



## Building America Case Study

# Columbia County Habitat for Humanity Passive Townhomes

Hudson, New York

### PROJECT INFORMATION

**Project Name:** Columbia Passive Townhomes II

**Location:** Hudson, NY

**Partners:**

Columbia County Habitat for Humanity, [columbiacountyhabitat.org](http://columbiacountyhabitat.org)

Advanced Residential Integrated Solutions Collaborative (ARIES), [levypartnership.com](http://levypartnership.com)

**Building Component:** Whole building

**Application:** New construction, single-family

**Applicable Climate Zone(s):** 5

### PERFORMANCE DATA

(Comparison to ENERGY STAR v.3)

Cost of energy-efficiency measure (including labor): \$26,000 per unit

Projected source energy savings: 35% whole home

Projected energy cost savings: \$221 per year per home

Affordable-housing developers are increasingly looking toward high-performance construction to reduce life-cycle costs for their homebuyers and to fulfill their mission to build sustainably. Habitat for Humanity is one such developer.

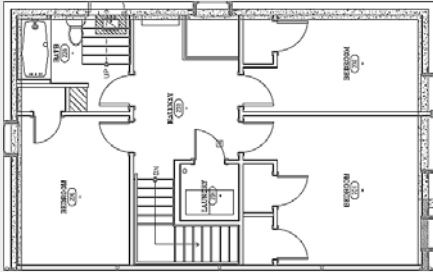
The Columbia County (New York) Habitat for Humanity (Columbia County Habitat) affiliate has been experimenting with high-performance building since 2012, starting with ENERGY STAR® Certified Homes. In 2013, they constructed their first homes aimed at the Passive House standards. Building off of this effort, in 2014 they began work on a second set of Passive Townhomes in Hudson, New York, in partnership with the Advanced Residential Integrated Energy Solutions (ARIES) Building America team and BarlisWedlick Architects.

The design is the most recent of three Passive House projects intended as case studies of various construction approaches. The long-term objective is to develop a prototype Passive House solution for future projects built by Columbia County Habitat and other Habitat chapters building in similar climates. In addition to meeting Passive House criteria, the homes participated in the U.S. Department of Energy Zero Energy Ready Home (ZERH), ENERGY STAR Certified Homes, and U.S. Environmental Protection Agency Indoor airPLUS programs.

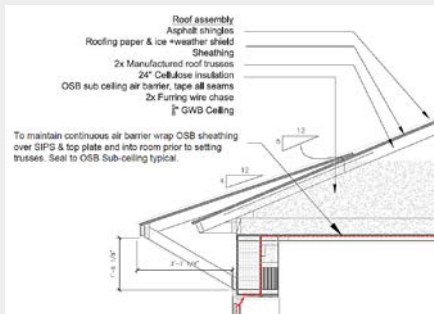
Costs were higher by about \$26,000 per unit for Passive House construction compared to a theoretical ENERGY STAR Version 3 home—or about 18% of total construction cost. Structural insulated panels (SIPs) comprised the largest cost component, representing about half of this extra cost. Lower-cost wall methods such as double-wall framing (as used in the first set of Passive Townhomes) would likely be more cost-effective if the volunteer labor force can achieve airtightness. Evidence from the first pair of Passive Townhomes built in 2013 suggests that they can. Other significant upgrade costs were for the ventilation system, floor insulation, ceiling insulation, and doors. Windows were a very small cost, in part due to Habitat's discount. The smaller mechanical system used in the Passive House saved about \$2,700 per unit compared to the theoretical ENERGY STAR design.

## Key Energy-Efficiency Measures

- Central heat-recovery ventilation system with dedicated ducts
- A single mini-split heat pump on the second floor combined with ceiling fans



- 2-in. x 6-in. frame construction filled with dense-packed cellulose
- 7.75-in. structural insulated panels hung on frame
- Vented attic with loose-fill cellulose insulation
- Exceptional airtightness (0.80 air change per hour at 50 pascals)
- Windows and glass doors about R-8
- Frame floor with 9.25-in. dense-pack cellulose and 8-in. Neopor expanded polystyrene above unconditioned basement



For more information see the Building America report *Columbia County Habitat for Humanity Passive Townhomes* at [buildingamerica.gov](http://buildingamerica.gov).

Image credit: All images were created by the ARIES team.

## Only One Heat Pump

To reduce costs, one ductless heat pump is used for all space conditioning in each unit. Because previous efforts experienced challenges with the effectiveness of point-source space conditioning, this issue was strategically addressed in this project. To ensure sufficient thermal distribution, the following approach was taken:

- The indoor unit is located on the second floor where it can more effectively cool bedrooms.
- There is no conditioned basement to which cooled air could flow.
- A ceiling fan circulates air among floors.
- A floor opening provides a second pathway for air to circulate between floors in addition to the open stair.
- Residents are trained to keep the heat pump on at a constant set point rather than adjusting it frequently, which causes inefficiencies and prolonged makeup time for the heat pump.

## Lessons Learned

- To date, the homes have been occupied in spring and summer, and residents have reported excellent comfort results, indicating that the space-conditioning strategy is effective. Importantly, the residents have been following the recommendation to keep their heat pump on at a constant set point. Heating-season performance has not yet been observed.
- Because Habitat for Humanity uses a volunteer workforce for many tasks, its cost framework differs from that of for-profit builders. Unskilled and semi-skilled labor costs are very low, which means that site-built envelopes may be more effective for Habitat than SIPs in terms of cost.

## Looking Ahead

Habitat chapters are mission-driven to provide affordable housing, and they enter into long-term relationships with their clients by holding the mortgage, so they are also motivated to provide housing with low operating costs. Consequently, energy efficiency, a healthful indoor environment, and durability are important factors. ENERGY STAR, ZERH, and Passive House are pathways to achieving these goals that provide independent verification and recognition.

Columbia County Habitat's long-term goal is to develop a system that allows them to meet Passive House standards cost-effectively. The team built on the experience of its first Passive Townhome project, identifying opportunities to improve the cost-effectiveness of performance. Columbia County Habitat will be designing and building the third of its case study projects in 2015–16, fleshing out the range of construction approaches it wishes to explore.