-efficiency criteria of the U.S. Department of Energy's Zero Energy Ready Home program. The townhomes at the REVIVE community in Fort Collins, Colorado, received a 2016 DOE Housing Innovation Award.

The modern, three-story highly insulated townhomes, have geothermal heating and cooling and a shed roof pitched at just the right angle to maximize solar electric production from the roof-mounted photovoltaic panels. They should perform as true zero energy homes providing home owners with average power bills of less than \$15 each month. "Our April utility bill was \$11," said one of the home owners, who was quick to point out how much this home differed from their previous homes. "We noticed a huge difference between ... our new house versus other homes we have lived in. Immediately after we moved in, there were several snowstorms. Our house stayed warm without the heat kicking on every 10 minutes."

The winning home is part of the REVIVE Fort Collins development, which includes 37 townhouses and 18 single-family homes with attached apartments, constructed in an urban renewal district near Old Town Fort Collins, Colorado. Philgreen Construction is the lead building contractor on the project and is one of a team of partners including designers, utility engineers, and energy modelers



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.

Philgreen Construction built this 1,158-ft² home in Fort Collins, Colorado, to the performance criteria of the DOE Zero Energy Ready Home (ZERH) program. For further energy savings, this home has an ENERGY STAR-rated appliances, EPA WaterSense-rated plumbing fixtures, and advanced technology LED lighting.



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

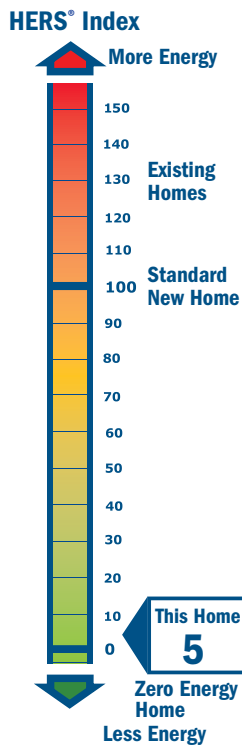
3 DUCT SYSTEM
located within the
home's thermal
boundary

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.



assembled by the owners, REVIVE Properties, LLC, with the goal of making REVIVE Fort Collins “the greenest development in Colorado.” REVIVE Properties chose the DOE Zero Energy Ready Home criteria to set the bar for the project.

Every unit in the development will be certified to the DOE Zero Energy Ready Home program, which 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, 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 a solar electric system installed or have the conduit and electrical panel space in place for it. The REVIVE Fort Collins townhomes include the installation of 5.46 kW of solar photovoltaic panels on the roof of each unit.

Thoughtful design and planning increased the overall resource efficiency of the development. In addition to the townhomes and duplexes, the 10-acre site includes three acres of open space including an irrigated park with bioswales, trails, and turf. Homes are constructed around two orchards of edible fruit trees and a community garden provides home owners with their own local food source. Pervious pavers are used in the alley and selected parking areas to increase storm water infiltration. The developer installed solar-powered street lights throughout the development. Phillips notes that “because our lights are not connected to the grid, we didn’t qualify for the City’s rebate for reducing site lighting, even though we reduced our site lighting power demand by 100%.” However, the solar street lights still turned out to be less expensive than traditional street lights because they didn’t have to trench and run wires. All of the detached homes include a studio apartment above the garage that could be rented to increase density in this close-in urban development.

The five townhouse units range in size from 1,160-ft² 2-bedroom, 1.5-bath to 1,444-ft² 2-bedroom, 2.5-bath homes. All of the units are three stories with attached two-car garages, patios, balconies, and vaulted ceilings on the third floors to maximize daylighting.

The home’s concrete foundation slabs are left exposed and polished to serve as the flooring for the first floors. The slabs are insulated with R-10 of closed-cell spray foam under the slabs and R-10 of rigid polystyrene wrapping the slab edges.



For enhanced comfort and reduced energy, the townhomes' foundation is wrapped in insulation. A thick R-60 layer of spray foam blankets the ground under the slab while slab edges are covered with an R-10 layer of rigid foam.

The above-grade walls are constructed with 2x4s staggered on 2x6 top and bottom plates allowing the R-23 of blown-in fiberglass insulation to wrap around the sides of the studs to minimize thermal bridging (or heat transfer) through the walls. The party walls between units are insulated with blown-in cellulose for an R-value of 13. The rim joists are insulated with R-23 of closed-cell spray foam. The vaulted ceilings are filled with R-50 of open-cell spray foam. The roof decking of 7/16-inch OSB that is covered with ice-and-water shield. Drip-edge flashing is installed along the eaves and the roof is topped with Class 4 asphalt shingles.

All of the windows are double-paned and vinyl framed with low-emissivity coatings to block heat transfer and an insulating argon gas fill between the panes. The windows have an insulation U-factor of 0.28 and a solar heat gain coefficient of 0.22.

The homes were blower door tested and showed an average airtightness across all units of 2.4 air changes per hour at 50 Pascals pressure difference (ACH 50). Heat recovery ventilators (HRV) supply fresh air throughout the homes.

All units are heated and cooled with a ground source heat pump with a heating coefficient of performance of 3.8 COP and a cooling energy efficiency ratio of 18.7 EER. The ground-source heat pumps for the duplexes have a desuperheater that can provide free domestic hot water heating when the ground source heat pump is in cooling mode. Electric resistance provides back-up water heating for those homes. The townhomes did not have room in their smaller utility closets for the two tanks plus the compressor required for the desuperheater so they are equipped with an air-source heat-pump water heater with an energy factor of 2.45.

ENERGY STAR ceiling fans are included in many of the rooms. Almost all (95%) of the lighting is supplied by LEDs and strategically placed windows provide daylighting even in closets, bathrooms, and garages. The refrigerators and dishwashers are ENERGY STAR rated.

Water conservation features, such as dual-flush toilets and WaterSense faucets are included throughout the home, while exterior landscaping incorporates low-water-use plants.

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.



The home is wrapped with house wrap with the seams taped. Flashing tape around the windows and doors is integrated with the house wrap to provide a continuous drainage plane and weather-resistant barrier and to serve as a secondary air barrier behind the siding.

All of the townhomes are sold with 5.46 kW of roof-top photovoltaic capacity installed and the garages are pre-wired for electric car charging stations. The winning home achieved a Home Energy Rating System (HERS) index of 42 without PV and 5 when the solar energy production is included in the calculation. This is better than the typical HERS score of 80 to 100 for new homes built to code across the country. The winning unit had a calculated annual energy bill of \$155 and estimated annual energy savings of \$1,586 (when compared to a home built to the state energy code equivalent, the 2012 International Energy Conservation Code [IECC].)

Despite the impressive suite of energy-efficiency measures, the REVIVE homes were slow to sell when they first came onto the market in 2014. Phillips reports that sales have picked up considerably in the past two years as more people become aware of net zero homes.

“Now that zero energy homes have more name recognition...these homes are selling well,” said Phillips. “We are now building as houses come under contract. We have no spec inventory because it sells before we build it. The community is [now] far more educated on what a HERS rating is. We have had two articles in the local paper about our project—that really helped with the sales.”

And then there are those utility bills. “Whenever we show the negative utility bills, people are so amazed. They have that “ah ha” moment and they really want to be a part of this green community,” said Phillips.

Photos courtesy of Philgreen Construction

KEY FEATURES

- **DOE Zero Energy Ready Home Path:** Performance.
- **Walls:** R-23 blown fiberglass in exterior walls, R-13 blown cellulose in party walls, R-20 open-cell spray foam in rim joist.
- **Roof:** R-50 open-cell foam in vaulted ceilings, 7/8 OSB sheathing, ice-and-water shield, drip edge, asphalt shingles.
- **Attic:** None.
- **Foundation:** Slab-on-grade, 2" R-10 closed-cell spray foam under slab, R-10 EPS slab edge.
- **Windows:** Double-pane, vinyl-framed, low-e, argon-filled windows, U=0.28, SHGC =0.17.
- **Air Sealing:** 2.4 ACH 50.
- **Ventilation:** HRV.
- **HVAC:** Ground source heat pump, 3.8 COP, 18.7 EER.
- **Hot Water:** Air-source heat pump; backup electric 50-gal tank heater, 2.45 EF.
- **Lighting:** 95% LED, two ENERGY STAR ceiling fans.
- **Appliances:** ENERGY STAR refrigerator, dishwasher.
- **Solar:** 5.46 kW PV.
- **Water Conservation:** Dual-flush toilets, low-water landscaping. WaterSense faucets.
- **Energy Management System:** Programmable thermostat.
- **Other:** Wired for electric car charging station; low-VOC paint; day-lit closets, bath and garage.