**Project Description**

The Washington State University (WSU) Energy Program—a member of the Building America Partnership for Improved Residential Construction (BA-PIRC)—has worked with builders in the cold and maritime climates of the Pacific Northwest for more than 30 years to develop exceptionally efficient residential construction practices.

BA-PIRC and the WSU Energy Program approached this project as an opportunity to:

- Evaluate the Passive House design approach and process outcomes.
- Document home performance.
- Track costs and determine obstacles to moving the Passive House into a cost-effective production environment.

The Hood River Passive Project, developed by Root Design Build of Hood River, Oregon, incorporates all features of the Passive House Planning Package (PHPP) and meets all of the requirements for certification under the European Passive House standards.

The Passive House design approach has been gaining momentum among residential designers for custom homes. BEoptE+ modeling indicates that these designs may actually exceed the goal of the Building America program to reduce home energy use by 30%–50% (compared to 2009 energy codes for new homes).

The Hood River project was initiated in 2009, but market conditions delayed completion until August 2012.
The Shift House, built by Root Design Build in Hood River, Oregon, meets all requirements for certification under European Passive House standards.

**Lessons Learned**

- Incremental costs of building enclosure enhancements (air sealing, insulation, and fenestration) were $50,687.
- The total package of energy performance enhancements implemented in this project did not meet the Building America standard for cost neutrality.
- Individually ductless mini-split heat pump, lighting, and advanced air leakage control were the most cost-effective measures.
- The single-point source space conditioning from the mini-split heat pump did require some zonal resistance heat to maintain comfort in extreme conditions (6.5% of heat load).
- Overheating has not been a problem because the house has adequate shading.
- Comparisons between Passive House design development using PHPP and modeling with BEoptE+ indicates sizable differences. Monitored energy use was higher than modeled by PHPP but significantly lower than modeled by BEoptE+.
- Monitored energy use was 43.9% lower than modeled in BEoptE+.
- Measure costs, nontraditional building practices, space conditioning systems, and the design process are all obstacles to adoption by production builders.
- The process as seen here doesn’t ensure the cost benefit goals of Building America are met; rather, it appears to be driven by noneconomic forces (desire to do the right thing, etc.).