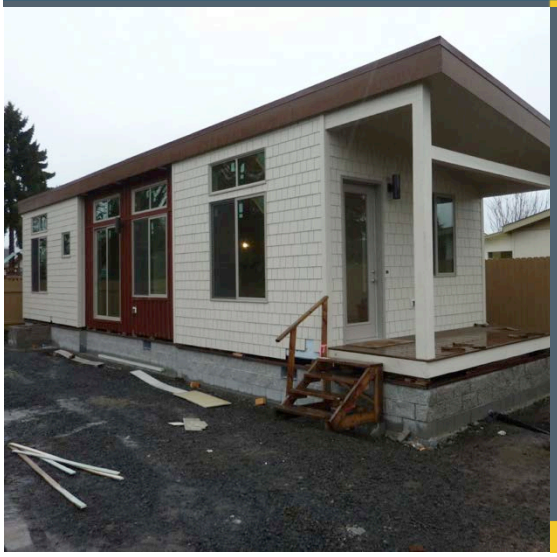

Building America
Efficient Solutions for New Homes

Case Study: 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 (Idaho, Oregon and Washington)

Partners: NW 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

The Building America Partnership for Improved Residential Construction worked with manufacturers to prototype and assess the performance of a package of readily available, cost-effective high performance building assemblies and mechanical systems that are not commonly deployed in the manufactured home sector. The measure package, given the working title “High Performance Manufactured Home” (HPMH), is able to reduce energy used for space conditioning, water heating and lighting by 50 percent over typical manufactured homes produced in the northwest.

The following basic technologies from the HPMH package have been prototyped: wall assemblies with reduced thermal bridging via exterior rigid foam sheathing, triple pane windows (U-0.22 or lower), improved attic insulation strategies that allow for more insulation; a redesigned HVAC system built around a ductless mini-split heat pump (DHP) for primary space conditioning with zoned supplemental electric resistance heating in secondary zones; domestic hot water via a heat pump water heater instead of traditional electric tank water heating.

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 also found that the practical limit to foam thickness is 5/8-inch (R-4) without necessitating significant changes to wall construction methods. Some home floorplans do not lend themselves to DHP installation in the factory, the project team explored approaches to facilitate on-site completion of the system. The fully ducted HPWH, which was expected to be available in time for the project was delayed, so this technology still requires prototyping.

ENVELOPE MEASURES

Rigid foam sheathing reduces thermal bridging in conventional R-21 2x6 framed wall assemblies. ¾-inch poly-isocyanurate sheets yield R-5.

Improved attic insulation strategy relying upon 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 project research report,

http://www.nrel.gov/docs/fy13osti/56761.pdf

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 upon switching on the home's power.

Lessons Learned

- Exterior foam sheathing is limited to 5/8 inch thickness to allow siding fasteners adequate penetration into framing—limits foam 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 floorplans will work for the application—some homes will require on-site 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 heat pump water heater leaves this aspect of the HPMH package untested, but equipment availability appears imminent.
- The HPMH package appears to be readily buildable, cost about $9,000 (assuming a builder-grade window can be sourced), and save 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

www.buildingamerica.gov

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