

Residential Research, Development and Demonstration – The PNNL Lab Homes

The Pacific Northwest National Laboratory's (PNNL's) Lab Homes are a matched pair of unoccupied 1,500 square-foot homes that provide a platform for research, development and demonstration of residential technologies and practices. With a suite of all the major home components (enclosure, ducted and un-ducted HVAC, lighting and appliances), these side-by-side labs provide a “control” and “experiment” environment that helps eliminate uncertainty due to the following:

- ▶ weather variations experienced in long term “before” and “after” retrofit field tests
- ▶ variable and unknown occupant behavior experienced in occupied residential data collection efforts
- ▶ unknown equipment installation and operation practices.

RECENT SUCCESS STORIES

Window Retrofit Research Helps Utilities



Lab Home results from exterior low-e storm window testing showed up to 10% energy savings on heating and cooling loads.



“The energy savings demonstrated by the PNNL Lab Homes low-e storm window experiments really inspired us and gave us the confidence to pursue a technology Proving Project [pilot program] in our district. The validation from national lab testing has helped give this project credibility.”

—Todd Blackman, Franklin Public Utility District

Heat Pump Water Heater (HPWH) Feedback for Manufacturers and Utilities

With support from the U.S. Department of Energy, the Bonneville Power Association and General Electric, experiments in the PNNL Lab Homes investigated barriers to widespread adoption of HPWHs including the

- ▶ impact on space conditioning, and
- ▶ use of HPWHs in utility demand response programs for managing energy loads.

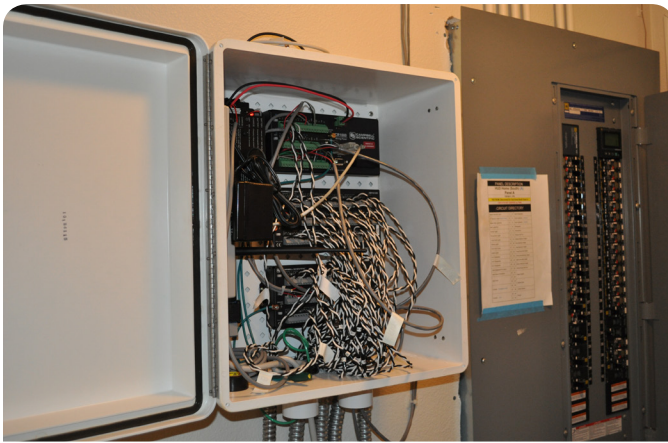
Other Recent Technology Demonstration Projects

- ▶ Energy savings potential of highly insulating triple pane windows
- ▶ Development of ideal electric vehicle charging time and duration dependent upon grid and household load
- ▶ Non-intrusive load monitoring technologies.

FLEXIBLE SENSOR CONFIGURATION

The Lab Homes use advanced monitoring equipment that can be configured to answer many different research questions. Both Lab Homes include the following:

- ▶ fully automated occupant simulation
- ▶ individually monitored circuits and controllable electrical breakers
- ▶ dozens of environmental sensors
- ▶ **remotely accessible data** through internet-connected data acquisition systems.



Remotely accessible data acquisition systems make troubleshooting experiments even easier

IMPROVING MANUFACTURED HOUSING

This market segment is experiencing big changes in codes and building practices. The Lab Homes can be deployed to help improve the energy efficiency of manufactured housing by

- ▶ documenting installation techniques and energy savings potential for technologies required by code
- ▶ temperature distribution and comfort studies for HVAC technologies such as ductless heat pumps
- ▶ calibration of building thermal modeling.

A PLATFORM FOR BUILDING SCIENCE EDUCATION

In coordination with ongoing experiments, PNNL aims to use the Lab Homes as an education platform for



- **Builders** – through step-by-step picture and/or video demonstrations for the **Building America Solution Center**
- **Code officials** – supplementing segmented learning strategies with right and wrong images, virtual field demonstrations and hands-on experience with the latest construction practices
- **Educators/Students** – active learning environments help students interpret written lessons and increases interest in the building science community
- **Utility Program Managers** – understanding how “smart” homes can optimally interface with the grid.

BEYOND RESEARCH

PNNL's Energy Technology Market Adoption Team, which manages Lab Home activities, has a long history of working with the manufactured housing industry to advance energy efficiency, and specializes in going

beyond research to transform the market. By **engaging the right partners early in a project**, research results from the Lab Homes can be used immediately to help increase the speed of adoption of the technologies studied.



For more information about the PNNL Lab Homes, visit the website at <http://labhomes.pnnl.gov> or contact:

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