Building America Case Study

Whole-House Solutions for New Homes

Technology Solutions for New Manufactured Homes

Idaho, Oregon, and Washington Manufactured Home Builders

PROJECT INFORMATION

Project Name: High Performance Manufactured Home Prototyping and Construction Development

Location: Pacific Northwest states (ID, OR, and WA)

Partners:

Northwest Manufactured Housing industry

Building America Partnership for Improved Residential Construction, *www.ba-pirc.org*

Building Components: HVAC, building envelope, lighting, and water heating

Application: New, single family

Year Tested: 2012-2013

Applicable Climate Zone(s): Cold and Marine

PERFORMANCE DATA

Cost of Energy Efficiency Measures (including labor): $9,000

Projected Energy Savings: 50% over current practice

Projected Energy Cost Savings: $850/year

Building America SM U.S. Department of Energy

Developing an energy efficiency measure package can reduce energy use for space conditioning, water heating, and lighting by 50% compared with typical manufactured homes produced in the Northwest. The U.S. Department of Energy Building America team Partnership for Improved Residential Construction worked with manufacturers in Idaho, Oregon, and Washington to prototype and assess a package of readily available, cost-effective, high performance building assemblies and mechanical systems not commonly deployed in the manufactured home sector. The package was given the working title High Performance Manufactured Home (HPMH).

The following technologies from the HPMH package have been prototyped: wall assemblies with reduced thermal bridging using exterior rigid foam sheathing, triple pane windows (U-0.22 or lower), and improved attic insulation strategies that allow for more insulation. In addition, a redesigned heating, ventilating, and air conditioning (HVAC) system built around a ductless mini-split heat pump (DHP) provides primary space conditioning with zoned supplemental electric resistance heating in secondary zones.

The attic insulation changes proved easy to implement, noticeably improved the quality of the process, and added little cost. Triple-pane windows proved to be another very simple measure to incorporate, and using the best practices demonstrated by the window manufacturer should provide building durability benefits. U-0.20 windows are available to the industry, but not through its primary supplier. Rigid foam sheathing presents a production challenge in that the workstation where it must be installed already tends to be a bottleneck in most plants. Some reconfiguration of workstations (e.g., location of saws, material staging areas, etc.) will be necessary to accommodate this measure. The project prototyped a home with .75-in. (R-5) foam sheathing, but found that the practical limit to foam thickness is .625-in. (R-4) to accommodate all siding products without necessitating significant changes to wall construction methods. Some home floor plans do not lend themselves to DHP installation in the factory,

ENVELOPE MEASURES

Rigid foam sheathing reduces thermal bridging in conventional R-21 2×6 framed wall assemblies. .75-in. polyisocyanurate sheets yield R-5.

Improved attic insulation strategy relying on dense-packed or compressed batt insulation in shallow attic area near the roof eaves. Area-weighted average insulation value of R-45 is achieved.

Triple-pane U-0.20 window installed using improved pan flashing and air sealing practices, compared to current factory processes.

For more information, see the Building America report, *Northwest Energy Efficient Manufactured Housing Program: High Performance Manufactured Home Prototyping and Construction Development* at *www.buildingamerica.gov*

Image credit: All images were created by the BA-PIRC team.

Views of factory-installed ductless mini-split heat pump system that eliminates the need for ductwork in the home and arrives on site complete and ready to operate.

and the project team explored approaches to facilitate onsite completion of the system. The fully ducted heat pump water heater (HPWH) was not available in time for the project, so this technology still requires prototyping.

Lessons Learned

- Exterior foam sheathing should be limited to.625-in. thickness to allow siding fasteners adequate penetration into framing for all siding products being used by the plants. This limits the added R-value to R-4. Plant workflow bottlenecks need to be addressed.
- Marginal improvement to attic insulation is readily achieved and appears to solve common problems with insulation detailing.
- Ductless heat pump integration is possible in the factory setting, but not all floor plans will work for the application—some homes will require onsite equipment installation.
- Triple pane windows do not appear to create any technical challenges, but the industry's primary window supplier does not produce such a product.
- The delayed market release of a fully ducted HPWH leaves this aspect of the HPMH package untested, but equipment availability appears imminent.
- The HPMH package appears to be readily buildable, costs about $9,000 (assuming a builder-grade window can be sourced), and saves homeowners about $850 annually.

Looking Ahead

The project team and the participating homebuilders look forward to building prototype homes that incorporate the full HPMH package. Plants will use the construction process outlines created by this project to integrate the new measures into their factory workflows.

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

For more information, visit:
www.buildingamerica.gov

Printed with a renewable-source ink on paper containing at least 50% wastepaper, including 10% post consumer waste.

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

DOE/GO-102013-4106 • November 2013