Building America Case Study

EcoVillage: A Net Zero Energy Ready Community

Ithaca, New York

PROJECT INFORMATION

Construction: New home

Type: Single-family

Partners:

Builder: Michael Carpenter, AquaZephyr, LLC

Consortium for Advanced Residential Buildings, *carb-swa.com*

Size: 1,250 ft² to 1,440 ft²

Price Range: ≈ $80,000–$235,000

Date Completed: 2014

Climate Zone: Cold

PERFORMANCE DATA

HERS Index: Case study house

- With renewables = 15
- Without renewables = 38

Projected annual energy cost savings: $1,112

Incremental cost of energy efficiency measures: ~$10.00/ft²

Annual cash flow: $200

Billing data: Full year not available at this time

At the EcoVillage cohousing community in Ithaca, New York, residents are committed to sustainable, green, and efficient building construction. With help from the U.S. Department of Energy (DOE) Building America team Consortium for Advanced Residential Buildings (CARB) and builder AquaZephyr, LLC, EcoVillage completed their third neighborhood—the Third Residential EcoVillage Experience (TREE). This community-scale project consists of 40 housing units—15 apartments and 25 single-family residences—that range in size from 1,250 ft² to 1,664 ft² and cost from $80,000 to $235,000.

The community is pursing DOE Zero Energy Ready Home, U.S. Green Building Council® Leadership in Energy and Environmental Design (LEED) Gold, and ENERGY STAR® certifications for the entire project. Additionally, seven of the 25 homes, along with the four-story apartment building and community center, are being constructed to the Passive House (PH) design standard.

The CARB team supported the implementation of the PH design and provided third-party verification for these programs. The goal was to develop two commercially and economically viable 50% source energy-savings packages: one for the homes attempting to achieve PH certification and one for those that were not. These packages resulted in predicted source energy savings of 47%, on average.

The products and construction methods used are commercially and readily available. Construction costs were approximately $100/ft² compared to an average of $138/ft² for that area of New York state. Based on the builder's feedback, successful implementation of the energy solutions package, and several successful certifications, the CARB team concluded that the solution packages were both economically and commercially viable.

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Key Energy Efficiency Measures

HVAC

- High efficiency two-stage air source heat pump system: 16 seasonal energy efficiency ratio, 9.8 heating season performance factor
- Electric resistance baseboard
- No cooling
- 83% efficient ERV supplies continuous whole-house ventilation

ENVELOPE

- Metal roof
- R-90 blown ceiling insulation in vented attic
- R-43 to R-52 grade-1, dense-packed insulation in double stud 2×4 frame walls and 3.5 in. ccSPF in outer stud bay (PH homes only)
- Triple-pane, low-e, cellular PVC windows. U = 0.17, solar heat gain coefficient = 0.62
- Tightly sealed house, ACH50 ≤ 0.6

LIGHTING, APPLIANCES, AND WATER HEATING

- 100% compact fluorescent lamps or light-emitting diodes
- ENERGY STAR ceiling fans, refrigerator, and dishwasher
- 80-gallon electric resistance domestic hot water with 65 ft^2 of solar thermal collectors

For more information, see the Building America report, *EcoVillage: A Net Zero Energy Ready Community,* at: *buildingamerica.gov*.

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

For the homes pursuing PH certification, AquaZephyr, LLC insulated the outer bay of the double stud walls with 3.5 in. of closed cell sprayed polyurethane foam (ccSPF) (left). A 4.1-kW photovoltaic (PV) system and 65-ft^2 solar thermal system were installed on the south-facing roofs (right).

Lessons Learned

- Proper air sealing of the energy recovery ventilator (ERV) duct insulation and vapor tight jacket are crucial to prevent moisture damage and ensure proper performance.
- Based on the first four months of data collected, the homes met energy goals and are using less energy on average than predicted by DOE's Building Energy Optimization Tool.
- Occupants in super-insulated homes should be encouraged to maintain constant temperatures and not try to employ deep thermostat setbacks because the interior temperatures in these homes respond very slowly due to the massive nature of the building envelope.
- A preheater is recommended for any ERV/heat recovery ventilator in a cold climate region to prevent the system from shutting down during extremely cold periods.
- In newly constructed, extremely airtight homes in cold climates, indoor relative humidity levels should be monitored, and ventilation adjusted or dehumidification used if humidity levels exceed 40%.
- For super-insulated, high performance homes, a dedicated person should be assigned to oversee the critical air sealing, insulation, and water management details at the start of the planning process.
- Evaluation of monitored end uses strongly suggests that a different method for sizing heating systems for super-insulated buildings is warranted, and thermal inertial and internal gains should be included in sizing calculations.

> *"Efficiency doesn't have to be costly. It is common sense to build houses this way."*
>
> – Michael Carpenter, AquaZephyr, LLC, builder

U.S. DEPARTMENT OF ENERGY
Energy Efficiency & Renewable Energy

For more information, visit:
buildingamerica.gov

The U.S. Department of Energy's Building America program is engineering the American home for energy performance, durability, quality, affordability, and comfort.

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