

# Philgreen Construction

REVIVE North Star Plan  
Fort Collins, CO



## BUILDER PROFILE

Philgreen Construction, Fort Collins, CO  
Dave Phillips, dave@philgreenco.com  
970-672-0089, www.philgreenco.com  
Rater: Energy Logic  
Robby Schwarz  
info@nrglogic.com

## FEATURED HOME/DEVELOPMENT:

### Project Data:

- Name: REVIVE North Star Plan
- Location: Fort Collins, CO
- Layout: 3 bdrm, 2.5 bath, 2 fl, 1,770 ft<sup>2</sup>
- Climate Zone: IECC 5B, cold
- Completion: September 2016
- Category: production

### Modeled Performance Data:

- HERS Index: without PV 42, with PV -9
- Projected Annual Energy Costs: without PV \$860, with PV -\$146
- Projected Annual Energy Cost Savings (vs home built to 2012 IECC): without PV \$1,063, with PV \$2,070
- Projected Annual Energy Savings: without PV 11,654 kWh, with PV 24,093 kWh
- Added Construction Cost: without PV \$0, with PV \$8,300

Negative is a positive at the REVIVE Fort Collins development where Philgreen Construction is building homes that are so energy efficient they have negative utility bills. These homes are earning money rather than costing money to operate. Philgreen's North Star model, a 2-story, 1,770-ft<sup>2</sup> home, won a 2016 Housing Innovation Award from the U.S. Department of Energy. The home is one of 55 solar-powered, ground-source heat pump-heated homes being built by Philgreen Construction at the REVIVE Fort Collins development located in an urban renewal district near Old Town Fort Collins, Colorado. All 55 units, including 37 townhomes and 18 single-family homes with attached apartments, will be certified to the requirements of the DOE Zero Energy Ready Home program.

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 assembled by the owners, REVIVE Properties, LLC, with the goal of making REVIVE Fort Collins "the greenest development in Colorado." One of the townhomes also won a 2016 DOE Housing Innovation Award. The North Star model home was also selected as the "Best Green Home" in the North Colorado Home Builders Association's 2015 Street of Dreams.

"We ARE actually the greenest community in Colorado," says Sue McFaddin, development consultant and broker for REVIVE. "We know this to be true because we measure the numbers with HERS (Home Energy Rating System) scores and are coming in with negative scores. No other community in Colorado is doing that."

The homes were assessed by an independent energy rater, as required by the DOE Zero Energy Ready Home program, and the North Star home achieved a Home Energy Rating System (HERS) score of 42 without PV and -9 when the solar



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 1,770-ft<sup>2</sup> production home at the REVIVE Fort Collins development located in an urban renewal district near Old Town Fort Collins, Colorado, to the high performance requirements of the DOE Zero Energy Ready Home program. All 55 homes in the development have solar photovoltaic systems and ground-source heat pumps. LED lighting and ENERGY STAR appliances add to energy savings in the efficient homes.



## 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

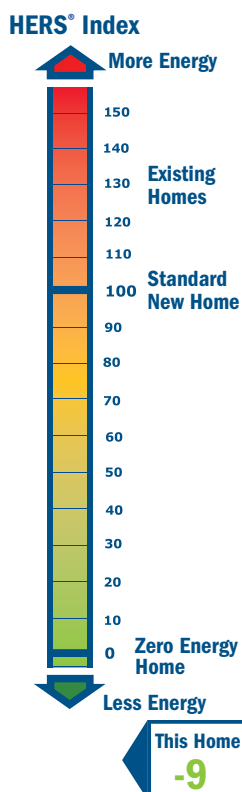
**3 DUCT SYSTEM**  
located within the  
home's thermal  
boundary

**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.



energy production is included in the calculation. This is far better than the typical HERS score of 80 to 100 for most new homes. A score of 0 would mean a home is net zero, or one that produces as much energy as it uses in a year. A score of minus 9 means the home is producing more energy than it uses in a year, enough to pay the home owners back or even enough to power an electric car. The North Star home has its own electric car charging station. The winning home had a calculated annual energy bill of minus \$146 and estimated annual energy savings of \$2,070 with PV (compared to a home built to the local energy code, which is equivalent to the 2012 International Energy Conservation Code.)

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 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 it. The single-family homes at REVIVE Fort Collins each include 8.56 kW of solar photovoltaic panels on the roof.

Everything about REVIVE Fort Collins was designed for efficiency. All of the detached homes include a 542-ft<sup>2</sup> studio apartment above the attached garage that could be rented to increase density in this close-in urban development. By consolidating most of the 55 units on the 10-acre site into attached three-story townhouses with compact footprints, space was made available for a three-acre city park with turfed open spaces, bioswales, and trails. The homes were constructed around two orchards of edible fruit trees and a community garden provides home owners with space to grow their own food. Pervious pavers were used in the alley and selected parking areas to increase storm water infiltration. In addition to the roof-top solar, the developer also installed solar-powered street lights throughout the development. Although the developer received no rebates for the street lights, they were still less expensive than traditional street lights because the builder didn't have to dig trenches and run wires.

To construct the energy-efficient homes, Philgreen Construction started with 2x6 24-inch on-center staggered-stud walls with advanced framing details including two-stud corners, open and insulated headers over windows and doors, and ladder



The insulated sheathing is taped at the seams to provide a continuous air barrier, thermal barrier, and drainage plane behind the siding. No house wrap is needed.

blocking at interior-exterior wall intersections. The wall sheathing has a weather-resistant coating. When the seams are taped with a proprietary tape, the sheathing forms a continuous drainage plane, air barrier, and thermal break. No house wrap is needed. The wall cavities are filled with R-23 of dense-pack fiberglass. The rim joists and box sills are insulated with R-26 closed-cell spray foam.

The roof decking of 7/16 OSB sheathing was covered with ice-and-water shield, then metal drip edge was installed and the roof was covered with class A asphalt shingles. The unvented attic was insulated with R-50 of open-cell spray foam installed on the underside of the roof deck.

The home had a slab-on-grade foundation. The slab was insulated with R-10 of closed-cell spray foam under the slab and R-10 of rigid polystyrene wrapping the slab edges. The home's concrete floor was left exposed and was stained, sealed, and polished to serve as the flooring for the first floor.

The tight home was tested per DOE Zero Energy Ready Home requirements and showed air leakage of only 1.8 air changes per hour at 50 Pascals. That's almost twice as tight as is 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, a heat recovery ventilator (HRV) was installed. The HRV brings in fresh air from an outside air intake and exhausts stale air. The fresh air and stale air ducts pass through a heat exchanger in the HRV where heat is transferred from the warmer stream to the colder stream so the incoming air is warmed in the winter and cooled in the summer.

Like all of the homes in the development, the award-winning home was heated and cooled with a ground-source heat pump. The unit had a heating coefficient of performance of 3.8 COP and a cooling energy efficiency ratio of 18.7 EER. The ground-source heat pump has a desuperheater that contributes to the domestic hot water heating. Water conservation features, such as dual-flush toilets and WaterSense faucets, were included throughout the home, while exterior landscaping incorporated low-water-use plants.

The home was equipped with an ENERGY STAR refrigerator, dishwasher, clothes washer, and dryer and two ENERGY STAR ceiling fans. The home was also equipped with an internet monitoring system that can help the home owners track the 8.56-kW PV system's production, use of the electric car charging

## HOME CERTIFICATIONS

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DOE Zero Energy Ready Home Program

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ENERGY STAR Certified Homes  
Version 3.0

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EPA Indoor airPLUS

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EPA's WaterSense

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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.





Spray foam covers the attic ceiling providing an insulated location for the HVAC ducts.

station, grid power use, hot water usage, and HVAC usage. The home automation system can also lock doors and shut off lights. A voice-activated system turns on lights and music.

The builder met all of the requirements for EPA's Indoor airPLUS certification, including use of low-VOC paints, cabinets, and carpets; good water management practices to reduce the risk of mold; fresh air ventilation; and other steps that contribute to cleaner indoor air.

Builder Dave Phillips, president of Philgreen Construction, has been so pleased with the DOE Zero Energy Ready Home program that the home builder has committed to building more homes to the program specifications. "It is a high standard and it has taught all of us better building practices. With this project I feel that we are making a difference by showing that you can build high-performance production homes for roughly the same cost [as code built homes] when you have the right dedicated team."

Home owners are just as impressed. Said one home owner: "I bought a DOE Zero Energy Ready home because I'm committed to sustainability and I believe that energy-efficient homes will be worth more in the future than a house built to code.... The thermal comfort is really great after coming from a drafty home where you always had to have a sweater. The reduced infiltration rates and HRV system work to provide a healthy environment. The most surprising part is how quiet the home is. My neighbors are also surprised by this. Even though there is plenty of construction going on outside, you don't seem to hear it inside. I work out of my house and I am home most days, so I would notice it. I'm really pleased by the renewable energy performance of this home. My energy bills including transportation for my electric car were \$10 and \$5 [in January and February] and now have gone negative in the spring and will continue to earn money in the summer. That is truly amazing. I won't have to worry about increasing energy bills in the future because I am more in control of both my energy use and production."

*Photos courtesy of Philgreen Construction*

## KEY FEATURES

- **DOE Zero Energy Ready Home Path:** Performance.
- **Walls:** R-32, 2x6 walls, R-25 closed-cell spray foam plus R-6 insulated sheathing. R-26 open-cell spray foam in box sill and rim joist.
- **Roof:** Ice-and-water shield, drip edge flashing, asphalt shingles.
- **Attic:** R-50 open-cell spray foam on underside of roof deck.
- **Foundation:** R-10 closed-cell spray foam under the slab and R-10 of rigid polystyrene wrapping the slab edges.
- **Windows:** Double-pane, vinyl-framed, low-e, argon-fill, U=0.28, SHGC=0.24.
- **Air Sealing:** 1.83 ACH 50.
- **Ventilation:** HRV.
- **HVAC:** Ground-source heat pump 3.8 COP, 18.7 EER.
- **Hot Water:** Electric 50-gal, 0.98 EF, with desuperheater preheat.
- **Lighting:** 95% LED, 2 ENERGY STAR ceiling fans.
- **Appliances:** ENERGY STAR refrigerator, dishwasher, clothes washer and dryer.
- **Solar:** 8.56-kW PV.
- **Water Conservation:** Dual-flush toilets, WaterSense hot water distribution design; low-water plants.
- **Energy Management System:** Programmable thermostat; internet monitoring of PV production, HVAC, car charging station, hot water, grid power use.
- **Other:** Electric car charging station, low-VOC paints, concrete counter tops and floors.