



Building America Case Study Whole-House Solutions for New Homes

Fort Devens: Cold Climate Market-Rate Townhomes Targeting HERS Index of 40

Harvard, Massachusetts

PROJECT INFORMATION

Project Name: Devens Sustainable Housing

Location: Harvard, MA

Partners:

Metric Construction
www.metriccorp.com

Consortium for Advanced Residential Buildings
www.carb-swa.com

Size: 1,300 ft² plus basement

Price: approx. \$250,000

Year Completed: 2012

Climate Zone: Cold

PERFORMANCE DATA

HERS Index: 39 (before renewables)

Projected Annual Energy Savings: \$580

Incremental Cost of Energy Efficiency Measures: \$7,804

Incremental Annual Mortgage increase: \$503

Achieving aggressive energy efficiency targets requires tight coordination and clear communication among owners, designers, builders, and subcontractors. For this townhome project, MassDevelopment, the quasi-governmental agency owner, selected Metric Development of Boston, teaming with the U.S. Department of Energy (DOE) Consortium for Advanced Residential Buildings (CARB) and Cambridge Seven Architects, to build very high performing market-rate homes. Fort Devens is part of a decommissioned army base in working-class Harvard, Massachusetts, approximately one hour northwest of Boston. The team proposed 12 net zero energy-ready townhomes, meaning that the application of renewable energy systems would result in annual net zero energy use in the homes. The homes were also designed to achieve a Home Energy Rating System (HERS) Index Score of 41 before adding renewables.

For this project, CARB drew on its experience working with Rural Development Inc. on a series of affordable townhomes in northern Massachusetts. The team carefully planned the site to maximize solar access, daylighting, and efficient building forms. The basic strategy was to design a very efficient thermal enclosure while minimizing incremental cost increases compared with standard construction. Using BEopt modeling software, the team established the requirements of the enclosure and investigated multiple assembly options. They settled on double-wall construction with dense-pack cellulose fill. High performance vinyl windows (U-0.24, solar heat gain coefficient [SHGC]-0.22), a vented R-59 attic, and exceptional air sealing completed the package.

The developer opted for a conventional but high-performance ducted heating, ventilating, and air-conditioning (HVAC) system, citing sales and marketing concerns. A compact ductwork design was integrated into the plan within conditioned space. Natural gas condensing tankless water heaters meet hot water needs in the homes.

Key Energy Efficiency Measures

ENVELOPE:

- Double 2×4 walls with 10.5 in. of dense-pack cellulose (R-38)
- Semi-conditioned basements with 2 in. of interior polyisocyanurate insulation (R-13)
- R-59 cellulose at ceiling plane
- U-0.24; SHGC-0.22 vinyl windows
- Advanced air sealing (1.6 ACH50)



Ten-and-a-half inches of dense-pack cellulose in double 2×4 walls, raised heel trusses, and foamed-in plastic rafter vent baffles.

HVAC:

- 96 annual fuel utilization efficiency condensing gas furnace
- 96 energy factor condensing gas water heater
- Compact inside the envelope HVAC
- Exhaust-only ventilation, 40 cfm continuous

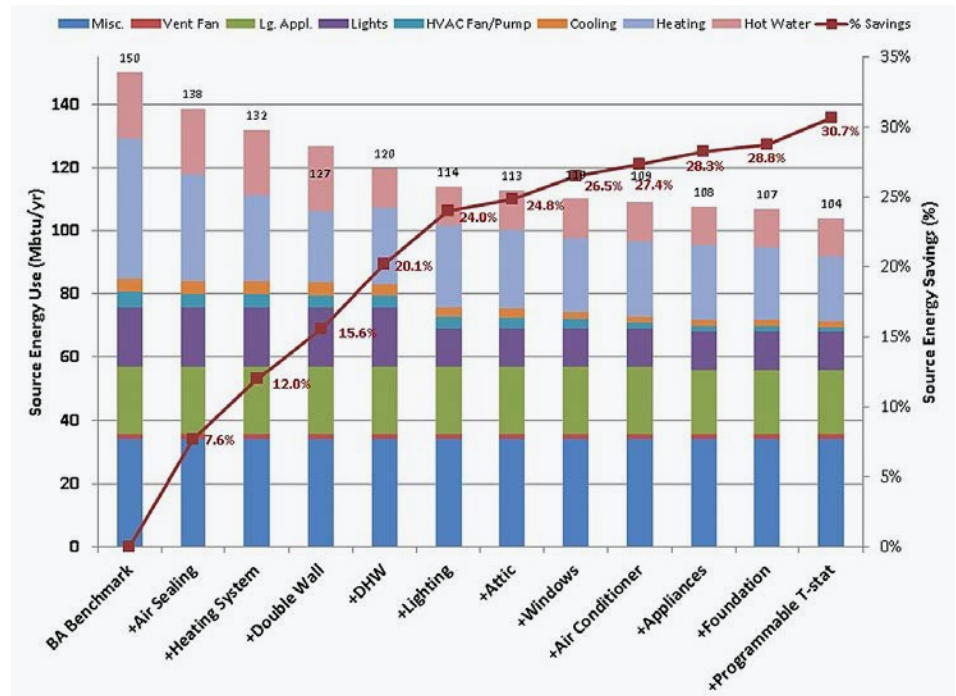


Exposed polyisocyanurate insulation panels in basement provide R-13 insulation and a finished appearance. All floor framing is open-web trusses to accommodate mechanicals.

For more information, see the Building America report, *Fort Devens: Cold Climate Market-Rate Townhomes Targeting HERS Index of 40*, at www.buildingamerica.gov

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

Final testing revealed that all performance targets were met, and the large unobstructed southern roof slopes assure that the buildings are solar ready and can accept enough photovoltaic panels to offset the estimated annual energy consumption of the homes.



CARB used the National Renewable Energy Laboratory's BEopt energy simulation software to analyze each of the energy efficiency measures for optimized whole-building performance.

Lessons Learned

- An integrated project team including the developer, designers, and performance engineering consultants is crucial for success. The hard HERS target of 41 required the developer, builder, and designer to understand that small variations could affect performance and to understand the roles of all participants.
- Subcontractor training is especially critical to achieving exceptional airtightness levels. The low targets (two air changes per hour at 50 pascals [2.0 ACH50]) required a full hands-on training approach, working one-on-one with the installer.

Looking Ahead

These homes are selling well even in a weak market, indicating a real desire for this type of housing. CARB continues to work with Metric Development and is gathering temperature and relative humidity data within the double-wall assemblies to better understand moisture dynamics in occupied homes over the course of a full year.